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Chunhui Yuan
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Ivoslav Ganchev
Editors

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An Analysis of COVID-19's Impact on Japanese Stock Market Returns Using Daily Growth in Cases and Death

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Abstract. COVID-19 is no doubt one the most influential global events in 2020, and scholars have been examining its impact in different economies. This paper focused on Japanese stock market's performance during the pandemic year. We first conducted event studies on specific COVID-19 related events, and we confirmed that Japan's stock market reacted similarly to those in other countries. Then we applied ordinary least squared regressions, and we found that one percent growth in daily confirmed cases or daily death is associated with 0.024 or 0.018 percent decrease in the Japanese market index, respectively. Lastly, we analyzed sectoral stock indexes' performance using the same methods.

Keywords: COVID-19 · Japan · Stock market

1 Introduction

In January 2020, many countries confirmed their first case of COVID-19, and the virus spread out quickly around the globe. In March 2020, the World Health Organization (WHO) officially declared the COVID-19 outbreak a global pandemic. It has affected the daily routine of billions of people - travel restriction, business shutdown, etc. There have been many studies examining the impact of COVID-19, and our paper belongs to those investigating COVID-19's impact on stock market.

While some studies (Liu et al. (2020), Ashraf (2020), Alam et al. (2020), Bash (2020), among many others) applied an event study model to measure COVID-19's impact to the stock market as a one-time shock, we use the reported cases and deaths of COVID-19 in our model for two reasons. First, there are arguments around how to choose the event date representing COVID-19's shock on the stock market. As we focus on Japan's response to the virus, Japan reported the first case on January 16th, quarantined the Diamond Princess cruise ship on February 3rd, reported total cases went over 1,000 on March 22nd, prevented travelers from eleven other countries from entering on March 27th, and expanded the state of emergency nationwide on April 16th. We do not know which of these dates best convey the shock of COVID-19 to the stock market. Second, the testing capacity, healthcare efficiency, and government regulation related to the virus evolve over time. We consider the number of reported cases and deaths as a quantifiable

tool to reflect the effectiveness of these evolutions, and we investigate how stock market response to them.

In fact, as we tested on different events related to COVID-19, their impact on stock markets varies. We picked a few dates according to the method of the existing studies: Bash (2020) chose the first confirmed case as the event date, equal to the day that first cases appear in Japan (January 16th, 2020); Alam et al. (2020) decided to use the day that Australia declared pandemic as their event date, equals to the day WHO declared pandemic (March 11th, 2020); Alam et al. (2020) set the day Indian government announced lock down, equals to the day Japanese Prime Minister announced state of emergency (April 7th, 2020). We found that TOPIX did not have any significant response to the first two event, while it responded positively and significantly to the last event. Sectorial performance also varies to these event as we will discuss in detail later in the result section.

We then used ordinary least squares (OLS) model to estimate how stock returns were affected by daily growth in confirmed cases and death in the entire 2020. Our baseline model has either daily growth in cases or daily growth in death as our independent variable. Both effects are negatively significant. As we include both in the regression, we found that the effect of daily growth in cases are larger than the effect of daily growth in death, while the latter is more significant than the former one.

2 Literature Review

Among all existing studies on COVID-19, the group that most related to our paper focuses on the relationship between the COVID-19's reported cases/deaths and stock market. Onali (2020) found that the changes in the number of cases and deaths in the U.S. and six other countries majorly affected by COVID-19 have no impact on the U.S. stock market returns, except for the number of COVID-19 cases from China. Also focusing on the U.S. stock market, Chowdhury and Abedin (2020) found a significant negative effect of deaths due to COVID-19 on the U.S. stock market, while the impact from confirmed cases is not significant and sometimes positive. On other countries, Elsayed and Elrhim (2020) compared Egyptian sectoral stock indices' response to both cumulative and daily cases/deaths. Al-Awadhi et al. (2020) found that both growth in total cases and deaths caused by COVID-19 have significant negative impacts on Chinese listed companies' stock return. Ashraf (2020) found an international evidence from 64 countries that overall stock markets responded negatively to the growth of COVID-19 cases. Our study is parallel to these by investigating how growth in cases and deaths of COVID-19 affected the Japanese stock market. Since most of existing studies use data in the first half of 2020, we extend the time period until the end of 2020. This extension is meaningful for studying COVID-19 in Japan since there was a surge in new cases in July-August and in November-December. In practice, we look at both market index (TOPIX) and its 17 sectoral components, and we tested the impact of both confirmed cases and deaths. Overall, there are different points of view on whether stock market was affected by COVID-19 cases or deaths and on to which extent it was affected. We add to this debate as we found that Japanese stock market return responded negatively and significantly to the growth in daily cases and death. In particular, most existing studies

use the early period data of COVID-19, while we used entire 2020 data. Our result shows that there is a long-lasting influence of COVID-19 on the Japanese stock market.

Our study is also related to the branch of COVID-19 related literature that focus on a particular country. For Australia, Alam et al. (2020), found that although overall stock market has declined due to COVID-19's shock, some sectors are more vulnerable than others. For China, He et al. (2020) concluded that some sectors are negatively affected by COVID-19, while others have been resilient. For U.S., Mazur et al. (2020) investigated the stock market crash during March 2020 using S&P 1500 and found 90% of stocks generated asymmetrically distributed large negative returns. At the sectoral level, Alam et al. (2020), He et al. (2020), and Mazur et al. (2020) all found transportation was adversely affected, while IT and healthcare were less affected or positively affected. For India, Alam et al. (2020) found that its stock market reacted negatively before the lockdown and positively after the lockdown, and they attributed this result to investors' changing sentiment. Our study adds a case study of Japan, which was the third largest economy by GDP before the pandemic, and once had the second highest number of confirmed COVID-19 cases. In terms of sectoral performance, we added to the discussion by using longer period data. In the relatively long term, we found that most sectors responded negatively and significantly to the daily growth cases and death, and we didn't find any sectors are positively affected.

Another thread of COVID-19 literature investigates the international impact of COVID-19, as they pull data from multiple countries. Bash (2020) used applied an event study on 30 countries, with each country's first registered cases of COVID-19 as its event date, and his results showed a significant negative impact of the COVID-19 outbreak on the stock market returns. Liu et al. (2020) also applied an event study on 21 leading stock markets in majorly affected countries, with the day that major news sources reported COVID-19 outbreak (January 20th) as the event date, and their results indicated that the stock markets in affected countries experienced a downward trend, especially countries in Asia. Sun et al. (2021) focused on medical stock portfolio from 5 countries, and they found Coronavirus-related news and economic-related announcements both have positive and significant effects. Phan and Nararyan (2020) used data from 25 countries and found the vast majority of their stock market reacted negatively during the early stage of COVID-19, but with time progressed, there were sign of market correction. Our study references some of these methods and data sources, but instead of evaluating the global impact of COVID-19, we focus on a single country - Japan, and thus we provide more insights to the investors and policy makers in Japan.

3 Data and Methodology

3.1 Data

This study obtains the COVID-19 new cases and deaths daily data from European Centre for Disease Prevention and Control (EDOC). The time period starts from December 31st, 2019 and ends in December 14th, 2020, after which EDOC switched to reporting weekly data. Figure 1 shows the daily new cases and death for Japan during this period. From the figure, we can observe roughly three waves of COVID-19 infections: the first wave was around March to April, the second wave was around July to September, and the

third wave started in November. The death has a spike on April 23rd, 2020, which is likely due to data collection reason (e.g. clustered reporting).

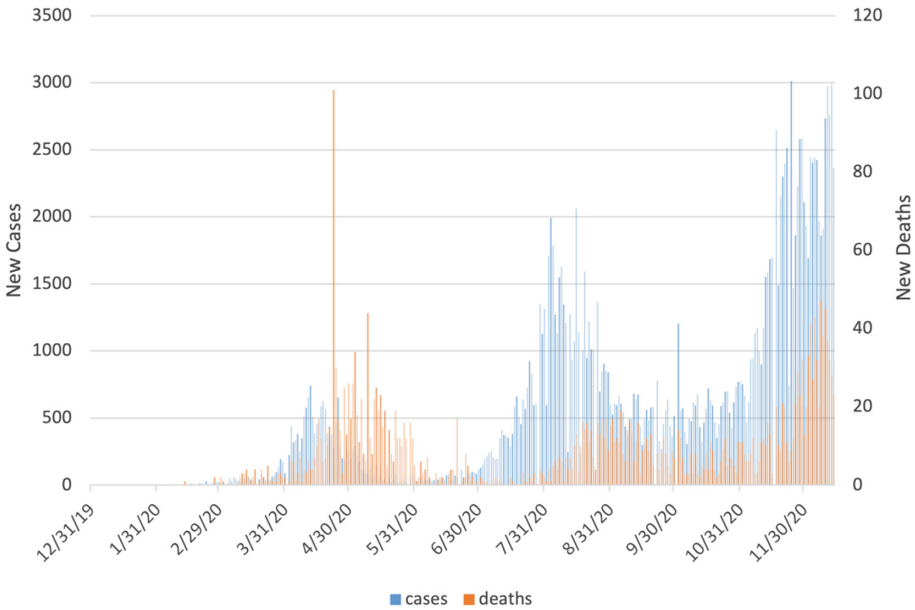


Fig. 1. The COVID-19 new cases and deaths daily data from European Centre for Disease Prevention and Control (EDOC)

We also collect the Tokyo Stock Price Index (TOPIX) and the TOPIX-17 Series Indexes from Yahoo! Finance for the same time period, which are available on daily basis. We also obtained MSCI All Country World Index (ACWI) from Yahoo! Finance, for which we use as the market index in the event study related to TOPIX. These data range from January 4th, 2019 to December 30th, 2020. Table 1 shows the 17 sectors under TOPIX. Table 2 and Table 3 present the summary statistics of the daily return rate of each index in 2019 and 2020, respectively. We use 2019 data in event study later as the estimation period's data, because it is not affected by any COVID-19 related events. We then combine 2020 stock data with COVID-19 new cases and death data and use OLS regression to test on how Japan's stock was affected by the spreading of COVID-19. As we can see from Table 2 and 3, comparing to 2019, most sectors had lower average return in 2020, except for electric power & gas and retail trade.

Table 1. TOPIX sector indexes and TOPIX-17 series

33 Sectors	TOPIX-17 Series
1 Fishery, Agriculture & Forestry	TOPIX-17 FOODS
2 Foods	
3 Mining	TOPIX-17 ENERGY RESOURCES
4 Oil and Coal Products	
5 Construction	TOPIX-17 CONSTRUCTION & MATERIALS
6 Metal Products	
7 Glass and Ceramics Products	
8 Textiles and Apparels	
9 Pulp and Paper	TOPIX-17 RAW MATERIALS & CHEMICALS
10 Chemicals	
11 Pharmaceutical	TOPIX-17 PHARMACEUTICAL
12 Rubber Products	TOPIX-17 AUTOMOBILES & TRANSPORTATION EQUIPM
13 Transportation Equipment	
14 Iron and Steel	TOPIX-17 STEEL & NONFERROUS METALS
15 Nonferrous Metals	
16 Machinery	TOPIX-17 MACHINERY
17 Electric Appliances	TOPIX-17 ELECTRIC APPLIANCES & PRECISION INSTRU
18 Precision Instruments	
19 Other Products	TOPIX-17 IT & SERVICES, OTHERS
20 Information & Communication	
21 Services	TOPIX-17 ELECTRIC POWER & GAS
22 Electric Power and Gas	
23 Land Transportation	TOPIX-17 TRANSPORTATION & LOGISTICS
24 Marine Transportation	
25 Air Transportation	
26 Warehousing and Harbor Transportation	
27 Wholesale Trade	TOPIX-17 COMMERCIAL & WHOLESALE TRADE
28 Retail Trade	TOPIX-17 RETAIL TRADE
29 Banks	TOPIX-17 BANKS
30 Securities and Commodities Futures	TOPIX-17 FINANCIALS (EX BANKS)
31 Insurance	
32 Other Financing Business	
33 Real Estate	TOPIX-17 REAL ESTATE

3.2 Even Study Method

An event study is a statistical method to examine the impact of an event on an outcome variable. Bash (2020) made an event study analysis studying the effect of the first registered case of COVID-19 on the stock market returns by using the mean-adjusted returns and market model methods to estimate cumulative abnormal returns for 30 countries. We use market model methods to calculate the abnormal returns in our event study to investigate the impact of the COVID-19 pandemic on the Japanese stock market, which is outlined as follows.

Calculate Returns ($R_{i,d}$):

$$R_{i,d} = (P_{i,d} - P_{i,d-1}) \div P_{i,d-1} \quad (1)$$

Table 2. The summary statistics of the daily return rate of each index in 2019

Index	Mean	Std. Dev.	Min	Max
1 TOPIX Exchange Traded Fund	0.0007041	0.0008522	-0.0270108	0.0283081
2 TOPIX-17 FOODS	-0.0000433	0.0073905	-0.0240596	0.026364
3 TOPIX-17 ENERGY RESOURCES	0.000042	0.01666	-0.0466238	0.0620945
4 TOPIX-17 CONSTRUCTION & MATERIALS	0.0005134	0.0103829	-0.0386686	0.0365365
5 TOPIX-17 RAW MATERIALS & CHEMICALS	0.00052	0.0103696	-0.0448393	0.0455696
6 TOPIX-17 PHARMACEUTICAL	0.0008873	0.0110328	-0.0397408	0.0375494
7 TOPIX-17 AUTOMOBILES & TRANSPORTATION EQUIPMENT	0.0003308	0.0106876	-0.0324708	0.0364103
8 TOPIX-17 STEEL & NONFERROUS METALS	-0.0000939	0.0142068	-0.088293	0.0452012
9 TOPIX-17 MACHINERY	0.000913	0.0107732	-0.0358209	0.0337838
10 TOPIX-17 ELECTRIC APPLIANCES & PRECISION INSTRUMENTS	0.0014992	0.0108776	-0.0333333	0.0575397
11 TOPIX-17 IT & SERVICES, OTHERS	0.0010622	0.0084025	-0.033169	0.031746
12 TOPIX-17 ELECTRIC POWER & GAS	-0.0005006	0.0109658	-0.0428016	0.0363409
13 TOPIX-17 TRANSPORTATION & LOGISTICS	0.0004859	0.0096086	-0.0252525	0.0863827
14 TOPIX-17 COMMERCIAL & WHOLESALE TRADE	0.0005661	0.0096845	-0.0432191	0.0303951
15 TOPIX-17 RETAIL TRADE	0.0002071	0.0081509	-0.0347082	0.0312668
16 TOPIX-17 BANKS	0.0000822	0.0104375	-0.0525114	0.0348706
17 TOPIX-17 FINANCIALS (EX BANKS)	0.0005315	0.010977	-0.0532003	0.0356522
18 TOPIX-17 REAL ESTATE	0.0006884	0.010659	-0.0395147	0.0461927
19 iShares MSCI ACWI ETF	0.0008711	0.0074821	-0.0295132	0.0318794

Table 3. The summary statistics of the daily return rate of each index in 2020

Index	Mean	Std. Dev.	Min	Max
1 TOPIX Exchange Traded Fund	0.0003089	0.0142325	-0.0563934	0.0672938
2 TOPIX-17 FOODS	-0.0001397	0.0138839	-0.0505319	0.0595998
3 TOPIX-17 ENERGY RESOURCES	-0.0014024	0.01862	-0.0958019	0.0824176
4 TOPIX-17 CONSTRUCTION & MATERIALS	-0.0002688	0.0180794	-0.0761364	0.1203822
5 TOPIX-17 RAW MATERIALS & CHEMICALS	0.0003725	0.0149814	-0.06298	0.0872257
6 TOPIX-17 PHARMACEUTICAL	0.0001511	0.0154928	-0.0546496	0.0641472
7 TOPIX-17 AUTOMOBILES & TRANSPORTATION EQUIPMENT	0.0000311	0.0193734	-0.0620653	0.0750323
8 TOPIX-17 STEEL & NONFERROUS METALS	-0.0001685	0.0230731	-0.0826996	0.0945652
9 TOPIX-17 MACHINERY	0.0006408	0.0170271	-0.0611814	0.0774371
10 TOPIX-17 ELECTRIC APPLIANCES & PRECISION INSTRUMENTS	0.0009882	0.015842	-0.0663456	0.0587097
11 TOPIX-17 IT & SERVICES, OTHERS	0.0008993	0.018311	-0.1241593	0.1110455
12 TOPIX-17 ELECTRIC POWER & GAS	-0.0004435	0.0158326	-0.0432	0.0833333
13 TOPIX-17 TRANSPORTATION & LOGISTICS	-0.0009399	0.0194594	-0.0912209	0.0772171
14 TOPIX-17 COMMERCIAL & WHOLESALE TRADE	0.0000504	0.0167514	-0.0789091	0.0743219
15 TOPIX-17 RETAIL TRADE	0.0004641	0.0184265	-0.1342282	0.1268499
16 TOPIX-17 BANKS	-0.0011529	0.0204724	-0.1414835	0.0725309
17 TOPIX-17 FINANCIALS (EX BANKS)	-0.0001497	0.0182139	-0.0708295	0.0728051
18 TOPIX-17 REAL ESTATE	-0.0003942	0.0237639	-0.1202586	0.1108247
19 iShares MSCI ACWI ETF	0.0007407	0.020206	-0.1121524	0.0813546

Calculate Abnormal Returns ($ABR_{i,d}$) using market model method by Brown and Warner (1985):

$$R_{i,d} = \alpha + \beta \times R_{i,m,d} + ABR_{i,d} + \varepsilon_{i,d} \quad (2)$$

$R_{i,d}$ is the return of index i on day d , where index i is either the TOPIX or one of the TOPIX-17 sectors. $R_{i,m,d}$ is the return of market index m on day d , and the market index choice corresponds to index i . When index i is the TOPIX, we use MSCI ACWI as the market index; when index i is one of the TOPIX-17 sectors, we use TOPIX as

the market index Alpha and beta are regression coefficients for the estimation window (January 1st, 2019 to December 31st, 2019) obtained by ordinary least squares estimation (OLS). $ABR_{i,d}$ is the abnormal return of index i on day d .

To avoid impact of the outbreak COVID-19, we choose the entire 2019 as our estimation window and use a 5-day event window, including the day prior to the event, the day of the event, and 3 days after the event.

Table 4 shows the timeline of major events related to the COVID-19 pandemic in Japan.

Table 4. The timeline of major events related to the COVID-19 pandemic in Japan.

Date	Event
January 16, 2020	First coronavirus case in Japan
February 3, 2020	The passenger of <i>Diamond Princess</i> cruise ship have tested positive
March 4, 2020	The total number of confirmed cases in Japan reached 1,000 level
March 11, 2020	Announcement of pandemic by WHO
April 7, 2020	Prime Minister announced state of emergency for 7 prefectures
April 16, 2020	Prime Minister expanded state of emergency to the entire nation
July 20, 2020	The official number of deaths in Japan over 1,000 cases since pandemic
October 29, 2020	The total number of confirmed cases in Japan crosses 100,000 mark since pandemic

4 Result

4.1 Event Study Method

As discussed earlier, it is difficult to decide which single event can best represent the COVID-19 pandemic. In the empirical testing, we follow existing studies and choose several dates as our event date. Bash (2020) set first cases as the event date. Alam et al. (2020) used the day that the Australian government announces the outbreak of the epidemic as the event date. Alam et al. (2020) chose the day of official announcement of the lockdown to be the event date. We picked the corresponding dates in Japan as the event date to calculate the abnormal return.

Japan First Case: 1/16/2020. The abnormal return of Japanese stock market and 17 industry indexes in the 5-day event period of -1 to 3 while the event date is January 16th, 2020, as well as their significant level are listed in Table 5.

Bash (2020) found abnormal return significantly negative on the event day calculated using the market model, within 30 countries in a 3-day event window. Our result shows that although the abnormal return is negative, it is not significant.

TOPIX had negative but not significant abnormal return on the event day. And it still did not exhibit significant abnormal returns on the day before the event day and 3 days after that. At the sector level, most coefficients are not significant, but the transportation sector had a positive abnormal return on the day before the event day and the food sector had a negative abnormal return on the second day after the event day. In addition, the cumulative abnormal return is not significantly different from 0 since very low F-statistics exists. Also, their response did not occur on the day of event.

Table 5. The abnormal return of Japanese stock market and 17 industry indexes in the 5-day event period of -1 to 3 while the event date is January 16th, 2020

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	TOPIX	Auto	Bank	Chemical	Commercial	Construction	Electricity	ElectricPower	Energy	Financial	Food	IT	Machinery	Pharmaceutical	RealEstate	Retail	Steel	Transportation
Day -1	-0.00549 (0.00524)	0.00114 (0.00840)	0.00441 (0.00788)	0.00582 (0.00857)	-0.00362 (0.00762)	0.00421 (0.00751)	-0.00151 (0.00859)	0.00341 (0.01001)	-0.00107 (0.0144)	0.00335 (0.00940)	0.00375 (0.00627)	-0.0000174 (0.00753)	0.000130 (0.00910)	0.00193 (0.00872)	0.000797 (0.00967)	0.00162 (0.0075)	-0.00606 (0.0119)	0.0163** (0.00720)
Day 0	-0.00426 (0.00525)	0.00147 (0.00840)	0.00686 (0.00787)	-0.00134 (0.00856)	0.00583 (0.00762)	0.00284 (0.00750)	0.000684 (0.00858)	0.00797 (0.01001)	0.00303 (0.0144)	-0.000844 (0.00939)	0.00138 (0.00627)	-0.0471 (0.00752)	0.00401 (0.00910)	0.00947 (0.00871)	0.000931 (0.00967)	0.00697 (0.0074)	0.00631 (0.0118)	0.00958 (0.00720)
Day 1	0.00355 (0.00524)	0.00719 (0.00840)	-0.00201 (0.00788)	-0.00333 (0.00856)	-0.00319 (0.00762)	-0.00357 (0.00750)	0.000655 (0.00858)	-0.018 (0.01001)	-0.00391 (0.0144)	-0.00304 (0.00940)	-0.00183 (0.00627)	-0.00329 (0.00752)	-0.00330 (0.00910)	-0.00353 (0.00871)	-0.00104 (0.00967)	-0.00149 (0.0075)	-0.00343 (0.0119)	-0.00164 (0.00720)
Day 2	0 ()	0.00606 (0.00840)	-0.00371 (0.00788)	-0.00411 (0.00856)	0.00291 (0.00762)	0.00772 (0.00750)	0.00103 (0.00858)	0.00787 (0.01001)	-0.00770 (0.0144)	-0.00187 (0.00940)	-0.014** (0.00627)	-0.00331 (0.00752)	-0.00306 (0.00910)	-0.00389 (0.00871)	0.00410 (0.00967)	-0.00130 (0.0074)	0.0143 (0.0118)	-0.00141 (0.00720)
Day 3	-0.00282 (0.00525)	0.00613 (0.00840)	0.00354 (0.00788)	0.00263 (0.00856)	0.00553 (0.00762)	0.00553 (0.00750)	0.00000701 (0.00858)	-0.000128 (0.01001)	0.00474 (0.0144)	0.000566 (0.00940)	0.00852 (0.00627)	0.000793 (0.00752)	0.0137 (0.00910)	0.00269 (0.00872)	0.0114 (0.00967)	0.00125 (0.0075)	-0.00975 (0.0119)	-0.00816 (0.00720)
World Market Return	0.242*** (0.0748)																	
Japan Market Return	0.766*** (0.0651)		0.786*** (0.0610)	0.714*** (0.0663)	0.707*** (0.0590)	0.824*** (0.0581)	0.685*** (0.0665)	0.512*** (0.0786)	1.038*** (0.109)	0.676*** (0.0728)	0.480*** (0.0486)	0.370*** (0.0583)	0.676*** (0.0705)	0.746*** (0.0675)	0.536*** (0.0749)	0.329*** (0.0600)	0.942*** (0.0918)	0.388*** (0.0558)
Constant	0.000255 (0.000546)	-0.00250 (0.000544)	-0.000495 (0.000510)	0.000138 (0.000555)	0.0000380 (0.000494)	-0.000107 (0.000486)	0.000841 (0.000556)	-0.000861 (0.000657)	0.000723 (0.000912)	0.0000177 (0.000609)	-0.000313 (0.000406)	0.000642 (0.000488)	0.000371 (0.000590)	0.000198 (0.000565)	0.000263 (0.000627)	0.000206 (0.000502)	-0.000770 (0.000768)	-0.0006948 (0.000460)
Observations	234	243	243	243	243	243	243	243	243	243	243	243	243	243	243	243	243	243
F-stat for event	0.238	0.363	0.328	0.193	0.333	0.455	0.115	0.540	0.109	0.0561	1.249	0.137	0.544	0.338	0.320	0.146	0.501	1.312

Standard errors in parentheses
 ** p<0.05 *** p<0.01
 =** p<0.10

During the event window, the cumulative abnormal return is not significant for TOPIX index based on the F test. All 17 sectors do not have significant cumulative abnormal returns since their F statistics are smaller than the critical value ($= 3.017$).

Therefore, we don't have enough evidence that the first COVID-19 case in Japan had a significant impact on the Japanese stock market. Our result is similar to Bash's (2020) result, using comparable event window, which is based on 30 countries that the impact of first COVID-19 case on stock markets is insignificant.

Announcement of Pandemic by WHO: 3/11/2020. The abnormal return of Japanese stock market and 17 industry indexes in the 5-day event period of -1 to 3 while the event date is March 11th, 2020, as well as their significant level are listed in Table 6.

Alam et al. (2020) found the abnormal return of food, pharmaceuticals and healthcare indices were significantly positive on the event day calculated using the market model, considered a 10-day event window within 8 Australia industry indices. Our result shows that the overall abnormal return of TOPIX index is negative but not significant on the event day. However, bank, construction, electric power, food, and retail exhibited a significantly positive abnormal returns on the day of event, while real estate exhibited a slightly significantly negative abnormal return.

During the event window, the cumulative abnormal return is significant for TOPIX index, and some sectors including auto, bank, commercial, construction, electric app, food, IT, real estate, retail, steel, and transportation since their F statistics are greater than the critical value ($= 3.017$).

Therefore, we don't enough evidence that the announcement of pandemic by WHO had a significant impact on the overall Japanese stock market, but we can conclude that the announcement of pandemic had a significant impact on some sectors (bank, construction, electric power, food, retail, and real estate). Our result is similar to Alam et al. (2020)'s result that the impact of the announcement of pandemic on food sector has a significantly positive abnormal return, but our pharmaceuticals did not exhibit a significant return.

Announcement of State of Emergency: 4/7/2020

Alam et al. (2020) found average abnormal return significantly positive around the lock-down period, considered a 35-day event window within sample of random 31 companies listed on Bombay Stock Exchange (BSE). Our result also indicates that the overall abnormal return of TOPIX index is significantly positive on the event day. On the sectoral level, bank, chemical, commercial, construction, IT, machinery, and transportation exhibited a significantly positive abnormal returns on the day of event, while financial and food exhibited a significantly negative abnormal return (Table 7).

During the event window, the cumulative abnormal return is significant for TOPIX index, and some sectors including auto, bank, chemical, commercial, construction, electric app, financial, food, IT, Machinery, retail, and transportation since their F statistics are greater than the critical value equals to 3.017 .

Table 6. The abnormal return of Japanese stock market and 17 industry indexes in the 5-day event period of – 1 to 3 while the event date is March 11th, 2020.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Auto	Bank	Chemical	Commercial	Construction	Electrics/Appl	Electric/Power	Energy	Financial	Food	IT	Machinery	Pharmaceutical	RealEstate	Retail	Steel	Transportation
Day-1	0.00250 (0.00890)	-0.0772** (0.00844)	-0.00325 (0.00860)	-0.00778 (0.00766)	-0.00611 (0.00754)	0.00970 (0.00862)	0.00579 (0.0102)	-0.0268* (0.0141)	0.0126 (0.00944)	-0.00720 (0.00650)	0.00446 (0.00756)	-0.0327*** (0.00914)	0.0165* (0.00876)	0.0154 (0.00972)	-0.0123 (0.00778)	0.0115 (0.0119)	0.0165** (0.00723)
Day 0	-0.00418 (0.00913)	0.0168** (0.00847)	0.00823 (0.00865)	0.00951 (0.00768)	0.0252*** (0.00756)	-0.00924 (0.00885)	0.0263** (0.0102)	0.0130 (0.0142)	-0.00754 (0.00947)	0.0249*** (0.00652)	-0.0110 (0.00759)	-0.00860 (0.00917)	-0.0139 (0.00839)	-0.076* (0.00975)	0.0291*** (0.00781)	-0.00196 (0.0119)	0.00151 (0.00726)
Day 1	-0.0168 (0.0111)	-0.0194** (0.00881)	-0.0241*** (0.00898)	-0.0149* (0.00799)	-0.0296*** (0.00787)	-0.0184** (0.00900)	-0.00688 (0.0106)	-0.0703 (0.0148)	-0.0217** (0.00985)	-0.0251*** (0.00658)	-0.0367*** (0.00789)	-0.0241** (0.00954)	-0.0138 (0.00914)	-0.0336*** (0.0101)	-0.0360*** (0.00812)	-0.0117 (0.0124)	-0.00920 (0.00755)
Day 2	-0.0692*** (0.00979)	0.0271*** (0.00849)	-0.0138 (0.00923)	-0.023*** (0.00821)	-0.0178** (0.00889)	0.00386 (0.00925)	-0.0133 (0.0109)	0.0134 (0.0152)	0.0180* (0.0101)	-0.00205 (0.00676)	-0.106*** (0.00811)	-0.00752 (0.00981)	0.00415 (0.00939)	-0.0029*** (0.0104)	-0.117*** (0.00835)	0.0385*** (0.0128)	-0.0479*** (0.00776)
Day 3	0.00320 (0.0118)	-0.0401*** (0.00854)	0.0294*** (0.00801)	0.0456*** (0.00775)	0.0197** (0.00763)	-0.0304*** (0.00873)	-0.0192* (0.0103)	0.00940 (0.0143)	-0.0128 (0.00956)	0.00729 (0.00638)	0.119*** (0.00765)	-0.00103 (0.00925)	-0.0143* (0.00886)	0.0130 (0.00984)	0.135*** (0.00788)	-0.0383*** (0.0121)	0.0688*** (0.00732)
World Market Return	0.242*** (0.0748)																
Japan Market Return	0.766*** (0.0651)	0.786*** (0.0610)	0.714*** (0.0663)	0.707*** (0.0590)	0.824*** (0.0581)	0.685*** (0.0665)	0.512*** (0.0786)	1.038*** (0.109)	0.676*** (0.0728)	0.480*** (0.0486)	0.370*** (0.0583)	0.676*** (0.0705)	0.746*** (0.0675)	0.536*** (0.0749)	0.329*** (0.0600)	0.942*** (0.0918)	0.388*** (0.0558)
Constant	0.000255 (0.000546)	-0.000261 (0.000544)	-0.000495 (0.000510)	0.000138 (0.000555)	0.0000380 (0.000494)	-0.000107 (0.000486)	-0.000861 (0.000657)	-0.000723 (0.000912)	0.0000177 (0.000609)	-0.000313 (0.000406)	0.000642 (0.000488)	0.000371 (0.000590)	0.000198 (0.000565)	0.000263 (0.000627)	0.0000206 (0.000502)	-0.0000770 (0.000768)	-0.0000948 (0.000466)
Observations	235	243	243	243	243	243	243	243	243	243	243	243	243	243	243	243	243
F-stat for event	14.28	8.260	25.87	3.160	14.41	7.813	3.657	2.437	1.154	2.647	6.914	92.36	4.159	2.488	18.44	112.5	4.602

Standard errors in parentheses
 *** p<0.05
 ** p<0.10
 * p<0.01

Table 7. The abnormal return of Japanese stock market and 17 industry indexes in the 5-day event period of -1 to 3 while the event date is April 7th, 2020

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
LDPX	Auto	Bank	Chemical	Commercial	Construction	Electricity	Electricity	Energy	Financial	Food	IT	Machinery	Pharmaceutical	RealEstate	Retail	Steel	Transportation
Day -1	0.0230** (0.0084)	0.0326*** (0.0083)	-0.00683 (0.0088)	-0.0176** (0.00792)	-0.0201** (0.00780)	0.00026 (0.0082)	-0.0182* (0.0105)	-0.0161 (0.0146)	0.0241** (0.00976)	-0.00691 (0.00651)	0.06542 (0.00782)	-0.0293*** (0.00845)	0.00601 (0.00906)	0.0264** (0.0100)	-0.0738*** (0.00885)	0.00173 (0.0123)	0.00247 (0.00748)
Day 0	0.0181** (0.00824)	0.0168** (0.00795)	0.0247*** (0.00864)	0.0209*** (0.00769)	0.0189** (0.00757)	-0.00193 (0.0086)	-0.00239 (0.0102)	0.0886 (0.0142)	-0.0420*** (0.00848)	-0.0227** (0.00633)	0.0144* (0.00759)	0.0201** (0.00918)	-0.00178 (0.00880)	0.00231 (0.00976)	0.00995 (0.00782)	0.000603 (0.0129)	0.0342*** (0.00726)
Day 1	0.012 (0.00842)	0.0193** (0.00793)	-0.0138* (0.00789)	-0.0154** (0.00767)	0.00852 (0.00755)	0.0177** (0.00864)	0.00638 (0.0102)	-0.0369*** (0.0142)	0.0282*** (0.00946)	0.0365*** (0.00631)	0.0224*** (0.00758)	0.00703 (0.00916)	0.0211** (0.00877)	0.0174* (0.00974)	-0.00537 (0.00776)	-0.0242** (0.0119)	0.0216*** (0.00725)
Day 2	-0.0125 (0.00830)	0.00446 (0.00841)	-0.00173 (0.00793)	0.00606 (0.00853)	0.0152** (0.00764)	0.00725 (0.00860)	0.00350 (0.0102)	0.0156 (0.0141)	-0.00774 (0.00942)	-0.0168** (0.00628)	0.00257 (0.00754)	0.00549 (0.00912)	-0.00577 (0.00873)	-0.0136 (0.00869)	0.0210*** (0.00776)	0.0176 (0.0119)	-0.0299*** (0.00721)
Day 3	0 (0.00842)	-0.0103 (0.00790)	0.0310*** (0.00859)	-0.0101 (0.00764)	0.00494 (0.00753)	-0.00868 (0.00861)	-0.00500 (0.0102)	-0.00998 (0.0141)	0.00602 (0.00943)	-0.0216*** (0.00629)	-0.0234*** (0.00555)	-0.00810 (0.00913)	0.0138 (0.00874)	0.00233 (0.00970)	-0.00855 (0.00777)	0.0157 (0.0119)	-0.0285*** (0.00722)
World Market Return	0.242*** (0.0748)																
Japan Market Return	0.766*** (0.0651)	0.786*** (0.0610)	0.714*** (0.0663)	0.707*** (0.0590)	0.824*** (0.0581)	0.685*** (0.0665)	0.512*** (0.0789)	1.088*** (0.109)	0.676*** (0.0728)	0.480*** (0.0486)	0.370*** (0.0583)	0.676*** (0.0705)	0.746*** (0.0675)	0.536*** (0.0749)	0.329*** (0.0600)	0.942*** (0.0918)	0.388*** (0.0588)
Constant	0.00255 (0.006546)	-0.00261 (0.00654)	-0.00495 (0.006510)	0.000138 (0.006555)	-0.000107 (0.006594)	-0.000841 (0.006550)	-0.000861 (0.00657)	-0.000723 (0.00699)	0.000177 (0.00669)	-0.000313 (0.00488)	0.000642 (0.00488)	0.000371 (0.006590)	0.000198 (0.006565)	0.000263 (0.00627)	0.000206 (0.00652)	-0.000770 (0.00668)	-0.0009348 (0.00646)
Observations	234	243	243	243	243	243	243	243	243	243	243	243	243	243	243	243	243
F-stat for event	3.508	4.592	4.618	3.241	3.365	3.142	5.769	0.788	1.983	7.329	14.19	4.522	1.734	2.326	18.93	1.626	11.97

Standard errors in parentheses
 **= p<0.10
 ***= p<0.01

Therefore, we have enough evidence that the announcement of state of emergency had a significant impact on the Japanese stock market and some sectors, such as: auto, real estate, and machinery. Our result is similar to Alam et al. (2020)'s result that the impact of the announcement of lockdown on Indian stock market has a significantly positive average abnormal return.

4.2 Overall Result of Event Study Method

Based on different selection of COVID-19 related events as our event date, the results differ quite a lot. Therefore, we cannot decide which day is most suitable to represent COVID-19. In the following part, we will employ an OLS method to test the impact of COVID-19 (in the form on the new cases and deaths) on the Japanese stock market.

5 Ordinary Least Squares (OLS) Method

We employ a similar model as the one used by Ashraf (2020):

$$R_{i,t} = \alpha_i + \beta_i \times COVID_t + \varepsilon_{i,t} \quad (3)$$

In this formula, i and t represents index and day, respectively. Dependent variable, $R_{i,t}$, represents the return of index i on day d , where index i is either the TOPIX or one of the TOPIX-17 sectors. $COVID_{i,t}$ represents the growth in either daily cases or deaths caused by COVID-19 on the day t . Table 8 shows how TOPIX responded to growth in daily cases and deaths in the entire 2020.

Table 8. TOPIX responded to growth in daily cases and deaths in the entire 2020

Variables	Stock Market Returns			
	(1)	(2)	(3)	(4)
Daily Cases Growth	-0.0240** (0.00988)		-0.0585** (0.0284)	-0.0577 (0.0357)
Daily Death Growth		-0.0178*** (0.00434)	-0.0141*** (0.00428)	-0.0131*** (0.00350)
World Market Return				0.249*** (0.0732)
Constant	0.00115 (0.000925)	0.000969 (0.00103)	0.00242** (0.000971)	0.00190* (0.00102)
N	223	203	203	197
R-sq	0.020	0.035	0.064	0.200

Standard errors in parentheses

* $p < 0.10$

** $p < 0.05$

*** $p < 0.01$ "

Table 9. Each sector responded to growth in daily cases and deaths in the entire 2020

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	Auto	Bank	Chemical	Commercial	Construction	Electric/yp	Electric/Power	Energy	Financial	Food	IT	Machinery	Pharmaceutical	Real/Estate	Retail	Steel	Transportation
Panel A																	
Daily Cases Growth	-0.0270** (0.0116)	-0.0153 (0.0102)	-0.0245** (0.0120)	-0.0290** (0.0137)	-0.0197* (0.0117)	-0.0328*** (0.0109)	-0.0028 (0.00669)	-0.0205** (0.00940)	-0.0114 (0.0131)	-0.0108 (0.00988)	-0.0267** (0.0124)	-0.0385* (0.0202)	-0.00938 (0.00989)	-0.0210* (0.0127)	-0.0209* (0.014)	-0.0318** (0.0133)	-0.0270** (0.0134)
Constant	0.00114 (0.00137)	-0.00582 (0.00147)	0.00127 (0.00104)	0.00106 (0.00117)	0.000465 (0.00126)	0.00192** (0.00106)	-0.00238 (0.00111)	-0.00783 (0.00124)	0.000191 (0.00129)	0.000520 (0.000943)	0.00185 (0.00117)	0.00265 (0.00120)	0.00354 (0.00165)	0.000465 (0.00166)	0.00120 (0.00115)	0.00086 (0.00165)	0.000170 (0.00139)
N	223	223	223	223	223	223	223	223	223	223	223	223	223	223	223	223	223
R-sq	0.014	0.004	0.019	0.021	0.008	0.030	0.001	0.009	0.003	0.004	0.015	0.036	0.003	0.005	0.009	0.013	0.014
Panel B																	
Daily Death Growth	-0.0177*** (0.00495)	-0.0157*** (0.00578)	-0.0190*** (0.00572)	-0.0183*** (0.00523)	-0.0164*** (0.00651)	-0.0208*** (0.00445)	-0.0150*** (0.00374)	-0.0177*** (0.00457)	-0.0159*** (0.00651)	-0.0154*** (0.00400)	-0.0277*** (0.00659)	-0.0184*** (0.00753)	-0.0160*** (0.00544)	-0.0272*** (0.00853)	-0.0150*** (0.00718)	-0.0116** (0.00490)	-0.00918 (0.00611)
Constant	0.00806 (0.0045)	-0.00572 (0.00155)	0.00117 (0.00105)	0.000576 (0.00120)	0.00386 (0.00133)	0.00150 (0.00114)	0.000186 (0.00116)	-0.00830 (0.00135)	0.000315 (0.00137)	0.00043 (0.00102)	0.00146 (0.00126)	0.00139 (0.00122)	0.00054 (0.00114)	0.00046 (0.00172)	0.00108 (0.00128)	0.000520 (0.00174)	-0.00403 (0.00146)
N	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203	203
R-sq	0.018	0.012	0.035	0.026	0.018	0.037	0.021	0.020	0.016	0.027	0.050	0.026	0.024	0.028	0.014	0.006	0.005

Standard errors in parentheses
** p<0.05 *** p<0.01*

Specification 1 and 2 are our baseline results, where we have TOPIX return as the dependent variable, and growth in daily confirmed cases or growth in daily deaths is the independent variable, respectively. From our baseline estimation, growth in both confirmed cases and deaths have a negative and significant effect on TOPIX's return. The impact from growth in deaths is smaller in magnitude than the impact from growth in cases according to the estimation results. The R-squared for these specifications are low, which is expected since COVID-19 cases and deaths only affect the stock market indirectly.

In specification 3, we put daily cases growth and daily death growth at the same time as independent variables. Comparing to specification 1, the impact from cases growth becomes larger, but its standard error is also larger, meaning the coefficient is less significant. In specification 4, we also include world market return in the independent variables, in order to control for systematic risk due to the international factors. Comparing to specification 3, the value of coefficients for growth in cases and growth in deaths decrease slightly, but the coefficient for growth in cases just misses the threshold for being statistically significant (it has a p-value of 0.108).

The estimation results indicate that in terms of magnitude, the impact of growth in confirmed COVID-19 cases is larger than the impact of growth in deaths due to COVID-19. However, the impact of growth in deaths is more robust as it remains statistically significant among all specifications. Since deaths due to COVID-19 must come from some confirmed COVID-19 cases, investors may expect death as a possible outcome after they receive the information about confirmed cases. Therefore, it's understandable that growth in deaths has less impact than growth in confirmed cases. However, the growth in confirmed cases does not necessarily reflect the growth in actual COVID-19 infections, especially in the early period of the pandemic. Reasons like the increasing in testing ability, increasing in testing accuracy, and increasing in testing frequency can all lead the growth in daily confirmed cases to raise. On the other hand, growth in death can accurately reflect the severity of the spreading of COVID-19 in Japan, and therefore it makes sense that its coefficient is significant in all specifications.

Table 9 presents how each sector responded to growth in daily cases and deaths in the entire 2020. In panel A, the independent variable is daily growth confirmed cases, while in panel B, the independent variable is daily growth death cases.

The results in panel A shows that auto, chemical, commercial, construction, electric app, energy, IT, machinery, real estate, retail, steel, and transportation are negatively affected by daily growth confirmed cases. Also, the results in panel B shows that all sectors, except for transportation, are negatively affected by daily growth death cases. In terms of magnitude and significance, the results are similar to that of the TOPIX index: in general, the impact of daily cases growth is larger than daily death growth, but the impact of daily death growth is more significant.

6 Conclusion

Analyzing Japanese stock market index, such as TOPIX and TOPIX-17 sectorial index, during the COVID-19 pandemic in 2020, we found that the effect of daily growth in cases is more negative than the effect of daily growth in death. Our baseline results showed that one percent increase in daily growth of confirmed cases of daily death is associated with 0.024 percent or 0.018 percent decrease in the Japanese market index. While both results are statistically significant, the latter is more robust than the former one. When we consider the fact that investors learn both daily growth in cases and daily growth in death, and when we control for internationally systematic risk, the impact from daily growth in cases increases to around 0.058 percent decrease in the market index, but the significance level decrease; meanwhile, the impact of daily growth in death reduces slightly to 0.013 percent decrease in the market index and it remains a similar significance level.

These results are meaningful as it connects the spreading speed of COVID-19 to Japan's stock market performance. The spreading speed is measured by the daily growth in confirmed cases or death due to COVID-19, and from data we can identify three waves of large spread in 2020. We can expect investors and business to have different attitude towards the pandemic in each wave: in the first wave, we can expect panic around the globe, and the death rate of the disease was high; in later waves, along with scientific research and the development of vaccines, we can expect people to have better understanding of disease and thus behaving more rational. It is out of the scope of this study, but in the future it might be interesting to look at how company's financial performances are linked with the spreading of COVID-19, and how this intertwines with company's stock performance. This might provide more direct evidence on how COVID-19 affected consumer's and industrial behaviors in different periods.

In the end, we realize that this study still comes with some limitations. One limitation is that we use world's market index to control for systematic risk, but COVID-19 spread worldwide, and thus we will not be able to model the world's stock market performance as if there is no COVID-19. Another limitation is that, there might be data reporting error when collecting COVID-19 confirmed cases or death. We have not found a good way to work around these, and it would be meaningful if future studies can design to avoid such limitations.

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The Empirical Analysis of Sharpe's One-Way Analysis of Variance in Chinese Market

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Abstract. In this paper, the sharpe single index model, a simplified portfolio model, is empirically tested. By selecting the stock data in China's stock market and the Shanghai Composite index for regression test, using the coefficient to construct the optimal portfolio, the paper calculate the return rate and test whether Sharpe's One-way Analysis of Variance is effective.

Keywords: Single index model · Portfolio · Robustness regression · Sharpe ratio

1 Introduction

With the continuous development and improvement of the financial market, investors are increasingly concerned about how to use historical data to make reasonable decisions in the financial market to obtain higher returns, that is, how to maximize the expected return as far as possible under certain risks. In 1952, Markowitz established the mean-variance model of optimal asset allocation by constructing investment portfolio. This model can obtain the effective frontier of asset portfolio, guide people to invest and has been widely used. However, there are some problems in the practical application of this model. Firstly, the model cannot provide the estimation method of security risk premium; secondly, the covariance matrix requires a huge amount of calculation and the calculation cost is too high.

In view of the complexity of the mean - variance model, in order to simplify the model and reduce computational complexity in the model, in 1963, William sharp diagonal model is put forward, namely Sharpe's One-way Analysis of Variance, greatly simplifies the original covariance matrix estimation, provides a way with lower computation to construct the optimal portfolio, widely used in financial investment research and other fields.

However, there are still some problems in the simplified model proposed by Sharp. Due to the widespread existence of outliers in the actual data, deviating from the normal distribution and inconsistent with the model assumptions, the traditional regression coefficient estimation will have errors, which will lead to wrong decisions of investors. Therefore, it is necessary to weaken the influence of outlier bands through robust estimation method to make the model more consistent with the actual situation and obtain more stable investment returns.

Therefore, this paper adopts the method of robust regression, and carries on the empirical regression analysis to the Sharpe's One-way Analysis of Variance, to judge whether Sharpe's model can effectively build the optimal combination, and observe the optimization effect of robust regression on outliers and the model.

2 Literature Review

Li (2017) used the traditional single index model, selected the data of ten stocks from 2012 to 2016, conducted regression analysis with the Shanghai Composite Index and constructed the investment portfolio, and concluded that the optimal venture portfolio can beat the market portfolio, but it is also accompanied by high risks. Liang (2018) selected the data of six stocks from 2011 to 2016 and conducted regression analysis with csi 300 index, and found that there was a significant linear relationship between each stock and the monthly excess return rate of the index. And the optimal investment portfolio can obtain higher excess returns. Lu (2012) selected the transaction data of 22 funds from 2005 to 2010 and conducted regression analysis with the Shanghai Composite Index, and found that the return rate of the optimal risk portfolio of funds based on the single index model could surpass the return rate of the market index in the same period.

Scholars also used robust regression method to further analyze Sharpe's One-way Analysis of Variance. Li and Wang (2020) selected the logarithmic return data of six stocks from 2018 to 2019 and the Shanghai Composite Index, and used the robust MM estimation method for regression analysis. They found that the robust estimation could better resist the influence of outliers and obtain the optimal asset portfolio with a higher Sharpe ratio. Xie (2013) used simple OLS regression and Huber's robust regression method and compared them in regression analysis. He found that the effective frontier of the portfolio obtained by the robust regression was closer to the upper left, indicating that the risk of the optimal portfolio obtained was lower than that of the optimal portfolio obtained by the traditional OLS method.

3 Theory and Formula

3.1 Single Index Model

The way to make the single index model workable is to consider the return of a market composite index as an effective proxy for common macroeconomic factors, and the excess return of individual stocks is only related to this factor. The regression equation is

$$R_i = \alpha_i + \beta_i R_m + e_i \quad (1)$$

3.2 Construct an Active Portfolio

After the risk premium and standard deviation of the market portfolio are obtained, regress the excess return rate of each stock to the market portfolio, so the coefficient

estimation in Eq. (1) is obtained. Calculate and adjust the position of each stock according to the coefficient, the formula is as follows

$$\omega_i^0 = \frac{\alpha_i}{\sigma^2(e_i)}; \omega_i = \frac{\omega_i^0}{\sum_{i=1}^n \omega_i^0} \quad (2)$$

On this basis, calculate the excess return, residual and so on of positive portfolio

$$\alpha_A = \sum_{i=1}^n \omega_i \alpha_i \quad (3)$$

$$\beta_A = \sum_{i=1}^n \omega_i \beta_i \quad (4)$$

$$\sigma^2(\varepsilon_A) = \sum_{i=1}^n \omega_i^2 \sigma_i^2(e_i) \quad (5)$$

3.3 Construct an Optimal Portfolio

After obtaining the data of the positive portfolio, add the negative index portfolio, namely the market portfolio to construct the optimal portfolio. The formula is as follows

$$\omega_A^0 = \left[\frac{\alpha_A / \sigma^2(e_A)}{E(R_M) / \sigma_M^2} \right]; \omega_A^* = \frac{\omega_A^0}{1 + (1 - \beta)\omega_A^0} \quad (6)$$

$$\omega_M^* = 1 - \omega_A^* \quad (7)$$

Then calculate the optimal portfolio excess return, standard deviation and other data. The formula is as follows

$$\beta_P = \omega_M^* + \omega_A^* \beta_A \quad (8)$$

$$E(R_P) = (\omega_M^* + \omega_A^* \beta_A)E(R_M) + \omega_A^* \alpha_A \quad (9)$$

$$\sigma_P^2 = (\omega_M^* + \omega_A^* \beta_A)^2 \sigma_M^2 + [\omega_A^* \sigma(e_A)]^2 \quad (10)$$

Finally, calculate the Sharpe ratio of each portfolio and then compare them.

4 The Empirical Analysis

4.1 Sample Selection

In stock sample selection, in order to make sample stocks more representative, stocks are selected from different industries and regions. At the same time, the rationality of the portfolio and the embodiment of outliers are considered, so both large-cap stocks and small-cap stocks are chosen in stock selection, so that the fitting results can not only ensure a certain rationality, but also reflect the misleading of abnormal data to investors

under the traditional fitting method. After comprehensive consideration, the following eight stocks were selected for empirical analysis of sharpe's single index model. The code of them are 601088, 601328, 000963, 600048, 000729, 601231, 600409, 002027. Meanwhile, the Shanghai Composite Index is adopted as the market portfolio.

In the sample range, the monthly revenue data of about four years from 2016.2 to 2020.12 is selected. At the same time, the one-year Treasury bond interest rate of each month in the above range is obtained from the People's Bank of China as the risk-free rate of return. After converting the annual rate of return into the monthly rate of return, the monthly excess rate of return of each stock can be obtained. After that, the data were input into Stata for regression analysis.

The line chart of excess returns for some stocks are as follows (Fig. 1).

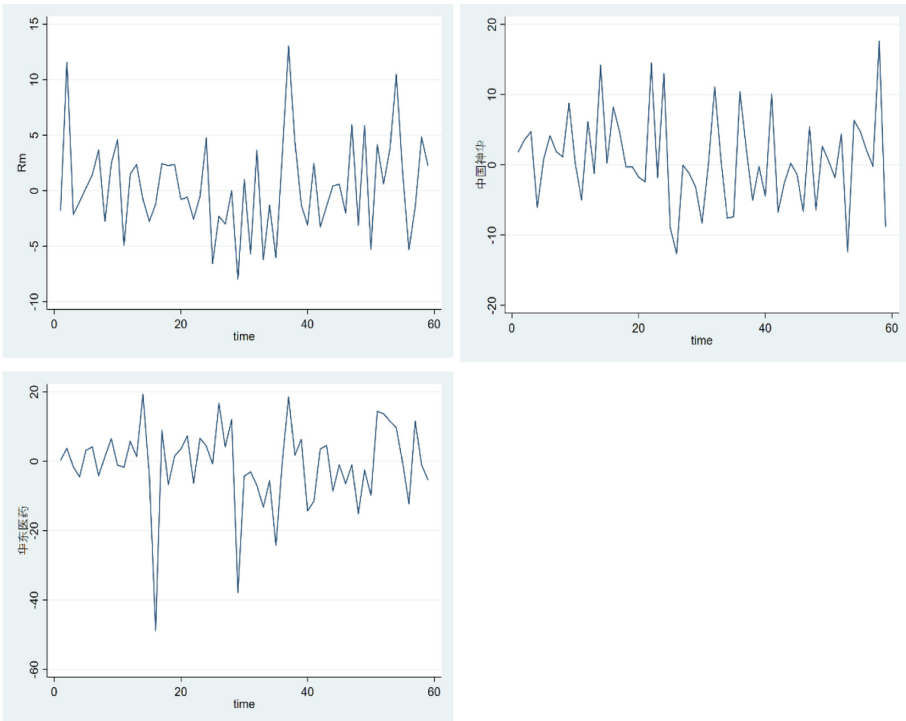


Fig. 1. Excess returns

4.2 Regression Analysis

According to the formula of single index model, the excess returns of each stock and the market are regressed to obtain α_i , β_i , and $e_i(t)$. The following figure takes the regression results of 601088 and Shanghai Composite Index for example (Fig. 2).

```
. reg Ri Rm
```

Source	SS	df	MS	Number of obs	=	59
Model	290.298182	1	290.298182	F(1, 57)	=	7.45
Residual	2220.7904	57	38.9612352	Prob > F	=	0.0084
				R-squared	=	0.1156
				Adj R-squared	=	0.1001
Total	2511.08859	58	43.2946308	Root MSE	=	6.2419

Ri	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Rm	.5230974	.1916359	2.73	0.008	.1393532 .9068416
_cons	.5195048	.8154485	0.64	0.527	-1.113403 2.152412

Fig. 2. Regression result

It can be seen that the P value of the model is less than 0.01, so the confidence of the regression model is more than 99%. Therefore, the regression model is believed to be basically effective. The coefficient of Rm is the estimate of β_i , and the constant term is the estimate of α_i . The residual term is the estimate of $e_i(t)$. The following figure shows the statistical values of residual items (Fig. 3).

```
. predict e,residual
. sum e
```

Variable	Obs	Mean	Std. Dev.	Min	Max
e	59	-1.52e-08	6.18785	-14.8293	15.33101

Fig. 3. Statistic values of residual

However, it can be seen that although the P value of the Rm coefficient is less than 0.01, which indicates that the confidence of the coefficient exceeds 99%, the P value of the constant term reaches 0.527. At the same time, in the descriptive statistics of residuals, it is also found that multiple data differ about 2.5 standard deviations from the mean, which is too high under the assumption of normal distribution. In the regression process of other sets of data, the problems are similar, among which, the outlier influence was more obvious in the regression analysis of the stock 000963 (Figs. 4 and 5).

```
. reg Ri Rm
```

Source	SS	df	MS	Number of obs	=	59
Model	1416.29409	1	1416.29409	F(1, 57)	=	12.18
Residual	6625.60769	57	116.238731	Prob > F	=	0.0009
				R-squared	=	0.1761
				Adj R-squared	=	0.1617
Total	8041.90178	58	138.653479	Root MSE	=	10.781

Ri	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Rm	1.155413	.331006	3.49	0.001	.4925846 1.818241
_cons	-1.401329	1.408496	-0.99	0.324	-4.221794 1.419135

Fig. 4. Regression analysis of the stock 000963

It can be seen that some outliers have a certain impact on the function estimation, and the outliers cause the residual distribution not to obey the normal distribution. The following is the statistical description and the normality test of the residual (Fig. 6).

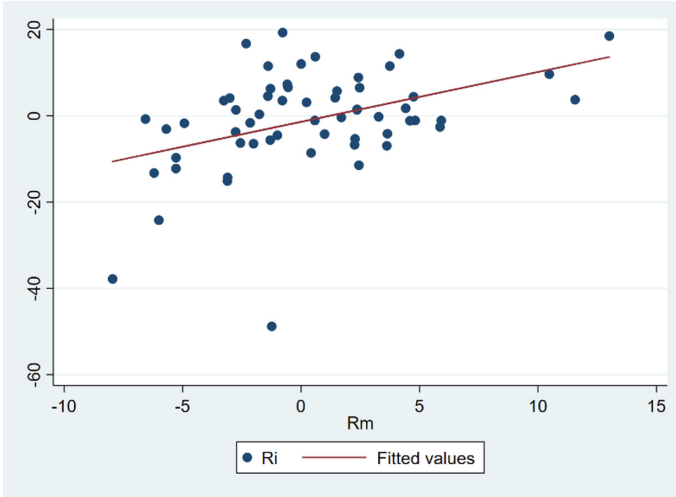


Fig. 5. The function fitting image of 000963

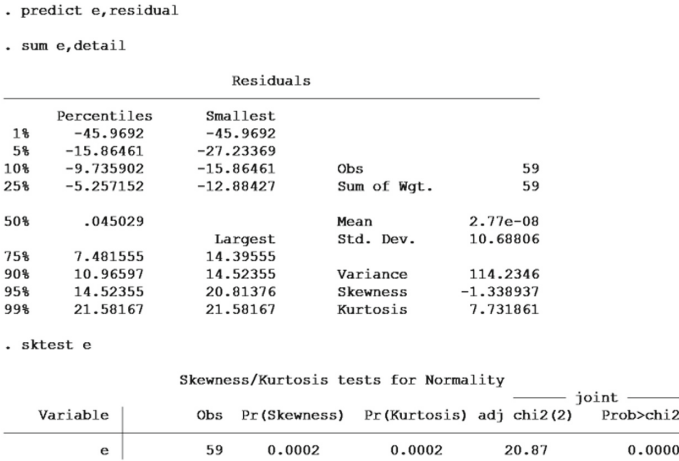


Fig. 6. The statistical description and the normality test of the residual.

It can be seen that the minimum residual is about four standard deviations from the mean. The Skewness and Kurtosis of the residual sequence are -1.33 and 7.73 respectively, which are different from the normal distribution. In SK test, P values of skewness and kurtosis are both less than 0.01 , rejecting the normal distribution hypothesis. Therefore, the non-normal distribution of outliers has an adverse effect on function fitting. However, it is not appropriate to simply eliminate outliers, because some outliers are just reflections of the real situation. Therefore, robust regression is adopted to reduce the weight of outliers in the fitting process by iterative algorithm to optimize the coefficient estimation. The following figure shows the robust regression results of 000963 (Fig. 7).

```

. rreg Ri Rm

      Huber iteration 1: maximum difference in weights = .74371653
      Huber iteration 2: maximum difference in weights = .09400388
      Huber iteration 3: maximum difference in weights = .02682857
Biweight iteration 4: maximum difference in weights = .26896226
Biweight iteration 5: maximum difference in weights = .05874703
Biweight iteration 6: maximum difference in weights = .04492435
Biweight iteration 7: maximum difference in weights = .03070128
Biweight iteration 8: maximum difference in weights = .0215376
Biweight iteration 9: maximum difference in weights = .01541991
Biweight iteration 10: maximum difference in weights = .01103468
Biweight iteration 11: maximum difference in weights = .00392534

Robust regression                               Number of obs   =          59
                                                F( 1,          57) =          9.96
                                                Prob > F         =          0.0026

```

Ri	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
Rm	.8445942	.2676309	3.16	0.003	.3086726 1.380516
_cons	-.2006812	1.138822	-0.18	0.861	-2.481134 2.079771

Fig. 7. Robust regression results

According to the M estimation proposed by Huber in 1964, the weight of each data depends on the residuals, but the residuals depend on the regression coefficient, which depends on the weight. Therefore, several iterations are required until the regression results are consistent. According to the statistical analysis of the robust regression residual, the special value of the residual is reduced, and the measurement of skewness and kurtosis as well as the SK test show that the residual is closer to the normal distribution. Therefore, it is believe that the coefficient estimation of the robust regression is better than that of the traditional regression.

4.3 Build the Portfolio

After the traditional regression and robust regression were performed on the excess returns of the above eight stocks respectively, the coefficient estimation of the single index model of each stock was obtained in the following table (Table 1).

After obtaining coefficient estimates, start building active portfolio positions. According to the active portfolio position formula in the theory and formula section, the initial position of each stock is obtained by dividing α by variance, and then the total position of the active portfolio is 1 (short selling is allowed). After the position of each stock is obtained, the formula is used to calculate the α , β and standard deviation of the portfolio sum. Then find the sharpe ratio of the combination. The figure below is the calculation result (Table 2).

After acquiring positions in the active portfolio, they join the market portfolio to construct the optimal portfolio. Firstly, the statistical values of the market portfolio are obtained by using the yield data of Shanghai Composite index, and then the respective positions of the active portfolio and the market portfolio are obtained according to the optimal portfolio position formula to construct the optimal portfolio. The following figure shows the optimal portfolio calculation results (Table 3).

In order to make the comparison between data more intuitive, I summarize the above data into the following Table 4.

Table 1. Coefficient estimation

Traditional coefficient estimation	α_i	β_i	e_i
601088	0.5195048	0.5230974	6.18785
601328	-0.4876207	0.4022278	3.297723
000963	-1.401329	1.155413	10.68806
600048	0.8698839	0.7569882	6.466876
000729	0.4351448	0.8877567	6.546619
601231	1.278418	1.343227	11.11584
600409	0.7372108	1.289068	10.69229
002027	-1.566404	1.371212	11.65
Robust coefficient estimation			
601088	0.2192452	0.5152997	6.18794
601328	-0.4480112	0.5660725	3.371353
000963	-0.2006812	0.8445942	10.77041
600048	0.5984217	0.7684688	6.467062
000729	0.2512596	0.8611667	6.547606
601231	1.281184	1.437063	11.12308
600409	-0.3113463	1.297057	10.69234
002027	-0.5932467	1.430595	11.65277

4.4 Results Analysis

As can be seen from the above portfolio, due to the existence of positive alpha in a single stock and the permit of short selling, the expected excess return of the positive portfolio will be higher and the Sharpe ratio will be higher, even exceeding that of the market portfolio. However, by adding the market portfolio to construct the optimal portfolio, although the alpha decreases, the risk is eliminated to some extent, and the standard deviation decreases, and the sharpe ratio is higher than that of the simple positive portfolio, which demonstrates the effectiveness of the single index model in the construction of portfolio. At the same time, it can be seen that both α and standard deviation are smaller after the robust regression is adopted, indicating that the robust regression can reduce the influence of outliers on the results and have higher value in long-term investment. Meanwhile, the sharpe ratio of the robust optimal portfolio is slightly higher than that of the standard optimal portfolio, indicating that the robust regression can better guide investors to invest.

Table 2. Positions and coefficients in the portfolio

Traditional coefficient estimation	Adjusted positions		α_i	β_i	e_i
601088	1.850746	Positive portfolio	14.278297	0.8228	44.13230477
601328	-6.11633	Sharpe ratio	0.3235339		
000963	-1.67332				
600048	2.837325				
000729	1.384958				
601231	1.411319				
600409	0.879604				
002027	-1.5743				
Robust coefficient estimation					
601088	0.477606	Positive portfolio	3.8372746	0.026533	17.89070171
601328	-3.28785	Sharpe ratio	0.2144843		
000963	-0.1443				
600048	1.193508				
000729	0.488866				
601231	0.86376				
600409	-0.22716				
002027	-0.36443				

Table 3. Optimal portfolio

	Positive positions	Market positions	Coefficient	Expected return	Variance	The standard deviation	Sharpe Ratio
Market portfolio	0	1	1	0.3537	18.29157	4.276865	0.082701
Traditional optimal portfolio	0.355255907	0.644744093	0.937048557	5.403883	261.869	16.1823669	0.333937
Robust optimal portfolio	0.386638031	0.613361969	0.623620555	2.574213	54.96165	7.413612612	0.347228

Table 4. Summary

	α	β	Standard deviation	Sharpe ratio
Market portfolio	0.3537	1	4.276865	0.08270076
Traditional positive portfolio	14.27829681	0.82279973	44.13230477	0.3235339
Robust positive portfolio	3.837274564	0.026532793	17.89070171	0.2144843
Traditional optimal portfolio	5.403883366	0.937048557	16.1823669	0.33393652
Robust optimal portfolio	2.574212871	0.623620555	7.413612612	0.34722786

5 Conclusion

With the advent of the era of financial big data and the improvement of the financial market, how to obtain stable and high returns in the financial market is the main concern of investors. However, the traditional Markowitz mean-variance model is too expensive to calculate, so the Sharpe's One-way Analysis of Variance is introduced to solve this problem.

According to the empirical results, the optimal portfolio constructed based on Sharpe single index model can obtain returns that exceed the market index, and can obtain a higher Sharpe ratio than the market portfolio and active portfolio, indicating the feasibility of Sharpe's model in portfolio construction.

At the same time, due to the existence of outliers, the results obtained by the traditional Sharpe single index model do not conform to the actual situation. Therefore, this paper uses robust regression to construct robust Sharpe single index regression to reduce the influence of outliers. The final results show that the standard deviation of the robust optimal portfolio is lower, and it has the highest Sharpe ratio, indicating that the robust Sharpe single index model has good resistance to difference and anti-interference, and can bring investors more in line with the actual situation of investment decisions. In the actual market, transaction friction exists, so transaction costs need to be taken into account in the model in practical application. At the same time, there are still some problems in China's securities market, such as unreasonable ownership structure, poor liquidity, imperfect information disclosure and so on. Therefore, after using historical data to construct the portfolio of single index model, the actual market trends still need to be analyzed before making investment decisions.

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Will COVID-19 Ever Rule Individual Market Returns

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Abstract. This study examines the relationship between COVID-19 and volatility that is a must in the finance domain while predicting. The objective of this research is to analyze the influence of COVID-19 on the fluctuation of the abnormal returns in the stock market. By using the market model to analyze the returns of individual stocks, MC.PA and SRB.F, the results reveal that the pandemic witness the bear market and exacerbate the volatility of abnormal returns.

Keywords: Volatility · COVID-19 · Abnormal return in individual stock market

1 Introduction

The COVID-19 was designated the World Health Organization (WHO) to be a world-wide pandemic in March 2020, initially seen in China. Indeed, numerous recent articles argue that the COVID-19 pandemic produced an unparalleled economic and financial catastrophe that dwarfed any preceding crises. (Baker et al. 2020; Spatt 2020; Zhang et al. 2020). The recent outbreak of COVID-19 hit financial market in the world, which, according to the International Monetary Fund (IMF) (2020), the global GDP is anticipated to be 3% lower in 2020 than it was during the 2008–2009 financial crisis, and stock prices continued to fall sharply. Low investment crept into during the recession owing to the overall market factors; specifically Sohail et al. (2020) found that market volatility, investors' confidence, Govt policies, political stability, brokers advice, herding, and financial returns are the most considerable factors. While there are numerous literatures, including some instances of an emerging economy on the impact of COVID-19 on the stock market, there are limited studies on individual stock returns in industries. Individual stock returns have a prominent presence in the overall stock market, serving a vital role in evaluating the financial markets, and providing a particular perspective on the financial shock facing the pandemic. This project, by analyzing the returns of MC.PA and SRB.F, provided an important opportunity to advance the understanding of the effect of changes in abnormal returns caused by the coronavirus outbreak.

To achieve this goal, I have organized my paper into four main section, one of which have sub-section. In the first section, I provide accounts of the impact on stock market during COVID-19. In the second section, I introduce data and methodology: market model, and two certain individual stocks MC.PA and SRB.F. I end my paper with a third section that offers figures and graphs with discussion and analysis attempted to answer

the research questions and conclude with a fourth section that discuss the importance of expanding this particular project.

2 Literature Review

A world struggling with financial market closures could experience sharp declines in share prices due to the COVID-19 pandemic taking financial markets out of various trading directions and will eventually impact the global economy. The statistical examination of the impact of the COVID-19 pandemic on equity risks was presented by Zhang et al. (2020). They showed that there was an increase in the financial market risks in response to the pandemic and the intensity of the epidemic in each nation influenced the reactions of the stock markets. Data from the Hang Seng Index and Shanghai Stock Exchange Composite Index (SSE) indicate that Al-Awadhi et al. (2020) have a seriously unfavorable relationship between equity rates, daily increase of total confirmed cases and daily growth of overall pandemic-related fatalities. Precisely, coronavirus illness in South Korea has led KOSPI after ten years to decrease below 1,600 in their history; at the same time increased uncertainty in China is due to COVID-19, resulting in greater stock volatility (So 2020; Leduc and Liu 2020). An empirical research by Cepoi (2020) has revealed that a stock market is reliant on COVID-19 asymmetry by using a quantity regression panel. The previous study supports some parts of that study, so there are individual stocks that are asymmetry dependent.

Previously, the market model has been applying into many researches and analysis. Tramontana et al. (2015) introduced a basic model for financial markets driven by a discontinuous linear map of chartists and fundamentalist interactions. Examples of big data and IoT service providers achieving maximum profit were utilized in the market model (Niyato et al. 2016), and some initial tests for a broad cross-section of the European common stocks in European common stocks (Pogue and Solnik 2015). However, it rarely appear in the analysis of researches during the pandemic.

There are several articles on the impact on different sectors of the COVID-19. There, however, has been a limited particular examination of the influence on the stock market for individual shares. In this study, a combination of quantitative and qualitative approaches was used in the data analysis; simultaneously, the market model is used to test the performance of MC.PA and SRB.F.

3 Data and Methodology

Data are gathered from 28 November 2019 to 7 February 2020, both before to and during COVID-19. The time frame of the WHO release of the first issue of Outbreak News from 28 November 2019 till 5 January 2020 is considered to be the same as before the COVID-19 stage and from 6 January 2020 till 7 February 2020, that being the first 25 days prior to the COVID-19 phase and the following 25 days during the COVID-19 period.

The return of MC.PA and SRB.F (<https://in.finance.yahoo.com/>) have been also calculated to investigate the scenario of change in stock price return during pre-COVID-19 and COVID-29 period by using the market model. To calculate the return, the following hypothesis named drunkard's walk has been used:

$$X_t = \mu + X_{t-1} + \varepsilon_t \quad (1)$$

here X_t is prices or log of prices. The shock ε_t is a random variable with mean zero and is independent and identically distributed over time like a game of chance.

The random walk model for log prices says that returns are random with mean μ :

$$R_t = \mu + \varepsilon_t \quad (2)$$

To check whether COVID-19 really influence stock market returns, the first things to do is to predict what would the stock price have been in the absence of the event COVID-19 based on historical data, thus, Market Model have been used in measuring the normal return and abnormal returns.

Individual stock returns R_t are related to contemporaneous market returns:

$$R_t = \alpha + \beta R_{mt} + \varepsilon_t \quad \text{var}(\varepsilon_t) = \sigma^2 \quad (3)$$

here the market return R_{mt} is the return on the market portfolio (that is, all the stocks in the market weighted by value (in this paper CAC40)); the parameter β measures the systematic risk of stock, the higher the value of β , the higher the riskiness of the stock because its own returns are amplified returns on the market; the parameter α measures the idiosyncratic return of stock. Usually α is quite small; the parameter σ measures the variability of the idiosyncratic shock.

Abnormal return occurs when predicting the returns that should occur during the event window using the market model.

$$\alpha + \beta R_{mt} \quad (4)$$

and then compare with the actual returns that happened R_t .

$$AR_t = R_t - (\alpha + \beta R_{mt}), \quad t = 1, \dots, E \text{ for } (t \in E) \quad (5)$$

4 Discussion and Analysis

This paper uses the daily price and return of two stock shares, MC.PA, and SRB.F. Firstly, I calculate the descriptive statistics of the price and return of the MC.PA and SRB.F series to make regression lines.

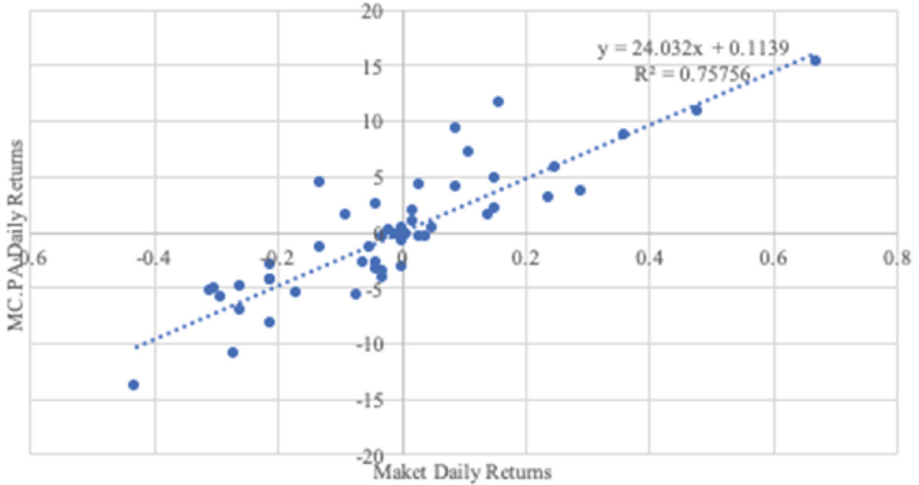


Fig. 1. Market returns plot MC.PA returns

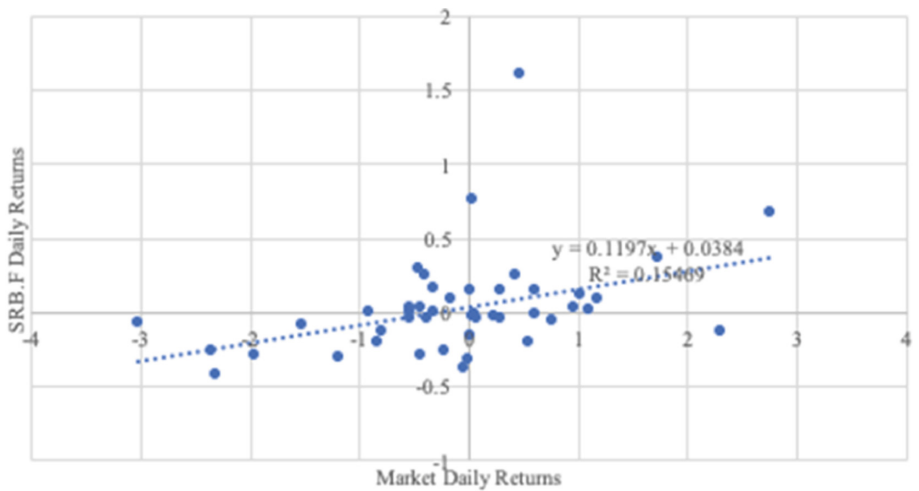


Fig. 2. Market returns plot SRB.F returns

As shown in Fig. 1 and Fig. 2, although these are both large listed companies, the risks to investors are entirely different. Comparing the two results, it can be seen that people tend to take higher risks when invest MC.PA owing to $\alpha = 24.032$ which is much higher than 1; likewise, buying SRB.F is likely to suffer lower riskiness. Then I divide the data into two periods.

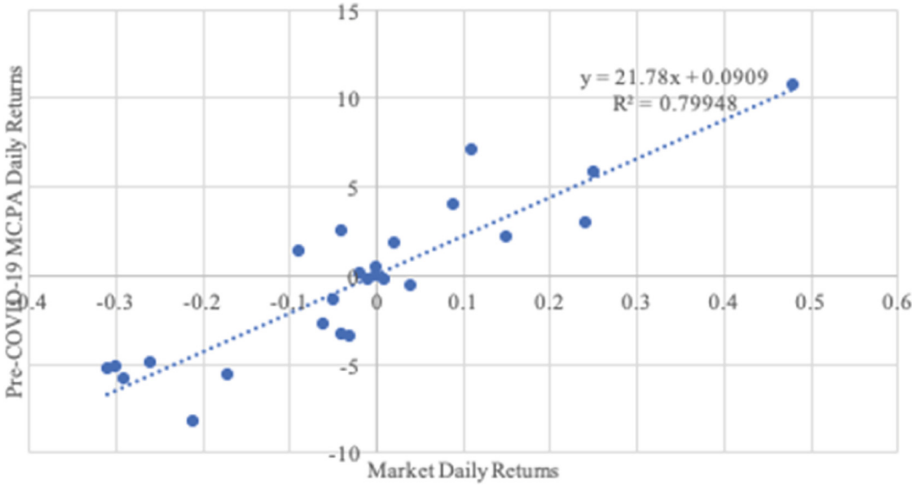


Fig. 3. Market returns plot Pre-COVID-19 MC.PA returns

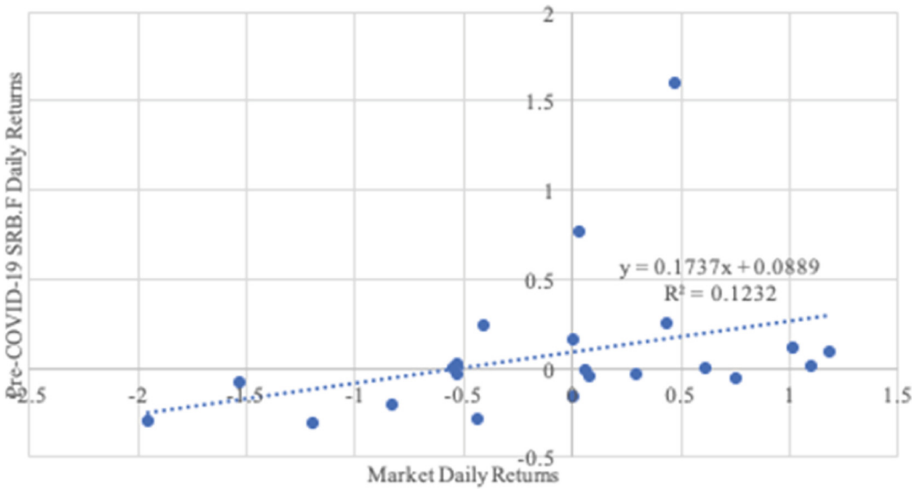


Fig. 4. Market returns plot Pre-COVID-19 SRB.F returns

In Fig. 4 and Fig. 6, the single most striking observation to emerge from the data comparison is a decrease in α of SRB.F during the pandemic, which causes a fall of riskiness. Meanwhile, the change in the correlation between MC.PA returns and market returns shown in Fig. 3 and Fig. 5 is more in line with most researchers' studies. Investors are inclined to take higher risks during the pandemic. These data came primarily from the different industries that act differently in the face of the pandemic.

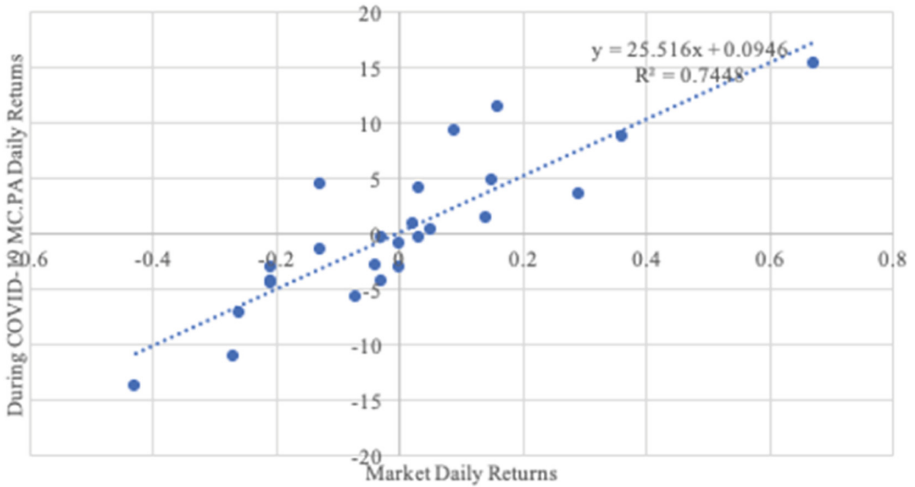


Fig. 5. Market returns plot during COVID-19 MC.PA returns



Fig. 6. Market returns plot during COVID-19 SRB.F returns

Figure 7 and Fig. 8 indicate that both MC.PA and SRB.F are influenced by COVID-19. Cumulative abnormal returns decreased sharply when the market was notified of the outbreak. Interestingly, in late January, SRB.F still shows a negative trend, but MC.PA still shows a positive trend. First, a tightening policy was adopted by the government on masking and nucleic acid testing (NAT) starting in February. Second, many companies have taken steps such as working from home; therefore, people may have more time to spend, and also demand for exports, including some LVMH luxury products, did not decrease as many countries did not suffer from the pandemic. Combined, these results

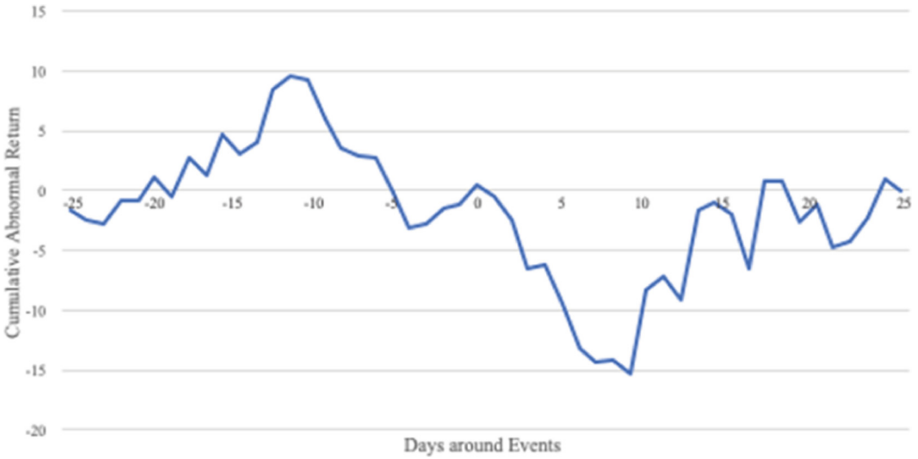


Fig. 7. Time plot cumulative abnormal return of MC.PA

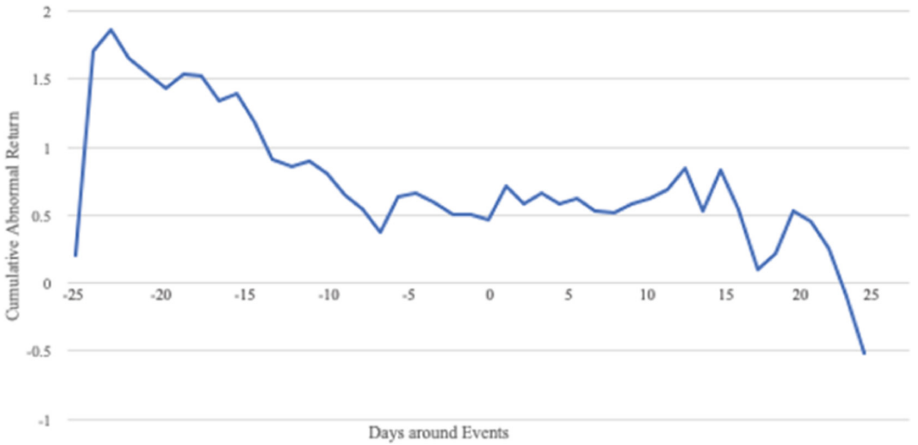


Fig. 8. Time plot cumulative abnormal return of SRB.F

provide important information on the small impact of the COVID-19 period on the volatility of MC.PA abnormal returns, but important for SRB.F.

5 Conclusion

In this study, by using the market model, the result of the analysis has assessed that the abnormal returns of MC.PA and SRB.F experience a greater range of fluctuations during the pandemic. These findings are designed to reveal that the COVID-19 pandemic may be analyzed in a very basic but novel way by obtaining stock returns from MC.PA and SRB.F. It is obvious that the effect is greater than that of MC.PA on SRB's anomalous returns. Generally, the data demonstrate that the epidemic of coronavirus impaired stock

returns MC.PA and SRB.F, increased abnormal return volatility, and an impact on the financial system. However, the occurrence, why stock returns from SRB.F, which one of these adverse events not explained by the study results is the reduction in risk during the COVID-19 pandemic.

Although the general financial environment was experiencing the bear market, investors should be bold in their investments as the economy is cyclical in nature and will slowly recover after a recession; meantime, for most countries, governments have already enact intervention measures both monetary policy and fiscal policy to reduce market volatility caused by the pandemic and spur economic growth. Additionally, further researches into the role of individual stock returns behaviors would respond to various types of industries as they face a crisis like COVID-19 and the volatility of abnormal returns when government intervention is at work are needed.

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The Relationship Between Children's Financial Support and the Purchasing Intention of Supplementary Medical Insurance for the Elderly – Based on the Survey Data of CHARLS in 2018

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Abstract. Due to the continuous improvement of the average life expectancy and the continuous decline of the overall fertility rate, the aging of the population has become one of the social realities that cannot be ignored in China. The huge number of elderly people, the rapid growth of the aging rate, the frequent population movements and the severe health conditions of the elderly have all brought tremendous pressure and challenges to China's long-term pension mode which is mainly based on children care.

Utilizing the baseline survey data of CHARLS in 2018 and based on the Intergenerational Support, this paper focuses on the relationship of children's economic support on the purchasing intention of supplementary medical insurance for the elderly. The influencing factors of purchasing intention of supplementary medical insurance service for the elderly are extended from the purchasing subject to the influencers and supporters of the purchasing subject. Overall, children's financial support has a positive relationship on the purchase of the elderly health insurance intention. The elderly who receive more financial support from their children are more inclined to purchase supplementary medical insurance, but the financial support of their children may have a reverse and substitute effect for the elderly to purchase supplementary medical insurance. Medical insurance service is not only a direct service for the elderly, but also a relief for children's support. Taking the situation of the children of the elderly into consideration makes the formulation of medical services for the elderly more scientific, effective and can better relieve the pension pressure of the whole society.

Keywords: Children's financial support · Aging society · Supplementary medical insurance · Intergenerational theory

1 Introduction

This study investigates the relationship of children's financial support on the willingness of the elderly to purchase supplementary medical insurance from the perspective of

intergenerational support. In Chinese society, children are often taught that they have an obligation to support their parents. In this case, the financial support of children is a significant variable in the study of the many circumstances of the elderly. Meanwhile, due to the declining physical capabilities of the elderly, health insurance becomes a part of the necessity that cannot be turned a blind eye. Furthermore, aging has become a major social trend that cannot be ignored worldwide, and China has been the most populous aging country in the world up to now. With the purpose of improving the health status of the elderly and facilitating their access to healthcare services, China has responded positively to promote the implementation of the strategic goal of a healthy China.

Under such circumstances, studying the relationship of children's financial support on the willingness of the elderly to purchase supplementary medical insurance from the perspective of intergenerational support is in line with the call of the times. Moreover, it will also rationalize the formulation of medical insurance for the elderly and reduce the pressure on healthcare for the elderly in the whole society. Therefore, this paper focuses on the relationship of children's financial support on the purchase of supplementary medical insurance for the elderly.

In addition, this paper will explain some terms mentioned. First, "financial support from children" is specifically the total amount of money and goods that children have supported their parents in the past year. Second, the elderly referred to in this law are citizens aged sixty years or older [1]. Internationally, an elderly person is defined as an adult aged 65 years and above. As this paper is a study of the elderly and children in the Chinese context, the term "elderly" in this paper refers to citizens of China who are 60 years of age or older. Third, an area is an aging society when 10% of the total population is over 60 years of age, or when 7% of the total population is over 65 years of age [2]. Fourth, the medical insurance studied in this paper is supplementary medical insurance. Supplementary medical insurance means that because the country's basic medical insurance can only meet the basic medical needs of the insured, medical needs beyond the scope of the basic medical insurance can be supplemented by supplementary medical insurance. This is relative to basic medical insurance, which includes various forms such as corporate supplementary medical insurance, commercial medical insurance, social mutual assistance, and community medical insurance [3]. At last, intergenerational support refers to the mutual help between two generations of parents and children, the form of financial support, household support and care for grandchildren. This paper, however, focuses more on the traditional theoretical basis of intergenerational support. To be more specific, it pays more attention to the economic support given by children to their parents, which mainly refers to the support of money and money equivalents from children to their parents in the past year.

Due to the deep-rooted culture of filial piety that has been passed down in China for thousands of years, the concept of "raising children to provide for old age" is still prevalent. Children provide for their parents in many ways, including financial support, daily care and companionship. The elderly relies heavily on their children in their later years, and their children's support has a crucial relationship on their perceptions and consumption behavior. This paper focuses on the relationship of financial support from children on the willingness of the elderly to purchase supplementary health insurance.

2 Literature Review

Research on the relationship of children's support on the purchase of supplementary health insurance for older people is still lacking in China. Whether this relationship is positive or negative is also a matter of debate. Based on the CHARLS database, Chen and Ning used the IV-Tobit model to find that children support has a negative relationship on older people's healthcare expenditure and a positive relationship on healthcare service utilization, reducing healthcare burden [4]. Huang and Fu found no substitution relationship of children care support on healthcare service utilization [5]. Yu and Feng used instrumental variables approach to find that family financial support significantly increases the probability of outpatient and inpatient care [6].

Financial support from children makes older people more likely to go to hospital rather than buy medication, which contributes to their level of health. Soraya Nouraei Motlagh used Classification and Regression Trees (CART) and Bayesian logit and found that the decision to purchase supplementary medical insurance strongly depends on household income and economic status [7].

However, when children provide more daily care for older people, family support replaces the role of medical care to some extent. In a study of the CHARLS database in 2011 and 2013, Jiao finds that older people who are covered by agricultural insurance are less likely to receive daily care from their children than those who are not covered. With health insurance "crowding out" daily care from children, the elderly are more likely to help their children care for their grandchildren [8]. Kohli's research suggests that the direction of children's financial support changes as a result of the presence of health insurance; Jensen's study in South Africa finds that health insurance substitutes for intergenerational support received by older parents by as much as 30%. There is a substitution relationship with substitution rates as high as 30% [9].

Up to now, different studies have had mixed results. There are few articles in the relevant research literature both nationally and internationally on the relationship of children's financial support on older people's willingness to purchase health insurance.

Almost all studies have focused on the users of health care services, e.g. the elderly subjects, but there is a lack of research on the influencers of health care purchases, such as the children of the elderly and their relationship.

This paper examines the relationship of children's support on older people's willingness to purchase supplementary health insurance, based on data from the CHARLS 2018 survey. On the one hand, the financial support provided by children can increase the consumption ability of older people and increase their healthcare expenditure and promote the purchase of health insurance services. On the other hand, there may also be a substitution relationship between the support provided by children and healthcare expenditure. In other words, the financial support of children has a different relationship on older people's health care expenditure and purchase intentions, and this difference is worth exploring.

3 Methodology

3.1 Data Source

The data in this paper come from the 2018 China Health and Aging Tracking Survey (CHARLS), a National Natural Science Foundation of China-funded database that collects data on middle-aged and older people aged 45 years and above in China. The questionnaire which is the most authoritative, extensive and high-quality micro-database dedicated to the elderly includes data from 150 counties and 450 communities and villages in 28 provinces, autonomous regions and municipalities. As of 2018, the CHARLS database covers a total of 19,000 respondents in 12,400 households nationwide. The data selected for this paper are the sample of elderly people aged 60 and above, as well as adult children in the household, aggregated according to household and child numbers. After eliminating some missing data sets, a total of 6,576 valid sample data are obtained as the data source for the empirical analysis of this paper.

3.2 Modeling

Willingness = $1(\alpha_1 + \beta_1\text{support} + \gamma_1X + \varepsilon_1 > 0)$.

In order to investigate the relationship of children's financial support on the willingness of the elderly to purchase supplementary medical insurance, the explanatory variable of whether the elderly purchase supplementary medical insurance is set as a dummy variable, and the explanatory variable of children's financial support is set as the amount of money and money equivalent support provided by children to the elderly in the past year (in units of RMB 10,000). The variable willingness indicates the willingness of the elderly to purchase supplementary medical insurance, support indicates the financial support provided by children, X indicates the control variables considered in this model, specifically gender, education level, ethnicity, marital status, type of household registration, health status, pension, personal assets, satisfaction with one's health status and relationship with children.

α_1 indicates the constant term, ε_1 indicates the residual and the rest is the regression coefficients.

As for the variables, what is worth noticing is the "types of account" which is unique of China. There are two types of account: agricultural household and non-agricultural household, and the non-agricultural household is urban household.

4 Results

To investigate the relationship of financial support from children on the willingness of the elderly to purchase supplementary health insurance, I conducted Probit model regressions.

Empirical results on the relationships of children's financial support on the elderly's willingness to purchase supplementary health insurance are showed as follows (Table 1):

Table 1. The results of the Probit model regressions

Variables	The willingness of the elderly to buy supplementary health insurance
Financial support from children	0.033** (.017)
Gender	0.079 (0.057)
Type of account	0.245*** (0.063)
Marital status	0.41 (0.064)
Age	-0.006*** (.004)
Years of Education	0.008 (.007)
National	-0.128 (.094)
Health conditions	0.061 (.043)
Pension	-0.35*** (0.033)
The degree of satisfaction with own health	-0.007 (0.033)
The degree of satisfaction with the relation of children	0.047 (0.031)
The assets of the elderly	0.000 (0.000)
Constant term	-1.312*** (0.326)
Chi-square	123.241
Prob > chi2	0.000
Number of obs	6576.000

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, data from CHARLS database.

The results show that the financial support of children has a positive relationship on the willingness of seniors to purchase supplementary health insurance. The greater the financial support of children, the stronger the willingness of seniors to purchase supplementary health insurance. According to the margin regression, this is reflected in a 0.40% increase in the willingness to purchase supplementary health insurance for a \$10,000 increase in financial support from children. Among control variables, the type of household registration and the age of the elderly show a significant relationship on whether or not the elderly purchase supplementary health insurance. This is reflected in

the fact that the elderly in urban areas are more likely to purchase supplementary health insurance than those in rural areas; the older they are, the less likely they are to purchase supplementary health insurance; and the larger their pension, the less likely they are to purchase supplementary health insurance.

In order to prove the accuracy of the relationship of children's financial support on the elderly's willingness to purchase supplementary health insurance, this paper also adopts Logit model to conduct the robustness test to ensure the reliability of the results (Table 2).

Table 2. The results of the robustness test by conducting Logit model

Variables	The willingness of the elderly to buy supplementary health insurance
Financial support from children	0.064** (0.031)
Gender	0.175 (0.119)
Type of account	0.51*** (0.13)
Age	-0.013*** (0.008)
Marital status	0.51*** (0.13)
Health conditions	-0.022 (0.07)
Pension	-0.736*** (0.127)
The degree of satisfaction with own health	-0.022 (0.07)
The degree of satisfaction with the relation of children	0.088 (0.065)
The assets of the elderly	0.000 (0.001)
Constant term	-2.329*** (0.688)
Chi-square	124.230
Prob > chi2	0.000
Number of obs	6576.000

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, data from CHARLS database.

This Logit model is used to test the data and ensure that the financial support from children has a positive relationship on the willingness of the elderly to purchase supplementary health insurance. For instance, the more financial support from children, the

more likely the elderly are to purchase supplementary health insurance. Among the control variables of gender, education level, ethnicity, marital status, type of account, health status, pension, personal assets, satisfaction with their health status and relationship with their children, age, type of account and pension also have a significant relationship on the willingness of the elderly to purchase supplementary medical insurance. This is reflected in the fact that older people in urban areas are more willing to purchase supplementary health insurance than those in rural areas; the older the person, the lower the willingness to purchase supplementary health insurance; and the more pension the person has, the lower the willingness to purchase supplementary health insurance. The results are consistent with the results of the previous regression analysis using the Probit model, and the test proves the reliability of this finding. Meanwhile this result is in accordance with Soraya Nouraei Motlagh's findings mentioned before because the financial support of children is a key element of household income and economic status [7]. Tao Tao explicitly mentions some similar reasons in his paper on the influence of children's support on the purchase intention of elderly care services in urban and rural areas. Younger, better-educated, urban-accounted older people are more willing to purchase elderly care services. Older people, who are better off themselves, may have a greater ability and willingness to buy and are more focused on the quality of life in old age [10].

To sum up, the results show that the relationship of children's financial support on the elderly's willingness to purchase supplementary health insurance is positive. Specifically, for a \$10,000 increase in financial support from children, the willingness of the elderly to purchase supplementary health insurance increases by 0.4%. The more financial support from children, the more likely it is to increase the willingness of the elderly to purchase supplementary medical insurance, and the more likely it is that the elderly with financial support from their children will be more confident in their consumption ability, more concerned about their health, and more likely to increase their awareness of supplementary medical insurance, thus upgrading their medical concept and medical consumption and increasing their purchase of medical insurance.

5 Conclusions

Aging is an unavoidable social reality in China and has given rise to a series of social problems, such as the increasing number of the elderly and the decrease in the number of children and the labor force. It influences the level of risk faced by families and their internal security function. Moreover, it also places a significant burden on the State's expenditure on health care and pension services for the elderly and may even lead to social conflicts and affect social order. The demand for insurance, as a product to spread risk and provide external protection, is also influenced by aging. The analysis of this paper shows that the financial support of children has a positive relationship on the willingness of the elderly to purchase supplementary medical insurance in urban and rural areas.

6 Suggestions

6.1 For the Government

The government needs to promote a culture of filial piety and enhance the support of children for their elderly parents. In an increasingly aging Chinese society, it is essential to build and maintain a culture of 'mutual help and filial piety' and intergenerational relationships. Filial piety has a profound correlation on the social values and outlook of the elderly and their children. Meanwhile it also plays a key role in the intergenerational support the elderly receives from their children.

The data collected denotes that many older people have received zero financial support from their children in the past year, which weakens the elderly's consumption ability, not to mention the ability and willingness to buy supplemental medical insurance. Due to the positive aging strategy called for by the Chinese government, there is an urgent need to make joint efforts to build a "filial society" and promote the traditional virtues of Chinese culture. To be more specific, the government and society should adopt a series of laws, regulations and moral codes to urge the next generation to support their elderly parents and to ensure their healthy living expenses. No matter for the sake of promoting the traditional virtues of Chinese culture or for the sake of the healthy development of society, children are bound to take up the responsibility to support their elderly parents and to pay attention to the state of health of the elderly.

6.2 For the Insurance Companies

While controlling the cost of risk, insurance companies should also take the initiative to assume their social responsibility by introducing targeted and cost-relationship insurance for the elderly, such as long-term care insurance and pension insurance products. Providing that insurance companies are capable of developing mature products for the elderly, it is conducive to reducing the pressure on children to support parents and promoting the development of healthy medical insurance for the elderly. The lack of a wide range of insurance for the elderly and high rates are the main reasons for their development. Medical insurance in the market has strict age limits due to the cost of risk. The risk of illness and death is much higher for older people than for younger people due to the general decline in their health which has become an unspoken rule in the industry that many health insurance products are not available to the elderly. Insurance companies, in their own interest and to avoid risk, have a habit of compensating for the high risk of elderly insurance with high premium rates or by severely limiting the scope of coverage to avoid the possibility of losses. The high premium rates and the small coverage of senior health insurance have made it unaffordable for many elderly parents. Therefore, in the long run, elderly people have discouraged their own insurance needs, which has led to a decreasing demand for senior insurance and a dilemma in the development of senior insurance.

7 Summary and the Future Study

To sum up, the solid conclusion can be drawn that the financial support from children has a positive relationship on the willingness of the elderly to buy supplementary medical

insurance. Future study may consider more aspects of the intergenerational theory, for instance, the emotional influence between the elderly and their children.

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Import Competition and Employer Contributions in the US

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Abstract. Despite numerous investigations on import competition, its impact on employer contributions is unclear. This paper uses panel data from the US between 2010 and 2016 at county level to study how import competition affects employer contributions in the US. The findings are that the county exposure to competition from international imports has negative and significant effects on employer contributions, and the effects have heterogeneity across countries and regions in the US. In the sample of Mexico and Canada, the results show that the effect remains negatively significant, while in the sample of China, there is no evidence to confirm this relationship. Also, I find that the decrease in employer contributions is even larger in regions with higher import competition.

Keywords: Import competition · Employer contributions · International trade

1 Introduction

Mounting literature debates the impact of import competition, as global trade plays an essential role between domestic economy and international market. On the one hand, some researchers suggest that import competition brings harm to domestic labor market and hinders the growth of domestic industry's profit and patenting [1–3]. On the other hand, some researchers argue that import competition stimulates technical innovation and improves the resource reallocation of the local economy [4, 5]. So, as a controversial topic, whether import competition has an overall positive or negative impact on domestic market never reaches a consensus.

In addition, there is a growing trend to analyze the association between import and social issues such as security, mobility, and mortality. Yi Che et al. studied that increase in import competition results in higher crime rates [6]. Greenland et al. proposed that migration rate is positively affected by import exposure [7]. Pierce and Schott explored the evidence that regions with more trade liberalization show higher mortality [8].

In this paper, I attempt to consider how import competition affects employer contributions as another aspect of economic security. From previous studies on the determinants of employer contributions, the majority focuses on individual and firm level [9, 10]. Because social security transfers are financed largely by employer contributions, employer contributions can be one key factor to prices formation and wage level.

Changes in benefit payments also plays a part in personal disposable income of households. Therefore, promised future benefits may affect the consumption and labor supply decisions of individuals and industries. These various effects give rise to critical patterns that influence economic behaviors throughout the entire market.

In view of present research, I suspect two potential patterns of how import competition impacts employer contributions. The first pattern is that higher regional exposure to import competition will restrain the amount of employer contributions. The reasons are that import products dramatically suppress the production scale of domestic firms, and their profitability and revenues shrink [11, 12]. As affordability is a key consideration to contributions, employers will be discouraged to provide pensions. The second pattern is a positive relationship between import exposure and employer contributions. Evidences show that import competition deteriorates the local labor market conditions with rising unemployment, lower wage, and decreased labor-force participation [1]. As a result, benefit managers show less incentive to alter their insurance plan offers, which causes a number of new employers to offer in order to fill positions [13, 14].

Following the approach by Autor et al., I use panel data of US between 2010 and 2016 at county level to analyze how employer contribution is affected by exposure to import competition [1]. The study is based on OLS estimation and attempts to figure out the heterogenous effect of import exposure.

The rest of the paper is structured as follows. Section 2 presents the key measurement and the empirical methodology and documents the data sources. Section 3 provides the empirical results, divided into the study of international import, heterogeneity of three main import suppliers, and regions of the US. Section 4 is the conclusion.

2 Empirical Strategy and Data

2.1 Empirical Strategy

To examine whether import competition has effect on employer contributions, the baseline specification is as follows:

$$\ln(\text{contribution}_{ct}) = \alpha_0 + \beta \Delta \text{Exposure}_{ct} + \theta_1 X_{ct} + \Phi_t + \Upsilon_c + \varepsilon_{ct} \quad (1)$$

where c indexes a county and t ranges from 2010 to 2016, representing time (year).

As county-level data on imports were limited, I used the measurement based on the approach of Autor, Dorn, and Hanson (2013). The key regressor of interest, change in the county exposure to import competition, is:

$$\Delta \text{Exposure}_{ct} = \sum_j \frac{L_{jct}}{L_{jt}} \frac{\Delta \text{import}_{jt}^{US_World}}{L_{ct}} \quad (2)$$

$$\Delta \text{import}_{jt}^{US_World} = \text{import, trade value}_{jt}^{US_World} - \text{import trade value}_{jt-1}^{US_World};$$

L_{jct} is the total employment in industry j in county c in year t ; L_{jt} is the total employment in industry j in year t ; L_{ct} is the total employment in county c in year t ; import trade value $^{US_World}_{jt}$ is the total import trade value of industry j in year t from the world to the US, and import trade value $^{US_World}_{jt-1}$ is the import trade value of industry j in year $t - 1$. A high $\Delta Exposure_{ct}$ means great exposure change to import competition.

The dependent variable $\ln(contribution_{ct})$ is the natural log of employer contributions. It has two categories, one is for employee pension and insurance funds, denoted as $contribution1_{ct}$, and the other is for government's social insurance, denoted as $contribution2_{ct}$. I also computed the total employer contributions as another dependent variable, $Total\ contribution_{ct}$, that is

$$Total\ contribution_{ct} = contribution1_{ct} + contribution2_{ct} \quad (3)$$

In Eq. (1), if the coefficient β is negative, it means that higher exposure to import competition results in lower employer contributions.

To further study the impact based on the baseline results, I also tested the heterogeneity across countries and regions in US. Firstly, in light of the fact that trade volume and trade value vary greatly across countries, and hence, impact of import competition from different countries may be heterogenous. I selected three countries as the main research target – China, Canada, and Mexico – since they account for the top portion of the US imports. The key variable of interest is calculated in the similar way as shown in Eq. (2).

Secondly, to explore the heterogenous effect across regions in US, I sorted counties into different groups, counted the average import exposure from 2010 to 2016 for each county and divided them into two groups. The estimating equation is

$$\begin{aligned} \ln(contribution_{ct}) = & \alpha_0 + \beta \Delta Exposure_{ct} + \delta Region_c + \lambda Region_c \\ & \times \Delta Exposure_{ct} + \theta X_{ct} + \Phi_t + \varepsilon_{ct} \end{aligned} \quad (4)$$

where $Region_c$ is a binary indicator variable that takes a value of $Region_c = 1$ if the average import exposure of county c ranks among the top 50% of the total and a value of $Region_c = 0$ if one county belongs to the last 50%; $Region_c \times \Delta Exposure_{ct}$ is the interaction term between $Region_c$ and the key regressor, $\Delta Exposure_{ct}$. The coefficient, λ , captures the heterogeneous effect of county exposure on employer contributions across the newly-classified regions.

As county is the unit of analysis, there are rich variations for observation. For control variables, considering that economic scale, economic prosperity, and labor market condition are the main concerns which drive both the imports and employer contributions, I include real GDP, income per capita, population, and unemployment rate at county level into a vector of variables, denoted as X_{ct} in Eq. (1) [1, 14]. Additionally, other factors like dividends, interest, rent per capita, net earnings per capita, and unemployment insurance compensation per capita, which are likely to have effect on employer contributions, are also included into X_{ct} (Foster and Ann 1998). Φ_t in Eq. (1) stands for year-fixed effects and Υ_c represents county-fixed effects in order to control for the unobservable factors over years and across counties which may impact upon employer contributions. ε_c is the error term.

2.2 Data Sources

To compute the key regressor in Eq. (2), I firstly obtained the number of employees from 2010–2016 by industry and county level from County Business Pattern (CBP). According to Autor et al., the original data from CBP represents an interval rather than the exact number of employments. So, I utilized the code provided by Autor et al. to get an imputed employment number [1]. While the industry codes (NAICS) are switched every five years, I used the concordance table from CBP to get a consistent industry code.

The trade value of export from 2010 to 2016 is provided by UN Comtrade Database at the Harmonized System (HS) six-digit level. I matched the products with industries through the concordance table between HS6 and NAICS. With the data of employment and trade value, I calculated the exposure to import competition of the counties.

The county-level data of employer contributions between 2010 and 2016 is from Bureau of Economic Analysis (BEA).

The data of unemployment is from the US Bureau of Labor Statistics (BLS). The data of real GDP, income per capita, population, dividends, interest, rent per capita, net earnings per capita and unemployment insurance compensation per capita are all extracted from BEA.

3 Empirical Results

3.1 Basic Results

The baseline results of OLS estimates are reported in Table 1. All the three columns are fully controlled for the baseline covariates, year-fixed effects, and county-fixed effects. The first column of Table 1 shows the estimation results with $\ln(\text{contributions}_{1ct})$ as the dependent variable. The coefficient of county exposure to international import competition is negative and statistically significant at 1% level, -0.00062 , indicating that one unit increase in county exposure to import competition will lower employer contributions for employee pension and insurance funds by 0.062%. In the second column, the coefficient of county exposure is also significantly negative. The impact of import exposure on employer contributions for government is smaller than the one for employee. The third column shows that the coefficient of county exposure is negative and statistically significant at 1% level. This suggests that import competition has an overall negative impact on employer contributions: every unit increase in county import exposure corresponds to a decrease of 0.059% in total employer contributions.

3.2 Heterogeneity Across Countries

In Sect. 3.1, I only consider the imports from the whole world to the US. So, the heterogenous effects of imports from various countries are quite worth-investigating.

Table 1. Impact of international import competition on employer contributions

Variables	(1) Contribution 1	(2) Contribution 2	(3) Total contribution
Exposure	-0.00062***	-0.00056***	-0.00059***
	(0.00024)	(0.00017)	(0.00022)
Observations	21,592	21,592	21,592
R-squared	0.570	0.494	0.582

Notes: 1. Robust standard errors are given in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10%, respectively. 2. For the limit of space, the OLS estimations of control variables are not included in all the Table 3. I control real GDP, unemployment rate, income per capita, population, dividends, interest, rent per capita, net earnings per capita and unemployment insurance compensation per capita. For fixed effects, I include time-fixed effects and county-fixed effects.

From Table 2 and Table 3, the negatively significant estimated coefficients indicate that in sample of Mexico and Canada, employer contributions will decrease with more intense import exposure, which is consistent with one suggested pattern mentioned above. Import competition will diminish employer incentives to offer contributions. The results also show that the absolute value of the estimated coefficient in the sample of Mexico is larger than that of Canada, which means that one unit increase in import exposure to Mexican products will lead to more reduce in employer contributions than exposure to Canadian imports. I proposed that the reason behind this heterogenous effect was due to the different composition of import products. In Mexican, the top import category was vehicles and the rest categories were mostly composed of machines, while in Canadian, the majority were mineral fuels, plastic, and other raw materials. Accordingly, exposure to import competition of distinct products may have various effect on domestic market. In other words, employer contributions from industries in machine production endures more significantly adverse impact from import competition partly because the productivity of the former industries heavily depends on innovations, while some previous literatures concluded that trade exposed firms have fall in R&D investments [2].

However, in Table 4, we can find that with insignificant coefficient, no evidence can prove there is any association between import competition and employer contributions in the sample of China. This result may be demonstrated by the uncertainty of whether the two patterns mentioned in Sect. 1 can be equal in magnitude.

3.3 Heterogeneity Across Regions in US

Counties with different trade exposure always show various patterns of economic development. Therefore, I used interaction term in the specification as stated in part 2.1 to identify the heterogeneity in impact of trade exposure across counties in the US.

Table 2. Impact of Mexican import competition on employer contributions

Variables	(1) Contribution 1	(2) Contribution 2	(3) Total contribution
Exposure	−0.00524*** (0.00202)	−0.00461*** (0.00135)	−0.00495*** (0.00182)
Observations	21,592	21,592	21,592
R-squared	0.571	0.495	0.583

Table 3. Impact of Canadian import competition on employer contributions

Variables	(1) Contribution 1	(2) Contribution 2	(3) Total contribution
Exposure	−0.00171** (0.00083)	−0.00123*** (0.00043)	−0.00153** (0.00071)
Observations	21,592	21,592	21,592
R-squared	0.569	0.493	0.581

Table 4. Impact of Chinese import competition on employer contributions

Variables	(1) Contribution 1	(2) Contribution 2	(3) Total contribution
Exposure	0.00098 (0.00222)	0.00391* (0.00230)	0.00189 (0.00210)
Observations	21,592	21,592	21,592
R-squared	0.567	0.492	0.579

Notes: 1. Robust standard errors are given in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. 2. I control real GDP, unemployment rate, income per capita, population, dividends, interest, rent per capita, net earnings per capita, and unemployment insurance compensation per capita. For fixed effects, I include time-fixed effects and county-fixed effects.

The results of column (1) in Table 5 indicate that there is a significantly amplified decrement in the effect of exposure with counties facing greater exposure to import competition, because the coefficient for the interaction is negative and statistically significant at 1% level. In other words, reduction in the employer contributions for employee of regions with higher levels of import exposure is relatively greater. Similar analysis of employer contributions for government and the total contributions can be reached as shown in column (2) and (3).

Table 5. Heterogenous effects of international import competition on employer contributions across regions in the US

Variables	Contribution 1	Contribution 2	Total contribution
Exposure	0.0078*** (0.0016)	0.0082*** (0.0017)	0.0079*** (0.0016)
Region (dummy)	0.3902*** (0.0194)	0.4280*** (0.0171)	0.3991*** (0.0188)
Exposure × Region (interaction)	-0.0104*** (0.0027)	-0.0105** (0.0031)	-0.0104** (0.0028)
Observations	21,592	21,592	21,592
R-squared	0.379	0.378	0.380

Notes: 1. Robust standard errors are given in parentheses. ***, **, and * indicate statistical significance at 1%, 5% and 10%, respectively. 2. I control real GDP, unemployment rate, income per capita, population, dividends, interest, rent per capita, net earnings per capita, unemployment insurance compensation per capita, and time fixed effects.

4 Conclusions

In this paper, I use US county data to investigate how its employer contribution is affected by Chinese import competition during 2010–2016. Based on the strategy of Autor et al., the empirical results imply that the effect in the sample of international imports is negative, while it shows heterogeneity in samples of different supply countries and regions across the US.

In order to find the balance between trade liberalization and the development of domestic industry, how to deal with import competition is a difficult but crucial task in the long run. This paper contributes to enrich the literature analyzing the impact of import competition and fill the gap between the study of economic security and trade liberalization.

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Netease Company Analysis Based on SWOT Analysis Theory

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Abstract. With the development of technology, video games take up a large part of people's time and is becoming inseparable for human. Buying game companies' stocks seems a good choice for people to increase their wealth. But many of them don't know what game companies they should buy, or how to analyze game companies. In this article, I introduced a top game company, Netease, in China and used SWOT analysis and other indexes, P/E ratio, P/B ratio, and ROE, to analyze this company. It concluded that Netease a company that is worthy to invest after finishing analysis. I hope this article can help people learning how to analyze companies basically and offer some useful information or thoughts to my readers.

Keywords: Netease · SWOT analysis · P/B ratio · P/E ratio · ROE

1 Introduction

As we all know that COVID-19 bring a huge effect to human society, lots of people have to stay at home, whatever working or studying, and many of them spend much more time on games than before. As the result, the revenue of game companies from their 2020 annual report increased a lot. Now, these companies' stock price has fallen down and been normal. The goal of my research is to analyze a top game company, Netease, in China and deem if now is a good time to buy its stock.

Netease was found in 1997, manly doing search engine and free e-mail system. In 2000, Netease was listed on NASDAQ. In December 2007, Netease's "Youdao" series of products were launched. Now, Netease's business includes online education, game, and music. Netease has three online education platform, which are all successful. At the begining of 2021, Youdao, which is an intelligent learning service company owned by Netease has huge increase in revenue and loss.

Recently, Chinese government publish the limitation for students to take expansive after-school tutor, in response, online education courses will be more popular than before, so that Intelligent learning service is worthy to expect. Netease's music app, called netease cloudmusic is well known in elaborate interface and convenient usage, but the lack of contents is criticized by users for long. Netease now is focusing on making up this question by foster original authors. Over 70% of total revenue of Netease is from game. Netease is keeping launching new games and earning reputation of games' quality.

The revenue of this company is continuously growing, all these three businesses are potential and beneficial in the future.

I will mainly use SWOT analysis from both internal (company) factors and external (game industry, environment, and policy) factors at first. Then, I will refer some basic indexes, P/E ratio, P/B ratio, and ROE, to do some comparisons. Because of the speciality of game industry, few companies dominating large portion of market shares. I will only use Tencent, another huge company in China, to compare with Netease, since these two companies occupy over 50% of market shares, and using other companies might cause a negative influence on my conclusion.

2 Literature Review

SWOT ANALYSIS is a powerful tool to analyze a company from four parts: Strength, Weakness, Opportunity, Threat. Strength (S) is the internal ability and positive factors of the enterprise, which is related to the enterprise goal and customer service. Weakness (W) is an internal factor that hinders organizational performance. Therefore, the company's strengths and weaknesses are internal factors. Opportunities (O) are external factors that companies can exploit their own advantages. Threat (T) involve negative factors outside the company that will hinder or delay the achievement of goals. Therefore, opportunities and threats are external factors [1, 2].

The formula of P/E ratio is Price per share/Earning per share, which means the years to pay back. Normally, the lower the ratio is, the better the company is, comparing to other companies in the same industry. Because lower ratio means that you can earn a paid money faster, which is definitely attractive [3]. The formula of P/B ratio is Price per share/Book value per share, which means that how much equity each shareholder own. The equity of the company is divided to each shareholder with the shares they owned, so the larger book value per share is, the more benefits shareholders can get from it. And the bigger book value per shares is, the smaller P/B ratio is. As the result, normally, we think that lower P/B ratio is better, also comparing to the companies in the same industry [4]. The formula of ROE ratio is Net income/total asset * total asset/equity * equity/shareholders' equity, which can be abbreviated as Net income/shareholders' equity. This index is mainly used to judge a company's profitability.

3 Swot Analysis of Netease

3.1 Strengths

Structure. Netease is VIE structure and list on NASDAQ. It means that this company can finance utmost (Fig. 1).

A Large Amount of In-House Developed Games (Creative). These are the game developed in-house (mobile and PC) (Figs. 2 and 3):

Revenue from games is 54.61 billion RMB, and grow by 17.6% from last year. What's more, game revenue accounts for 74% of the total revenue in NetEase [5].

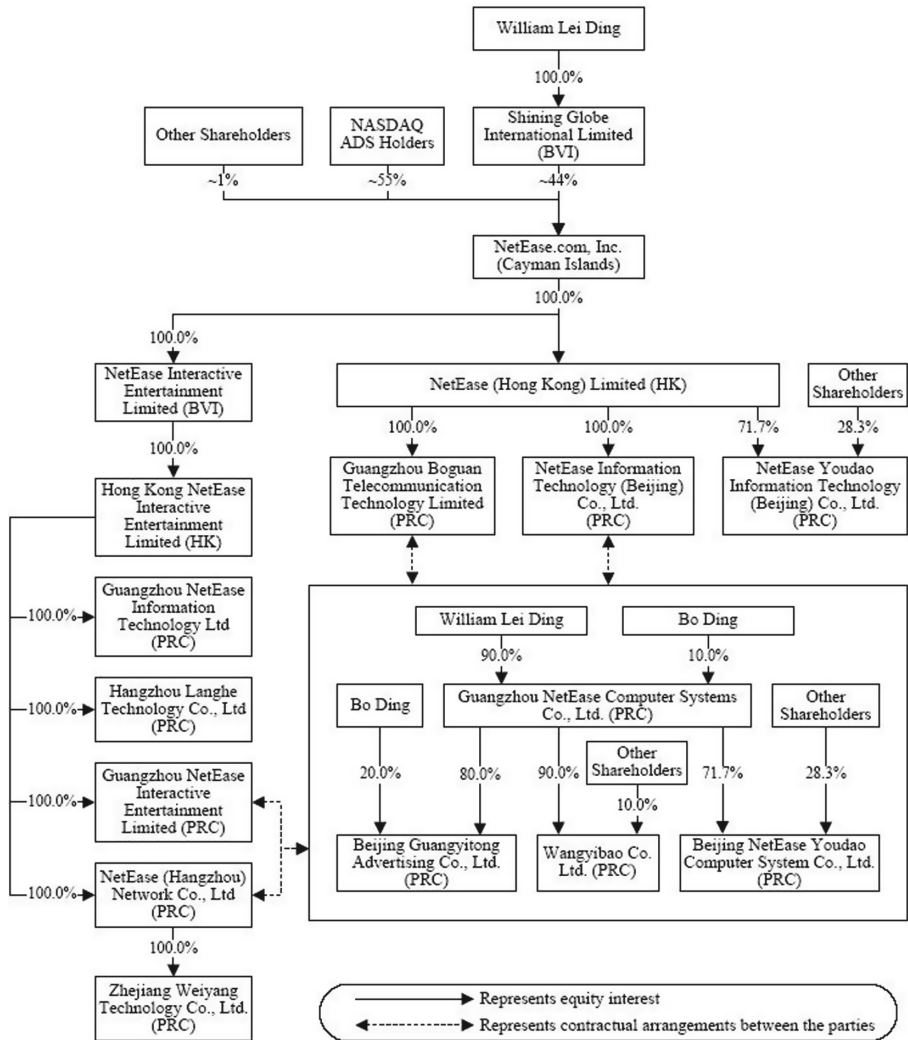


Fig. 1. VIE structure (Data source: Netease annual report)

Strong Cooperation with Foreign Companies. Netease also offers games from other international game developers, like Microsoft and Blizzard. Licensed games accounted for 7.5%, 7.5%, 9.1% of the total revenue in 2018, 2019, and 2020.

Netease collaborates with famous studios or contends owners in the world, such as Microsoft and Blizzard. Netease exclusively operates a series of the game for Blizzard in China, such as the world of warcraft, the StarCraft II series, Diablo III, Hearthstone, Heroes of the Storm and Overwatch and get the license of both PC and mobile version of Minecraft till 2023.

Game	Genre	Date of Initial Launch
Mobile Version of Fantasy Westward Journey II	Turn-based MMORPG	July 2013
Fantasy Westward Journey mobile game	Turn-based MMORPG	March 2015
Westward Journey Online mobile game	Turn-based MMORPG	September 2015
Invincible	SLG	October 2015
The mobile version of New Ghost	Real-time MMORPG	May 2016
Onmyoji	CCG & RPG	September 2016
Knives Out	Battle Arena	November 2017
Rules of Survival	Battle Arena	November 2017
All About Jianghu	Real-time MMORPG	January 2018
Onmyoji Arena	MOBA	January 2018
Identity V	Battle Arena	April 2018
Ancient Nocturne	CCG & RPG	September 2018
Life-After	Cooperative Survival RPG	November 2018
Fantasy Westward Journey 3D	3D MMORPG	December 2019
Onmyoji: The Card Game	CCG	December 2019
Fantasy Westward Journey H5	MMORPG	June 2020

Fig. 2. Games list (Data source: Netease annual report)

Game	Genre	Date(s) of Launch and Major Upgrade
New Westward Journey Online II (a comprehensive upgrade of Westward Journey Online II)	2D MMORPG, classical Chinese setting	August 2002 September 2013
Fantasy Westward Journey Online (previously known as Fantasy Westward Journey II)	2D MMORPG, classical Chinese setting	January 2004 July 2013
Tianxia III	3D MMORPG, classical Chinese setting	October 2011
New Ghost (a new version of Ghost II)	2.5D MMORPG, classical Chinese setting	April 2012 September 2015
Justice	3D MMORPG, classical Chinese setting	June 2018

Fig. 3. Games list (Data source: Netease annual report)

Technology. Netease has four key advanced technology: *User profile analysis, Intelligent non-player characters, Natural language processing, Advanced game graphics.*

The most recent game developed by Netease, Naraka Bladepoint, which is global published. Players can change their characters’ face by freely. There is a technology called intelligent face changing. Player put a person’s photo in and his character’s face will be changed automatically and same as the person in the photo on the whole. This technology is attractive to players, since nobody don’t want their character look specific.

Netease is well-known in elaborate designs and details, the quality of games developed by Netease are trusted by customers.

Successful in Intelligent Learning Service – YouDao. YouDao is an intelligent learning company owned by Netease, it has over 120 million MAUs in 2020 in China and operates in some markets overseas. YouDao provide a large range of products and services that satisfy people’s learning need from children to adults. People can get services online or through smart devices. In the devices, YouDao integrate AI algorithms and data analytics, which can offer users a more comfortable feeling.

Doing this education business definitely can bring Netease a good reputation. It is different from the reputation of a high quality of game, but is moral. As we all know, young children are easily involved in gaming, and parents will always shift their displeasure to the game companies, so that education learning service can help Netease to maintain a positive image.

High Quality Music Service – Netease Cloudmusic. Netease cloudmusic is one of the most well-known music APP. Even the market share is not that high, but the exquisite design brings Netease cloudmusic a good reputation. What's more, the facility of "recommending your favorite songs" earned rave review, which also indicate the advantage of technology. The little problem for Netease cloudmusic is lack of copyright. Many songs cannot be played in it. But I believe, a good reputation is the base, Netease cloudmusic is potential since there must be lots of new songs appear in the future and the most of the songs popular today will be obsolete on day.

3.2 Weakness

Low Growing Rates in Game Market Shares. The market share in game market is 14.46%, 14.90%, and 14.43% for 2018, 2019, and 2020 [6]. It shows that Netease is now in a bottleneck. And its market shares is hard to continuous grow, while it is facing stricter competition with new companies.

Unbalance. In 2020, Netease's game revenue is over 74% percent of the total revenue, which means that Netease can be influenced easily if the game market falters. (Netease 2020 annual report: game earn, education lost, music is stable) [6].

3.3 Opportunity

Netease's revenue are mainly from these three business, education, game and music.

New Education Rule. Recently, Chinese government announce that they will sift educational institutions, as the result, a portion of people might start to experience online education. And the online education population will increase generally. It is a chance for YouDao to increase its market shares.

New Technology. I think that microwave 5G will change the game market shares distribution and it is a good chance for Netease, a game company that focus on game content quality and cooperate with many content studios and foreign game developers. Microwave 5G might cause many PC games can be played on phone. The advantage of Netease is that the most potential and beneficial game developed by them is irreplaceable due to the creativity of these games. For example, the most two popular game in Tencent is King of Arena of Valor and peacekeeper elites, which are also the first and second beneficial free mobile phone in the world. Here is one question, King of Arena is exactly same as league of legend, and PUBG mobile is exactly same as PUBG. Once the microwave 5G allows people play League of Legend and PUBG on their phone. I think it might be effective to Tencent. Back to Netease, games are all developed by themselves or cooperate with foreign game companies, so that they can maintain their players and enjoy this opportunity, since PC games shifting to mobile will bring a lot of players into mobile market [7].

Government. Recently, Chinese government published a rule of changing after-school class and limit teachers to teach students for tutoring. The reason for that is because Chinese government want more smart students in poor family to get into good college, and for those students who doesn't like studying, while their parents push them to take tutorial to improve their grades and getting into college, the government want them to become laborers. As the result, game industry will be immutable, since these "drug" have to exist to let laborers release stresses and enjoy their life. Also, the online education service might be popular and supported by the government because of its low price and easy access.

3.4 Threat

Top 10 free-to-play titles, 2020

Rank	Title	Publisher	Genre	Revenue
1	<i>Honor of Kings</i>	Tencent	MOBA	\$2.45B
2	<i>Peacekeeper Elite</i>	Tencent	Shooter	\$2.32B
3	<i>Roblox</i>	Roblox Corporation	Simulation	\$2.29B
4	<i>Free Fire</i>	Garena	Shooter	\$2.13B
5	<i>Pokémon GO</i>	Niantic, Inc.	Action-adventure	\$1.92B
6	<i>League of Legends</i>	Riot Games, Tencent	MOBA	\$1.75B
7	<i>Candy Crush Saga</i>	King, Activision Blizzard	Puzzle	\$1.66B
8	<i>AFK Arena</i>	Lilith Games	Strategy	\$1.45B
9	<i>Gardenscapes - New Acres</i>	Playrix Games	Puzzle	\$1.43B
10	<i>Dungeon Fighter Online</i>	Nexon	RPG	\$1.41B

Fig. 4. Top 10 beneficial free games in the world in 2020 (Data source: <http://games.sina.com.cn/g/g/2021-01-07/iznctkf0637056.shtml>)

Competitions. Tencent had 37.42%, 33.44%, and 38.24% in shares market from 2018, 2019, and 2020, which is really an incredibly powerful company. And its share market is around two and half times more than Netease [6]. Tencent's capitalization is around 4.28

trillion, while Netease's capitalization is around 56 billion. The revenue from games is 156.1 billion in 2020. What's more, the most two beneficial games in the world are from Tencent (Fig. 4).

Besides, the competition with other relatively small companies is more furious than before. There are many old game companies grow a lot in 2020, including Lilith and miHOYO. What's more, ByteDance and Alibab were also entered this business. New companies' growth will influence Netease's market shares generally.

Barrier of Expanding Games Overseas. Only a few foreign people will like these Chinese games due to their culture and aesthetics. Here is an example, the latest game developed by Netease, called NARAKA BLADEPOINT, opened beta in America this year. And the participation population is 180,000 with 160,000 Chinese.

Stricter Regulation and Superintendent from Government. Chinese Government stipulate that people under 18 years old should be limited in gaming time up to 2 h a day. And Chinese government also strengthen the superintendent in e-commerce and online education.

In August, 2021, Chinese government send notice to every game companies that children under 18 only can play three hours a week instead of half and one hour per day, which is the previous regulation. According to this, we can know that the financial report from every game companies might be influenced, which might cause a fall in their stock price.

Effect of COVID-19. Many people stayed at home in this year because of COVID-19, so that the revenue might decrease after COVID-19.

Population Aging. According to the information shown on the national bureau of statistic, the average growth in population per year from 2010 to 2020 is 0.53%. And the average growth in population per year from 2000 to 2010 is 0.57%. The fertility rate reduced a lot, which means that young people will gradually decrease and the amount of player also decrease generally, since teenagers have more leisure time and can addict game easily [8].

4 Value Analysis of Netease

At this part, I will mainly use P/E ratio to get Netease's valuation, and other three index for support (Fig. 6).

P/E ttm. Netease PE ratio is 28.34 found in YaHoo Finance. Instead, Tencent PE ratio is 20.11 found in YaHoo. Even we can see directly that Netease's PE ratio is higher than Tencent, but there is another explanation. People has a high expectation to Netease, so it doesn't mean that Netease is worse. Of course, the price of the stock might be higher. Comparing to the P/E ratio of two other game companies in China, Netease is relatively safe. The P/E ratio of Perfect world was 54.41 and Wuhu Sanqi Interactive Entertainment Network Technology Group was around 17.27. However, P/E is just a basic indicator, and lots of basic information found in annual report might be forged easily, so we have to check other indicators.

	Current ^②	3/31/2021	12/31/2020	9/30/2020	6/30/2020
Market Cap (intraday) ⁵	55.64B	68.26B	63.68B	60.98B	59.08B
Enterprise Value ³	43.66B	57.02B	52.03B	50.11B	51.27B
Trailing P/E	28.34	37.76	30.15	26.59	28.26
Forward P/E ¹	21.10	25.19	21.14	20.45	23.70
PEG Ratio (5 yr expected) ¹	1.33	1.74	2.14	N/A	N/A
Price/Sales (ttm)	4.76	6.18	6.02	6.19	6.42
Price/Book (mrq)	4.25	5.55	4.92	4.96	6.67
Enterprise Value/Revenue ³	0.57	2.78	2.63	2.69	2.82
Enterprise Value/EBITDA ⁷	2.44	11.19	13.09	13.24	10.13

Fig. 5. Netease statistic chart (Data source: <https://finance.yahoo.com/quote/NTES?p=NTES&tsrc=fin-srch>)

	Current ^②	3/31/2021	12/31/2020	9/30/2020	6/30/2020
Market Cap (intraday) ⁵	537.39B	752.64B	700.45B	632.38B	614.68B
Enterprise Value ³	543.81B	758.22B	706.08B	636.12B	620.06B
Trailing P/E	20.11	41.82	37.39	43.08	46.32
Forward P/E ¹	26.60	32.79	29.15	29.24	36.63
PEG Ratio (5 yr expected) ¹	1.40	3.89	1.41	1.74	2.14
Price/Sales (ttm)	7.04	11.15	9.97	10.43	10.91
Price/Book (mrq)	4.67	8.73	7.81	8.26	9.47
Enterprise Value/Revenue ³	1.07	5.60	5.28	5.07	5.40
Enterprise Value/EBITDA ⁷	2.61	13.16	10.88	13.66	15.97

Fig. 6. Tencent statistic chart (Data source: <https://finance.yahoo.com/quote/TCEHY/key-statistics?p=TCEHY>)

The formula I used is get the mean value of P/E ratio for these four companies and then use this mean value times the earning per share of Netease to get the valuation of price per share and use the valuation to compare with Netease current stock price.

$$(28.34 + 20.11 + 54.41 + 17.27)/4 \approx 30.0$$

$$2.29 * 30.0 = 68.7 \quad (1)$$

The current stock price is 92.41, which is much higher than the valuation. But it doesn't mean that Netease is unworthy to invest, since 92.41 include future expectation from the shareholders.

P/B. Normally, the smaller a company's P/B is, the better this company is. Since Netease and Tencent are the two most dominant game companies in China, I just compared these two companies.

According to the Fig. 5, we know that P/B ratio of Netease is lower than Tencent in the past.

ROE

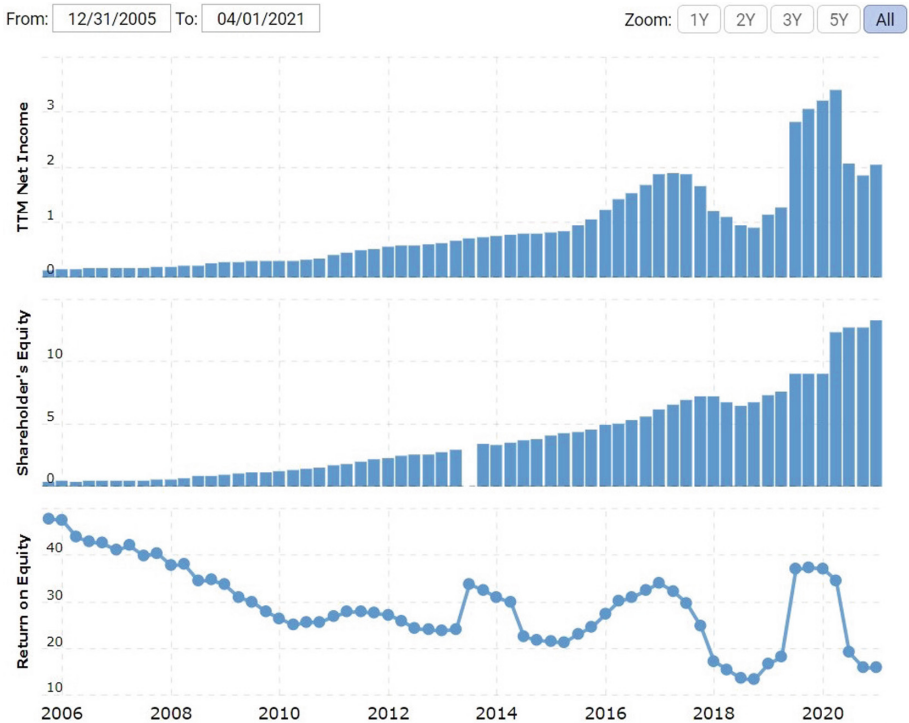


Fig. 7. Netease ROE (Date source: <https://www.macrotrends.net/stocks/charts/NTES/netease/roe>)

We can know that Netease's ROE was intensely influenced by the COVID-19, its normal ROE after COVID will be around 15%, which is lower than Tencent. Tencent's ROE is stable in 20% (Figs. 7 and 8).

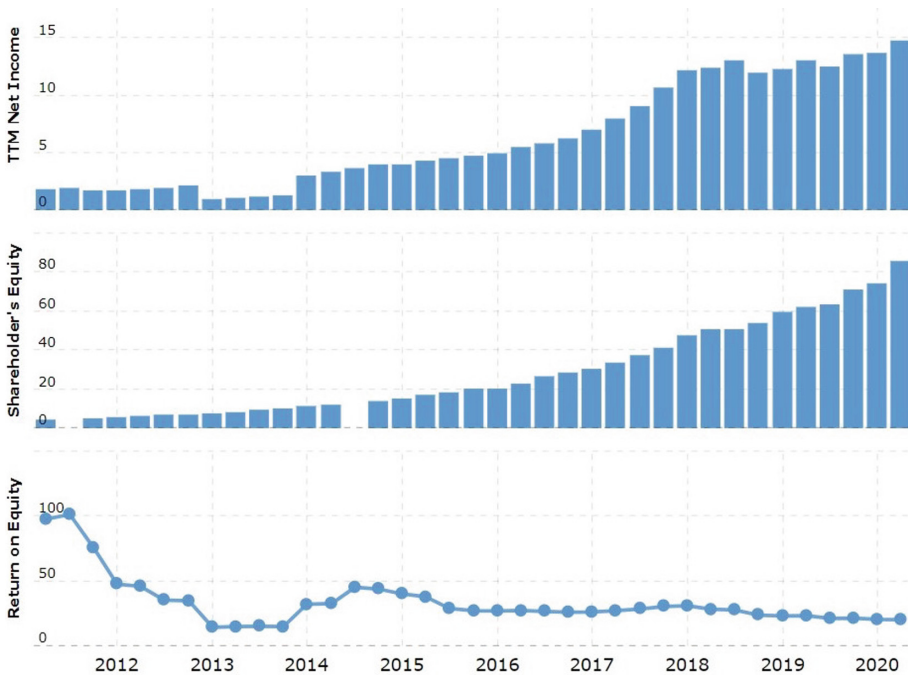


Fig. 8. Tencent ROE (Data source: <https://www.macrotrends.net/stocks/charts/TCEHY/tencent-holding/roe>)

5 Conclusion

In my opinion, focus in current news, policy and environment is much more helpful than on numbers since human action and emotion are uncontrolled and cannot be digitized, that's why Tesla and Bitcoin are still existing and popular. The analysis I did above is simple and only can play a role in reference and is lack of convince. However, what I listed on SWOT analysis can play an important role in analyzing game industry and Netease. Finally, I want to say that buying Netease stock now is not a good choice since after COVID-19, Netease's revenue will decreased and the stock price will be influenced. But Netease is a creative company, I have high expectation of its future. For game industry, it will be an immutable beneficial industry, since these games has to be existed to satisfy many laborers' life and lull them to work without protest.

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Testing for Normality for Stock Returns

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Abstract. The normal distribution is one of the most important models in economics, biology and statistics. While many economists assume stock return is normally distributed, in this paper I will use code-generated programs to test that statement and see if the conclusion is true. In this paper, I employed mostly the Kolmogorov-Smirnov test to test the stock market at different lengths: from one-year period, three-year period to ten-year period. While I used samples from AAPL at first, I later used a more macro sample which is SPX500. Not only have I mentioned different methods for normality, but I have also suggested my one distinctive way of two-sample t-test to see if this test could be an accurate method. It seems that my sample sizes are generally large so I used the Kolmogorov-Smirnov test most of the time to ensure there is less bias. Using this test, I get the result that suggests most of the time stock return is not normally distributed. Using a two-sample t-test, I also get a similar result and it helps me to conclude when the sample size increase, using a two-sample t-test is indeed becoming a more reliable method.

Keywords: Normal distribution · Kolmogorov-Smirnov test · SPX500

1 Introduction

The normal distribution is a commonly used tool in almost every field. It is a distribution that appears to be bell-shaped and a standard or perfect normal distribution has an equal mode, median and mean.

The normal distribution is the most commonly appeared distribution used in statistics, stock market analysis and other types of data analyses. The stock market return is the calculation of the percentage rate of return over a measurement period. The calculation requires several inputs, share price gains or losses. We need to visualize the distribution of stock returns to see if it is normal or not. In most cases, an annual stock market differs from a stock market that crosses several years.

The normal distribution consists of two types of descriptive data, mean and standard deviation. Mean “ μ ” is the average of a set of data and its formula is the total sum of the data and divided by the number of measurements. Standard deviation “ σ ” is one of the measures of dispersion which is the measure of the dispersion of data from its mean. A large standard deviation means that data are mostly far away from the mean. In a normal distribution, the distribution is centered at the mean and we divide the distribution into areas by classifying the points of mean plus or minus some numbers of standard

deviation. According to empirical rule, one standard deviation away from the mean has an area of approximately 68% of the whole area; two standard deviations away have an area of approximately 95% and then 99.7% of the whole area. Usually, more than three standard deviations away from the mean consist of the area of more than 99% of the whole data. The normal distribution is therefore very capable of predicting data and measure the patterns of data. It is therefore commonly used in stock market analyses and economics. I am going to focus my research topic on whether the market return has a normal distribution.

The hypothesis test is a way of testing using sample data (sample descriptive data, such as sample mean, sample proportion) to predict population parameters. There are several terminologies for such kinds of testing.

Null hypothesis (H_0) is a hypothesis that means not different, the same or “ $A-B = 0$ ”. An alternative hypothesis (H_a) is a hypothesis that we want to test whether it is true or not. For instance, if we want to know that whether the stock market price increases this year compared to the past year, our null hypothesis H_0 will be the price of this year equals last year and our alternative hypothesis will be that price of this year is greater than the price of last year. P-value is the probability of getting our result assuming our null hypothesis is true. We then set a certain threshold that is called significance level “ α ” that serves to compare with the p-value. When the p-value is less than the significance level, we reject the null hypothesis and conclude that we have evidence for the alternative hypothesis and vice versa, if the p-value is greater than the significance level, we fail to reject the null and lack evidence of the alternative. These symbols will be helpful for our testing for normality. For normality, we have several special methods of testing: Shapiro–Wilk test and Kolmogorov–Smirnov test. While the former method is more precise and appropriate for sample sizes that are less than 50, the latter is more adequate when sample sizes are greater than fifty. If we get a p-value less than or equal to 0.05, we reject the null hypothesis and support the alternative that the data is not normally distributed.

I will use both descriptive statistics and inferential statistics to test and determine whether a stock market return is normally distributed.

Later in my essay I will choose three certain periods for analysis which stands for a reason. I will include one-year, three-year and ten-year periods and figure out their p-values and analyze their centers. Because one-year is the foundation for stock return figures, I choose that and provide the most analysis about it. Also, the three-year return’s figure has a distinctive feature of being bimodal which makes it my interest of study. So is the reason I choose a ten-year period.

2 Background

2.1 Empirical Rules of Normal Distribution

The Empirical rule is a rule that is useful for forecasting what percentage of the data is under the whole normal distribution. For example, if we calculate a Z score of 2, calculated by $(x-\mu)/\sigma$ (x is the observed value, μ is the sample mean and σ is the sample standard deviation). It means we cover an area of data that lies within two standard deviations away from the mean. Therefore, the empirical rule can apply to give

what percentage of data is under the normal distribution and we get approximately 95% in a standard normal distribution. However, the empirical is applicable in only normal distributions and has the approximate range of:

- $\approx 68\%$ of the data falls within 1 standard deviation of the mean
- $\approx 95\%$ of the data falls within 2 standard deviations of the mean
- $\approx 99.7\%$ of the data falls within 3 standard deviations of the mean

Graph illustration is listed below (Fig. 1).

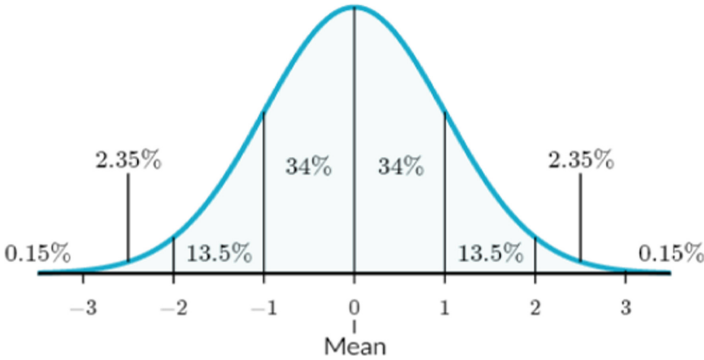


Fig. 1. The general model of standard normal distribution.

2.2 Statistics in Hypothesis Tests

In hypothesis tests, a statistic is one important variable to determine when to reject the null hypothesis. A test statistic measures the degree of agreement between a sample of data and the null hypothesis. When the calculated data of statistics is significantly against the null hypothesis, it means the null hypothesis should be rejected. A large statistic usually means a small p-value, which indicates that it is nearly impossible for the null hypothesis to be true. For different statistics, we use different statistics and different distributions. Statisticians usually use z, t, chi-squared and f statistics based on different situations (Table 1).

Table 1. Different statistics for different hypothesis tests

Hypothesis test	Test statistic
Z test	Z statistic
T test	T statistic
Chi-square test	Chi-squared statistic
ANOVA	F-statistic

Different tests are suitable for different situations. T-tests are applied for hypothesis tests for the mean; Z tests are applied for hypothesis tests for proportion; Chi-squared tests

are applied are generally applied for tests for homogeneity, independence and goodness of fit; ANOVA is useful when to determine the influence that independent variables have on the dependent variable in a regression study.

2.3 Hypothesis Test Conditions

To form a hypothesis test, we need to ensure three prerequisites are met. The first condition is the randomness of the sample. The way for me to achieve this condition is using a random number generator. The second condition is the normality of the sample. For hypothesis tests for proportions, if the data show the result of np is greater than or equal to 10 and $n(1-p)$ is greater than 10, we could say the sample is normal. For hypothesis tests for mean, there is a theorem called central-limit theorem that states when the sample size is greater than 30, it is reasonable to assume the sample is normal. However, this condition is only an assumption and there will be chances that even we have a big sample, the result still shows the data is not normally distributed. And this is the goal of my research: to test whether a stock return is normal or not. The last condition is independence. If the sample size is less than ten percent of the population, then we could say the sample is independent. With those conditions being satisfied, we could begin our calculations.

3 Methods of Tests for Normality

3.1 Kurtosis and Skewness

A distribution is approximately normal when its absolute skewness value is less than or equal to 2 or an absolute kurtosis (excess) less than or equal to 4. This is a quite accurate method for large sized samples. However, for small-to-moderate samples, we can't just use kurtosis and skewness to test normality. Instead, we calculate Z-score, which has a formula of skewness value divided by the standard error. Skewness's formula is the sum of (all numbers' value minus their distribution's mean) divided by $[(\text{sample size} - 1) * \text{standard deviation}^3]$. For small samples ($n < 50$), we need a z score to be within the range of ± 1.96 . For moderate samples ($50 < n < 300$), we need a z score to be within the range of ± 3.29 .

To use a dataset as an example, I will use a large dataset to examine whether it's normally distributed or not. My sample has a size of approximately one thousand which could be indicated as a large sample size. Given the dataset from https://help.xlstat.com/s/article/shapiro-wilk-and-other-normality-tests-in-excel?language=en_US, we can get a skewness of 0.0678 which is within the normal range. Therefore, if we assume the null hypothesis that the dataset is normally distributed, the result fails to reject that and we have evidence that the distribution is normal.

3.2 Kolmogorov-Smirnov Test

For Samples That Have a Size Higher Than Fifty. Kolmogorov–Smirnov (K–S) test is most appropriate. Note that for normality tests, we always make our null

hypothesis of the distribution is normally distributed. As always, we set our significance value of 0.05. Using the K-S test, we get the p-value of 0.742 using the same dataset https://help.xlstat.com/s/article/shapiro-wilk-and-other-normality-tests-in-excel?lang-uage=en_US. The p-value is greater than the significance value and we, therefore, conclude that we fail to reject the null hypothesis and the distribution is indeed normally distributed.

3.3 T Statistic and T Test

The T-test is most accurate when a researcher wants to set a hypothesis of difference of mean. In most cases, researchers are not able to get population standard deviation. Therefore, standard error, the standard deviation of the sampling distribution, becomes responsible for calculating statistics. Its simplified form SE is calculated by a formula $SE = \frac{\sigma}{\sqrt{n}}$ where n stands for sample size. Then t statistic is calculated by the estimator of (parameter minus the sample statistics) divided by the standard error of the estimator.

After generating the t statistic, there is still one variable “degree of freedom”, also called df, to consider. Degree of freedom is the number of values in the final calculation of a statistic that are free to vary and it typically relates to the size of the sample. For the one- sample t-test, df equals n-1, whereas df equals n-1 for only the sample with a smaller sample size. To calculate the p-value, we look up the df and t value in the t-distribution table. Note that t distribution is a normal distribution, therefore, the value we get in the t table indicates the probability of generating results assuming the null hypothesis is true. When the alternative hypothesis has a sign of \neq , we multiply the p-value by two, since it is two tailed and we need to calculate both areas.

This test can also be used for test for normality. I will use experiments to test which sample size is this test the most accurate. According to my one-thousand-number sample, I will randomly choose two smaller samples of a size of fifty and conduct a two-sample t-test to test their mean difference. Since normal distribution generally means the population do not have significant outliers, a high p-value in the two-sample t-test means there is not enough evidence to say there is a mean difference which leads us to conclude the population is normally distributed. It makes sense because if the population is not normally distributed, the sample tends to have greater variability and tend to lead to differences. Thus, if the two-sample t-test suggests there is no such difference, we can say the population is normally distributed. However, we need to set the significance level higher to avoid making type-two errors. That is, we do not want to fail to reject the null hypothesis when the hypothesis is false. In this case, such error may lead us to make incorrect conclusions that the population is not normally distributed but we conclude that it is normally distributed. We raise the significance level to 0.1 to ensure we do not make type two errors.

To ensure the sample is independent and normal, I take the sample-size of 50 for both of the samples. I get the p-value of 0.655 which makes me conclude there is convincing evidence the two samples are not different. Therefore, we can say the dataset is normally distributed. A p-value of 0.655 from the two-sample t-test is close to the p-value of 0.742 from the Kolmogorov-Smirnov test and we could say both tests are valid for test for normality.

4 Stock Return Analysis

4.1 Reasons for My Chosen Time Length

Before I start my analysis, it is important to point out the reason why I choose one-year, three-year and ten-year periods. First off,

The one-year return has the most tremendous shift of its p-value and it's the most discussed problem, since people can make the most accurate prediction based on one-year return which has the least affecting variables. The three-year period captures my attention because it is bimodal. Such a feature does not appear even from four to five-year periods. To avoid bias, I ignored choosing a two-year period, because there is a gap at about 0.4 as shown in Fig. 2.

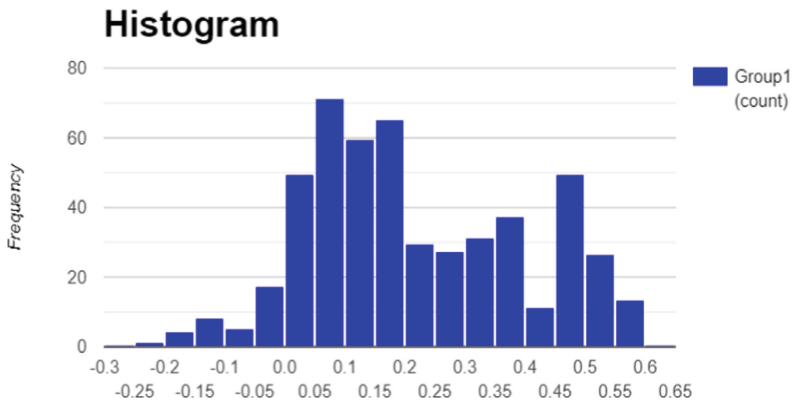


Fig. 2. Histogram for stock returns of SPX500 from 2018–2020 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

After a four-year period, every distribution will have zero p-values. Therefore, it does not make sense to list all graphs after four-year if they don't have different features. To determine which specific time frame to choose, I generated histograms as I increase the time expansion. It turns out that the ten-year period is the only graph that is trimodal among all my test results while from six to nine-year periods, all graphs are bimodal. See Fig. 3, Fig. 4, Fig. 5, and Fig. 6 to see their general pattern.

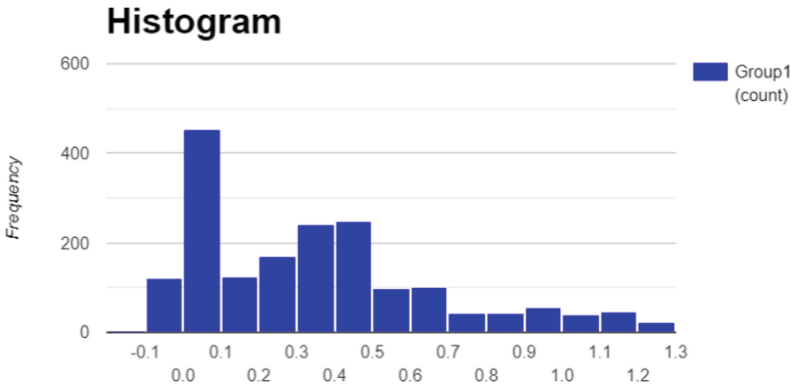


Fig. 3. Histogram for stock returns of SPX500 from 2014–2020 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

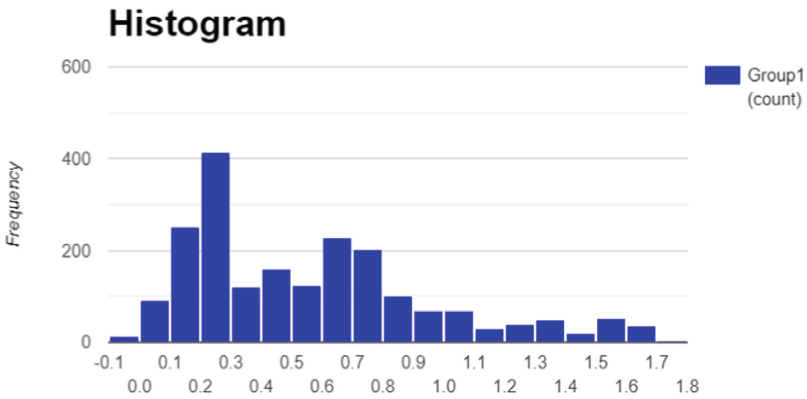


Fig. 4. Histogram for stock returns of SPX500 from 2013–2020 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

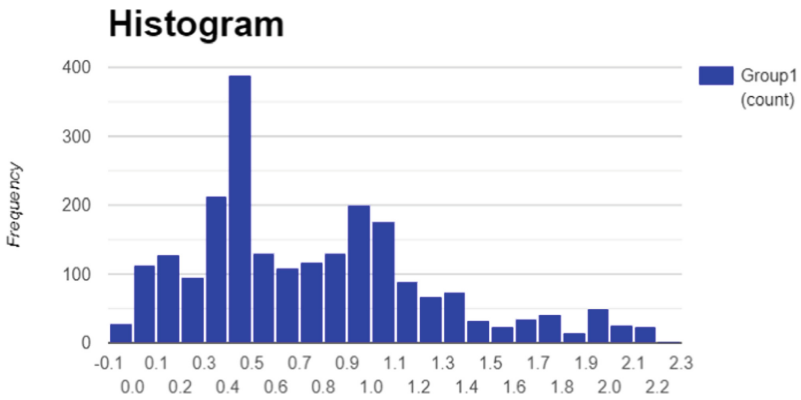


Fig. 5. Histogram for stock returns of SPX500 from 2012–2020 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

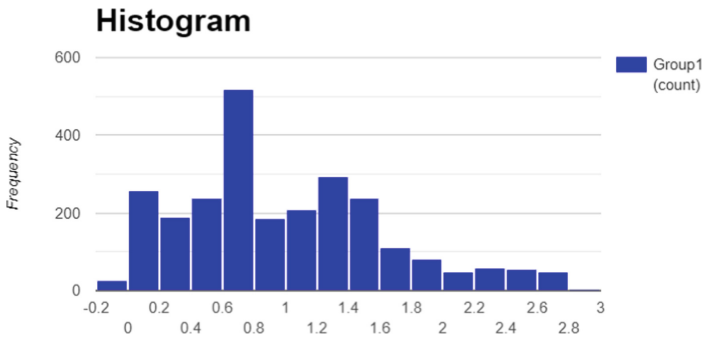


Fig. 6. Histogram for stock returns of SPX500 from 2011–2020 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

The four figures above are all bimodal which is the reason why I chose a ten-year period that is trimodal.

I have tried graphs at a longer time span such as fifteen years and twenty-year. They are no different in the identity of shape from ten years. They are all trimodal (Figs. 7 and 8).

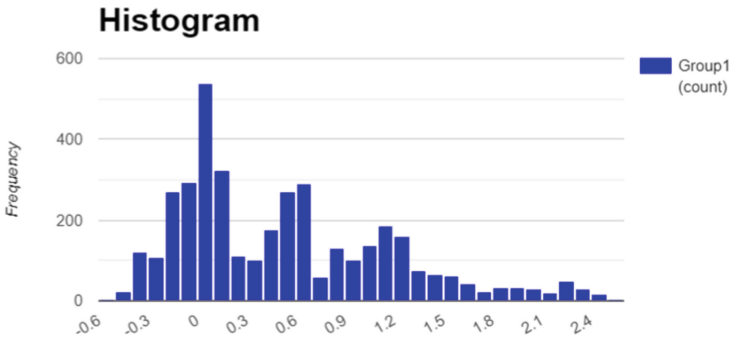


Fig. 7. Histogram for stock returns of SPX500 from 2005–2020 (the horizontal axis stands for stock return values; the vertical axis stands for frequencies)

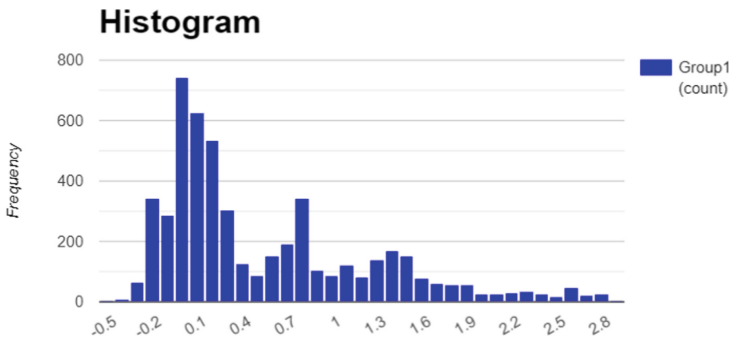


Fig. 8. Histogram for stock returns of SPX500 from 2000–2020 (horizontal axis stands for stock return values, vertical axis stands for frequencies)

4.2 One-Year Stock Return

In my test for normality, I refer to the data of the Apple stock market (AAPL) from 2020–2021 from this website (Apple Inc. (AAPL) Stock Historical Prices & Data - Yahoo Finance.) However, these data points are stock prices while the subject of our testing is the stock return. The formula for stock return is (the latter number minus the former number) divided by the former number. After such manipulation, we get 145 data points for our test for normality. Such sample size is considered rather moderate ($50 < n < 300$) and we should calculate Z-score to test AAPL.

We get the Z-score of 1.433 and this value is clearly within the range of $(-3.29, 3.29)$. Therefore, we conclude this one-year stock return of AAPL is normally distributed. Moreover, I will use the K-S test to directly calculate the p-value to let us better see why the one-year stock return of AAPL is normally distributed. Using computer-generated programs, we get the p-value of 0.8815 which tells us that the distribution is indeed normally distributed since 0.8815 is way higher than our preset significance level of 0.05. Also see Fig. 3 to have a better visualization (Fig. 9).

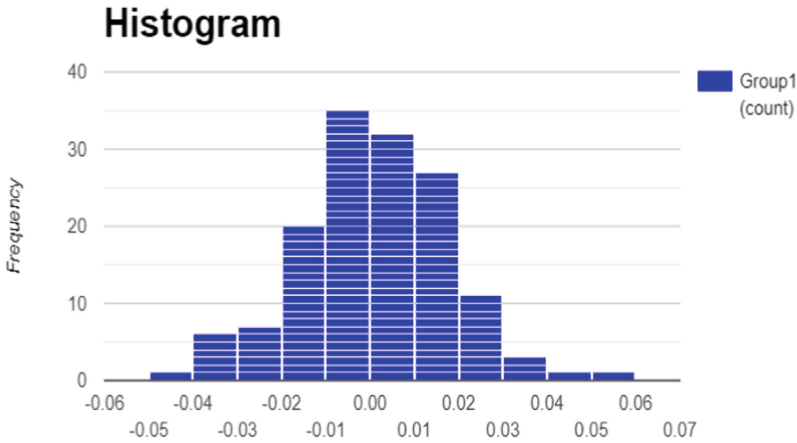


Fig. 9. The histogram for stock returns of AAPL from 2020–2021(the horizontal axis stands for stock return values; the vertical axis stands for frequencies)

Using the naked eye, we can already see that this distribution is quite normal. With the mean value of 0.001, we can see this graph appear to be close to the standard normal distribution where most of its data centered around the first and second standard deviations away from the mean. Also, when there is little or no outliers, it will be great evidence that our distribution is normal. In this case, there is only one outlier 0.053851243 which shows that our graph is almost not skewed and has quite good symmetry. Moreover, the median of this graph is 0.0013 which is very close to its mean. This is also a good indication of this dataset’s normality, since a standard normal distribution has the same median and mean. We can see almost the whole graph appears to be symmetric and normal. Keep in mind this graph has only one-year period. It seems every stock return graph of the one-year period is normal. Could it be that we get this one to be normal by

chance and the other ones will display different results? I will start off doing two more one-year stock returns.

Using two other one-year stock return for comparison, I use only the K-S test to help us form the p-value. For the stock return from 2019–2020, we have 252 data points; for the stock return from 2018–2019, we have 251 data points. For 2018–2019, we get a p-value (0.039) that is smaller than 0.05; for 2019–2020, we also get a very small p-value (0.027). Thus, we can say both of them are not normally distributed. See the two figures below. They also seem to be skewed and not normal.

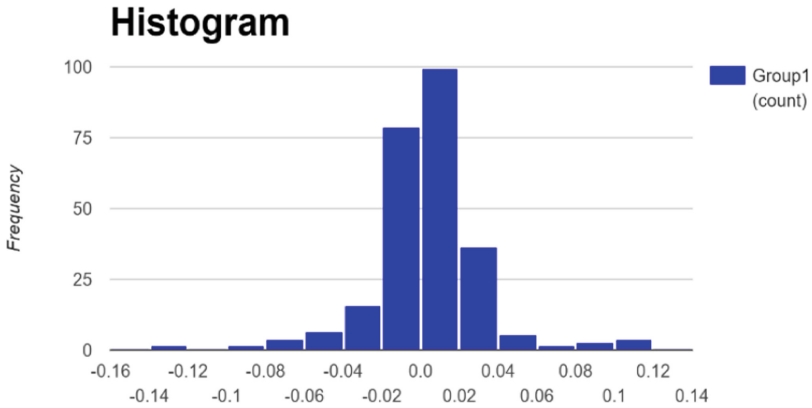


Fig. 10. The histogram for stock returns of AAPL from 2019–2020 (the horizontal axis stands for stock return values; the vertical axis stands for frequencies)

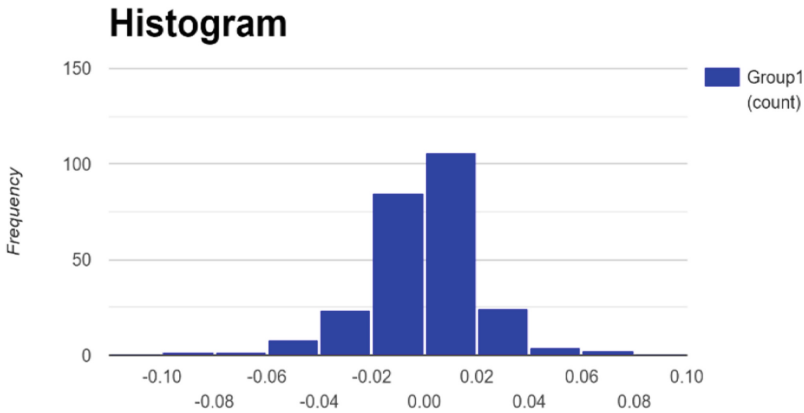


Fig. 11. The histogram for stock returns of AAPL from 2018–2019 (the horizontal axis stands for stock return values; the vertical axis stands for frequencies)

Comparing to the previous 2020–2021 distribution, Fig. 10 and Fig. 11 look quite skewed. 2019–2020 has excess kurtosis of 6.1677 which tells us that the distribution is not normal, at least visually because such a huge value of kurtosis is significantly

different from that of a normal distribution. The 2018–2019 stock return has excess kurtosis of 4.1375, which suggests the distribution is not normal since the graph looks thinner and narrower than the standard normal distribution. Also, the median of 2019–2020 is 0.00356 which is about seven percent difference from its mean of 0.003327. And the median of 2018–2019 is 0.0016 which is significantly far from its mean of 0.00026.

After the three tests for one year period, it can be hard for us to predict whether the stock return is normally distributed or not. It seems that in a micro perspective, which is a single company's stock market, the one-year stock return may alter significantly because of its rapid competition and supply and demand. That is what explains the skewness of the 2018–2019 and 2019–2020 distribution. It appears that Apple company did not expect its sale to be so low which leads the demand for their products to drop. It turns out that, during 2018–2020, their stock price continued to drop, causing a stock return to drop too. There are too many factors that greatly affect a company's stock price, for example, a company's unexpected low sale or a sudden widespread disease and the government's involvement. It proved to be true that after President Donald Trump increased tariff on China goods to 25% which directly weakens Apple's economy.

However, if most of the variables in the economy do not appear, then the stock return will be approximately normal for almost every year. While looking only in AAPL may lead us to look into a micro perspective, the SP500 is representative of the entire US system, consisting of 500 companies whose sample size for us is large to examine with less bias.

There are about 250 data points in the SPX500 for all three distributions: 2018, 2019, and 2020. Once again, we use the Kolmogorov-Smirnov test here. For the year 2018–2019, the graph looks strongly skewed to the left and this is what leads the graph to be not normal. Using the K-S test, I get a p-value of 0.01723 which lead us to conclude the distribution is not normal. In addition, the dataset's mean of 0.01877 has about six percent difference between its median 0.01768 which is considered a large difference.

For the year 2019–2020, we have a p-value of 0.0471 which is not supportive enough for us to conclude the distribution is normal. However, the graph looks quite normal by looking. The only thing that does not seem right is at the small cluster around 0.25, where the bins there are supposed to be higher. Therefore, we cannot say 2019 has a normal model but is reasonable for us to assume its normality since the p-value of 0.0471 is very close to 0.05.

For 2020–2021, reasonably, we get an extremely low p-value which is less than 0.01. The graph has a long tail on the left and the graph is significantly different from a normal distribution. Because the covid-19 had such a great global impact, it is reasonable to assume even SPX500 will be affected greatly and thus has this strongly skewed distribution.

If I use a two-sample t-test for these three datasets, I get a p-value of 0.073 for 2018, a p-value of 0.0874 for 2019 and 0.027 for 2020. I set the significance value at 0.1 so that I can avoid bias here. However, the significance level of 0.1 for the two-sample t-test is different from 0.05 of the K-S test. This shows that at such a moderate sample size, there will be risks that we make errors (Figs. 12, 13 and 14).

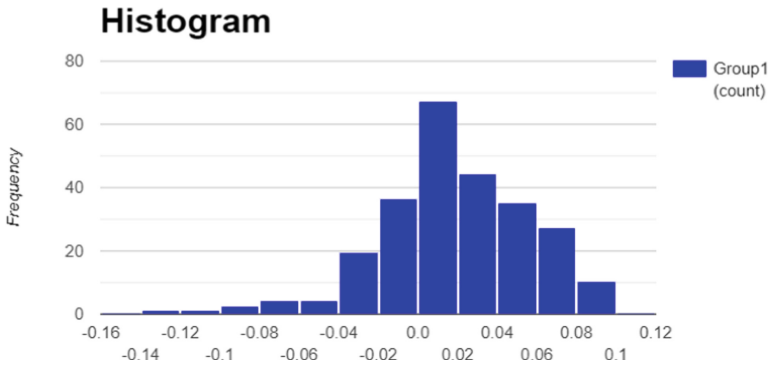


Fig. 12. Histogram for stock returns of SPX500 from 2018–2019 (the horizontal axis stands for stock return values; the vertical axis stands for frequencies)

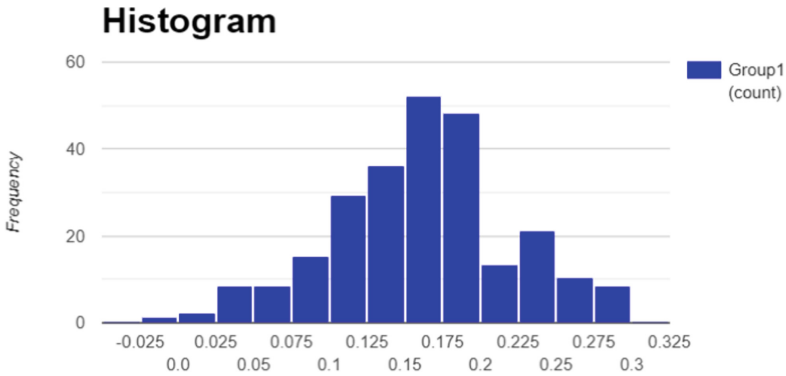


Fig. 13. Histogram for stock returns of SPX500 from 2019–2020 (the horizontal axis stands for stock return values; the vertical axis stands for frequencies)

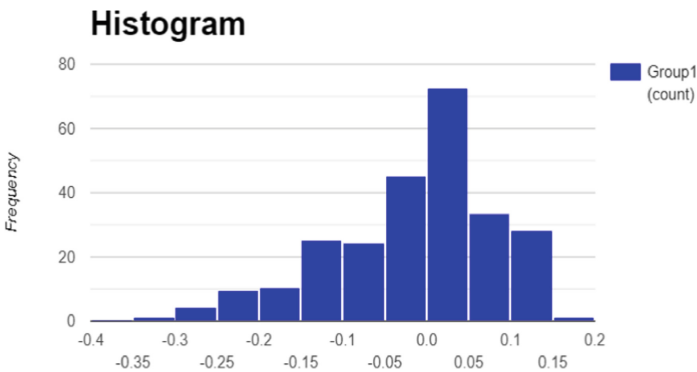


Fig. 14. Histogram for stock returns of SPX500 from 2020–2021 (the horizontal axis stands for stock return values; the vertical axis stands for frequencies)

Overall, one-year stock return is close to normal and such time length is a good reference for prediction.

4.3 Three-Year Stock Return

To ensure an unbiased result, from now on, I will use the data from the SPX stock market to test for normality.



Fig. 15. Histogram for stock returns of SPX500 from the beginning of 2017 to the end of 2019 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

Figure 15 is the graph for 3-year returns-from the beginning of 2017 to the ending of 2019. Unlike the annual return that has only one peak, this 3-year return has two peaks and is bimodal. The first peak is at about 0% return. At the first peak, most people’s purchase of stocks will lead to negative returns. This area near the left of 0% can be considered a bear market since the stock return is still negative and it indicates if people buy shares, they will probably lose money. It makes sense because, during some periods of SPX, the stock is not showing wonderful results and lead the first peak to be not attracting stock buyers. Then, the point from the first peak starts to decrease its frequency while increasing its rate of return. Once again, bimodal is like two normal distributions: From increase to reach its first peak then decrease, then increase to its second peak, then decrease. At the return rate of about 16%, the frequency of return starts to increase and reach its second peak. The second peak is somewhere around 30% and is located in the bull market. At that time, buying stocks have a high possibility for people to earn money.

I get a p-value of 0.0137 using the K-S test, and I conclude the graph of three-year stock return of SPX500 is not normally distributed. Using the two-sample test, I get a p-value of 0.0274 which allows us to set the same significance level, and we can see that the difference between those two p-values is diminishing. Therefore, it is true that when the sample size grows, the two-sample t-test gains more and more similar results with that of the K-S test.

In conclusion, the 3-year return may show a bull and bear market and have two peaks. Visually the graph has two somewhat skewed normal distributions and it is still reasonable for people to predict things assuming this chart is normal.

4.4 Ten-Year Stock Return

Finally, if I expand the time horizon to ten years, the graph looks a lot different from annual return or three-year return (see figure below). It looks trimodal and skewed to the right. In this case, bull market or bull market are considered secular which means both types of the market may last for many years. There are three obvious peaks in the figure. The first peak will always be in the bear market because the left side of the graph always shows a low return rate. The peak in the secular bear market is around 0% and investment in a stock at that time is abysmal. Then there is the second peak that is in a mixed interval. The interval where the second peak is at experienced both secular bear and bull market. So, at that time, people have a mediocre chance of making profits. The third peak is located on the right of the graph. Such a bull market is the most long-lasting one in history. It is not ordinary at all to have such a long-period bull market. Undoubtedly, we can say this graph is not normal but we can predict about the next decade. Since the secular bull market had lasted so long, it is only reasonable for us to assume that soon after the beginning of 2021, the stock return will turn into a mixed market where we experience the tail end of the bull market and the beginning of a secular bear market.

I get a p-value of 0 which lead us to conclude this graph is not normal using the K-S test. I also used a two-sample t-test and get a p-value that is also less than 0.01 which is another solid evidence that a ten-year period will not display a normally distributed graph. We can, meanwhile, see that at such a large sample size, the difference between the p-value of both kinds of test become smaller. Therefore, if the sample size becomes larger, it will be more reasonable to consider a two-sample t-test as an accurate method (Fig. 16).

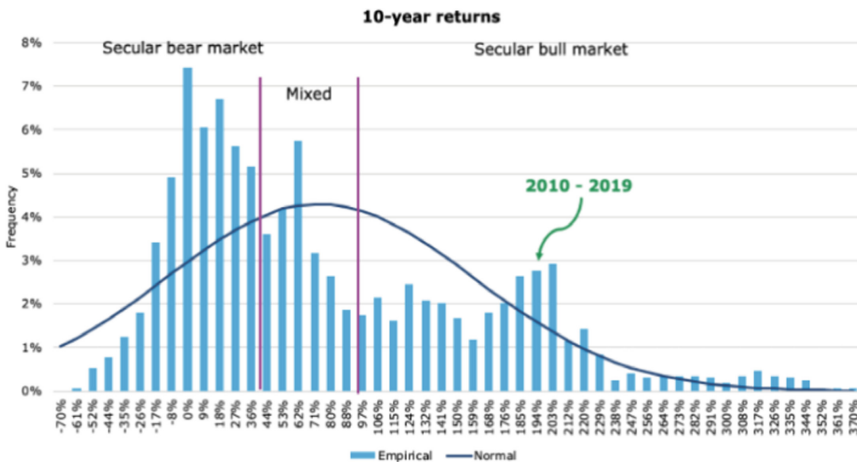


Fig. 16. Histogram for stock returns of SPX500 from the beginning of 2010 to the end of 2019 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

It is reasonable to predict ten-year return stock return is always trimodal, consisting of a secular bull market, bear market and a mixed interval. The economic cycle will explain such a phenomenon. When the Us economy suffers tremendously at the end of a decade, the next decade will, in contrast, begin with an economic boost in a long time. The same situation happens repeatedly. And from 2001–2011, the graph looks not as usual since it only consists of one center.

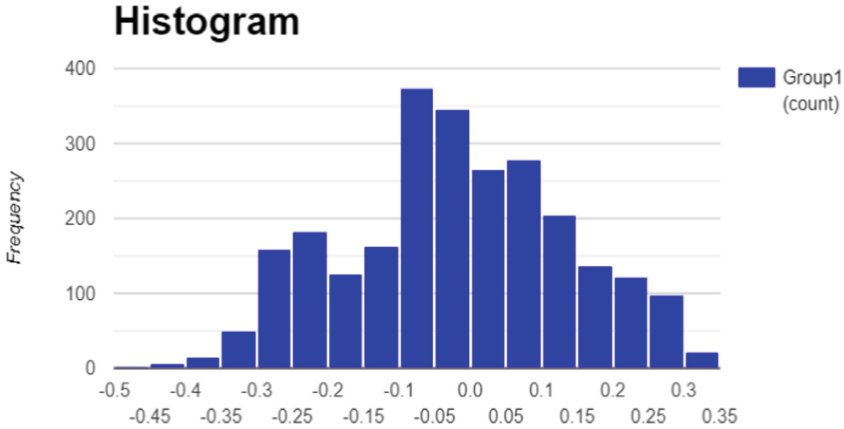


Fig. 17. Histogram for stock returns of SPX500 from 2001–2011 (the horizontal axis stands for stock return values, the vertical axis stands for frequencies)

In Fig. 17, approximately fifty percent of returns are negative, which is unusual for such a time span of ten years. Looking in my dataset, I discovered that from 2001 August to 2004 December and 2008 September to 2010 November are the range of negative returns. Moreover, the stock price of 2011 is lower than that of 2001, meaning the Us economy had grown negatively from 2001–2011 (Tables 2 and 3).

Table 2. Stock price of 2001 August (note that data at the last two columns are used as reference)

29-Aug-01	1161.51	1166.97	1147.38	1148.56	1148.56
28-Aug-01	1179.21	1179.66	1161.17	1161.51	1161.51
27-Aug-01	1184.93	1186.85	1178.07	1179.21	1179.21
24-Aug-01	1162.09	1185.15	1162.09	1184.93	1184.93

Table 3. Stock price of 2011 August which is lower than that of 2001.

23-Aug-11	1124.36	1162.35	1124.36	1162.35	1162.35
22-Aug-11	1123.55	1145.49	1121.09	1123.82	1123.82
19-Aug-11	1140.47	1154.54	1122.05	1123.53	1123.53
18-Aug-11	1189.62	1189.62	1131.03	1140.65	1140.65

The US was facing severe economic depression around 2002 and 2008 which leads to about fifty percent of negative returns.

From 2001 to 2011, SPX500 was having an economic boost at the end of its last decade which is another evidence for the economic cycle. From 1995 April to 1999 December were positive returns for SPX 500 which is considered to be a secular bull market that explains the economic crisis in 2002.

After all, the economy tends to grow gradually. There is no wonder for a non-normal distribution for the ten years. Unlike annual return that has little change for comparison, minor factors will accumulate and have a significant effect on the return rate of the stock market over ten years. While there will be significant incidents, most of the time long-lasting economic depression, led by an epidemic or unexpected crisis, that may lead a ten-year graph to not look trimodal, ten year's length is enough time for self-adjustment of the economy. The ten-year period is another great prediction model for people to expect what to happen in the next decade.

5 Conclusion

Stock returns prove to be not normally distributed most of the time. No matter how long of a period the stock market is, the distribution is still not normal. This is a phenomenon because many factors may somewhat shift the whole distribution. Factors such as the government's involvement of tariffs or taxes, a widespread disease or unexpected low sale of certain products may cause the whole stock return to be not normal. Although the distribution cannot be said to be normal, it is easier and more convenient for economists to assume the stock return is normal and use such a model for academic predictions. All such stock return has a distribution that has the qualities for prediction. The average stock return is close to 0 where most of the data clusters there. This is already reasonable for us to predict stock return is normal since unexpected factors will lead to some skewness, create some peak and fluctuations, and tails.

Moreover, the stock return market consists of dependent variables. The demand of customers changes every day and the chance for someone to purchase a product varies depending on their mood or financial condition. Therefore, the stock price is depending on many variables which make the whole stock return distribution not normal.

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The Engagement of Stakeholder Interactions on Social Media Platform Promoting by CSR-Related Content in China

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Abstract. In recent years, many scholars and managers have discovered that corporate social responsibility (CSR) is not just a simple topic, but could constitute the business model for companies to establish sustainable successful development, by helping companies consider the concerns of stakeholders. The promotion of CSR-related information also helps to trigger public participation, enhance the company's CSR influence, and accelerate the company's business success. Thus, the importance of disseminating CSR-related content is emphasized. In the era of web 3.0, a large number of applications of social media platforms have enabled companies to be contacted and explored, and have also advanced the promotion of CSR-related information and activities by companies. Many scholars have studied the methods that companies use to promote stakeholder engagement through online social activities, but the research is mainly based on Western business content, while relevant research in China's specific context has been neglected. Therefore, to bridge the research gap, we choose six companies in the fast-moving consumer goods industry (FMCG) as sample companies and Weibo as the selected social platform to explore which types of CSR-related topics and the message formats can trigger stakeholder participation. Through the Poisson regression of different variables, we found that publishing topics consistent with the company's business may not necessarily trigger public participation. Topics that are more worthy of attention are related to education, health, environment/energy, and public policy, and those contents in the formats of links, graphics, and videos could get more likes, comments, and shares.

Keywords: Corporate social responsibility · Stakeholder engagement · CSR content topic · Company-cause fit · Message format · Social media platform

1 Introduction

Being widely defined as the “commitment to improve social welfare through freely-controlled business behavior and contribution of company resources” [1], corporate social responsibility (CSR) means that companies should focus on goals that go beyond the economic interests, position themselves in the society and integrate the social and moral factors into economic activities [2]. It provides a way for companies to incorporate

stakeholders' concerns into their business models, by assessing the independent relationships existing between companies and their stakeholders [3]. According to Chandler, communication, including mobile devices and social media, is one of the interconnected CSR driving factors [3]. Also, nowadays, the development of technology has enabled stakeholders to be empowered [4]. For instance, recently, H&M and other companies have refused to use Xinjiang cotton. The boycotted crisis for such companies from Chinese consumers shows once again that the speed and influence of public criticism and doubt on the internet through social platforms is amazing. Once similar accusations are recognized by society, the criticized subjects in public opinion will be under tremendous pressure [4]. However, social platforms can provide different values for companies [5], not just bring negative CSR impact. For example, it can help enterprises enhance the brand image [6], therefore gain the social trust of consumers and other stakeholders. Besides, it is worth noting that the above influence depends on how the company itself uses social platforms to disseminate its CSR-related information [7].

Previous research involved little into the field of the way companies use local social media platforms as tools to enhance their positive CSR impacts in the Chinese context. Regarding how to increase CSR influence through public platforms, most of the papers focused on the disclosure of information on the company website [8–10]. Studies involving social platforms mainly focused on the Western context and explored the application of platforms such as Facebook [11, 12]. For Chinese specific context, most of the previous literature was keen on analyzing the platform's impact on companies' CSR performance, and the opportunities and challenges generated [4], without mentioning how companies should use such tools to actively spread their CSR influence. According to Hart and Milstein, companies can take different measures for different markets and economies [13]. As a super emerging market, even if the online social environment of stakeholders is different from that of Western society, China's attraction to multinational companies is unquestionable. This means as for how multinational companies could adapt to China's network environment and use digital social platforms to enhance their CSR influence, relevant research remains to be conducted.

Thus, to bridge this research gap, this paper aims to explore how multinational companies can positively enhance their CSR influence in China through local social platforms. Specifically, it examines whether the CSR-related information posted by multinational companies on Weibo will trigger stakeholder engagement on this platform. The two influencing factors that will be explored are content topics selection and dialogue strategy selection. Past studies have shown that 1. Information consistent with the company's causes could get more stakeholders involved, 2. Adding photos, images, or links to posts is an effective strategy [14]. The paper will further explore whether the above-mentioned findings and suggestions are applicable to the Chinese specific context.

Further, the second section of the paper will review the previous literature and propose two hypotheses related to the topics and formats of the CSR-related content posted. Then, the selection criteria of the samples and the research method will be introduced in the third section, and the results of the data analysis and the reasons behind them will be explained later on. Lastly, the theoretical and practical implications and limitations of this paper will be elaborated.

2 Literature Review

2.1 Stakeholder Engagement with Social Media

Stakeholder engagement is the prerequisite for a company to leave a CSR impression for the public [15]. It refers to the participation process of groups or individuals that affect or are affected by company activities [16]. According to BSR, if a company or organization publishes a policy or conducts an activity that demonstrates its commitment to stakeholders, this policy or activity will be considered responsible to stakeholders [17]. And higher the stakeholder participation, the more responsible behaviors [17]. Greenwood did refute the simple assumption that stakeholder participation is necessarily a corporate responsibility behavior [15]. However, this is not contrary to the finding that previous literature showed, meaning CSR communication and influence are highly related to stakeholder engagement [15, 18, 19]. In many literature, the authors used stakeholder engagement to represent the influence of a company's CSR [14].

According to Golob and Bartlett, high stakeholder engagement requires companies and organizations to be transparent and tolerate public evaluations, especially skepticism and criticism [20]. It also requires stakeholders and companies to understand each other and actively participate in dialogues with each other [21]. This means that it is more important for companies to strengthen their relationship with stakeholders than just disseminating information [22]. Especially in today's situation with volatility, uncertainty, complexity, and ambiguity, stakeholders' suspicion of company's CSR activities is increasing, which means companies need to adopt more advanced communication strategies to touch them [23, 24]. The key point here is that companies need to make sure their words are consistent with their deeds [25]. Otherwise, they will be regarded as just doing greenwashing [26].

In the Web 3.0 era, a large number of social platforms have emerged, and the number of users of social networks is increasing everyday [27], which has brought many challenges and opportunities to companies' CSR communication. According to Hou, in the era of social media, the relationship between companies and stakeholders has undergone great changes [4]. Social platforms provide a low-threshold platform for acquiring and exchanging information, enhance the transparency of corporate information [28], and increase the influence of stakeholder evaluations and attitudes on the long-term development of companies [4]. In the course of the game with them, the company is no longer in a strong position [4]. However, these challenges do not mean a negative impact. The rational use of social platforms can help companies increase their CSR influence [5]. When information is shared in a fast and effective manner, active stakeholder engagement will occur [29]. For example, if a company actively uses social platforms to disclose its CSR-related information, it may be able to reduce the suspicion from its stakeholders [30]. Obviously, one key that cannot be ignored here is that companies should ensure that the information they release and the activities they carry out are consistent [28]. In addition, it is worth noting that, the form of content and the call for specific actions are closely related to the stakeholder engagement [14].

2.2 Company-Cause Fit and Content Topics

Regarding company-cause fit, a method found in many studies which could improve the perception of customers and other stakeholders on company's CSR efforts [31], the fit refers to the perceptual connection between a company's brand image and the cause it supports. This theme is important because it affects people's further understanding of corporate behaviors [32], therefore affects their attitude towards the company [33], product evaluation [34], and purchase intention [34]. When publishing CSR-related information, companies should consider two basic elements, what to present and how to present [35]. Firstly, the company's CSR-related information should be in line with its value, vision, and mission [36]. Additionally, Hamlin and Wilson pointed out that stakeholders, such as consumers, have more appreciation on the organization's CSR efforts followed by its core business activities [37], which means in terms of CSR recognition, CSR projects that have a high degree of consistency with the enterprise's business may perform better than social projects that have a low degree of fit. Attribution theory [38] shows that people's attitudes and behaviors are influenced by the evaluation of others' motives. Forehand and Grier explained that two motivations for stakeholders to attribute to the company, public-serving and company-serving [39]. Among them, the latter makes stakeholders believe that the company's motives are more sincere and are therefore willing to help or participate in the cause [39], which constitutes a driving factor for stakeholder engagement. However, the above research mainly focuses on the Western context and for the situation in China, the previous literature research is limited. Therefore, this research will explore this field and propose the following hypothesis:

H1. CSR content consistent with the company's cause will cause public engagement on the social platform.

2.3 Dialogic Strategies and Message Formats

Regarding corporate dissemination of CSR-related information, the concept, dialogic communication, introduced by dialogic theory [40], can be used by companies as a way to communicate with stakeholders. Existing research has explored the influence of dialogic strategies [11], and has repeatedly shown that user-friendly information formats can help establish connections with users through social platforms. Such formats refer to information that needs to be expressed or transmitted in a way that the public can highly contact [14], and the specific methods include pictures, videos, links, and so on [41]. In fact, despite the existence of the above-mentioned benefits, most companies have limited use of this strategy, and some even ignore it [12]. Therefore, to further explore the enhancement of stakeholder engagement through information formats, especially for the Chinese context, this study puts forward the following hypothesis:

H2. CSR-related information in a user-friendly format, including links, videos, photos, and graphics, will lead to public participation.

3 Methodology

3.1 Data Collection

For the social media platform, Weibo was chosen as the publishing channel of research content, since among the many Chinese social platforms, the popularity of Weibo is unquestionable. On Weibo, companies can create an ordinary corporate account, or an account dedicated to a specific topic, to post what they want to express.

Regarding the sample companies selection, we decided to choose companies in the fast-moving consumer goods (FMCG) industry as the sample companies. The reason behind this choice is that the main stakeholders of FMCG companies, individual customers, can interact with the company on Weibo. Further, we referred to the following four criteria when selecting. 1. The company must attach importance to CSR and its CSR actions are recognized by the public. 2. The company must be international and run business in China. 3. The company must have a registered account on Weibo and has followers of more than 250 thousand. 4. The company must post content in Chinese. Therefore, six companies, satisfying the criteria, are selected.

It should be pointed out here that we do not need to distinguish between greenwashing and actual CSR content, since the research questions mainly focus on the influence of the CSR-related information' topics and formats on public engagement, rather than whether it is true or not. Besides, we assume that due to the development of digitalization and the advent of the information era, stakeholders are empowered, and the company can no longer control its CSR image in the minds of stakeholders. Therefore, a company cannot publish content that deceives its stakeholders for a long time.

3.2 Quantitative Content Analysis

The research method selected in this study is quantitative content analysis (QCA), since by using the method, the text, links, and other non-quantitative information with communication value published by the sample companies on Weibo can be transformed into quantitative data, and meaningful topics can be established to decompose the communication content. The process contains two steps, dividing the dissemination content into topics and analyzing the formats of each post. Besides, as the research topic and the methodology are similar, we will follow the method used by Abitbol and Lee, adopting Poisson regression for further data analysis.

We collected the CSR-related content of the above six sample companies on Weibo from November 1, 2020 to April 30, 2021, and analyzed them. It is worth noting that if the content includes CSR or CSR-related terms, such as green environment, sustainability, research input, and public welfare, it is considered to be analyzed. According to the two hypotheses mentioned in the second section, the content obtained was divided based on two categories, company-cause fit and user-friendly formats. There are several subdivided elements under each category. For company-cause fit, the study referred to

a list of 11 topics proposed by Abitbol and Lee, including education, health, research & development (R&D), business development, safety, environment/energy, finance, religion, public policy, employee/workplace engagement, and diversity [14]. According to Waters et al., the category user-friendly formats contains links, photos, graphics, and videos [12]. All CSR-related information posted will be analyzed according to different topics and formats. Each topic will be coded as being present (1) or absent (0), and one content posted can be coded as containing multiple topics. The coding method of formats is the same.

In terms of dependent variables, we used likes, shares, and comments to represent stakeholder engagement. These interactive methods have produced dynamic and interactive systems of organizational behaviors and public response [42]. Moreover, Weibo also provides users with a way to express their appreciation of information and convey this acknowledgment to others [43]. According to Cho, Schweichart, and Haase, like is the most passive interactive tool, because users who use it do not need to verbally express agreement with the post [44]. Share means the user's will to pass the information to others [44]. And comment, allowing users to communicate directly with the company, is the most engaged form [44].

The control variables of this study involve the type of the companies' main stakeholders (individuals rather than businesses), the size of the companies, and so on,

4 Results

We analyzed 226 CSR-related Weibo posts posted by six sample companies in the FMCG industry. Within half a year, the average number of posts per company is about 38, the average number of likes per post obtained is about 1,467, the average number of comments obtained is about 220, and the average number of shares obtained is about 863.

We intend to explore not only the type of CSR-related content topics but the message formats that could contribute to public participation. The independent variables of the research are divided into two categories, the content topics, and the message formats, and the dependent variables are likes, comments, and shares. It is worth mentioning that although the researcher pre-set eleven independent variables about the content topics in the third section, in the actual data collection process, no content related to the topic of business, safety, finance, and religion was found. Therefore, the discussion of the content topics relates only to the other seven.

We firstly explored the correlation between the respective independent variables, and the results are shown in Table 1. There is no obvious correlation between those variables, meaning that it is possible to investigate the research problem in the following step.

Table 1. Correlation between independent variables

	education	health	R&D	environment/energy	public policy	employee/ workplace engagement	diversity	photos	links	graphics	videos
education	1										
health	0.198*	1									
R&D	0.025	0.241*	1								
environment/energy	-0.250*	0.052	0.02	1							
public policy	-0.118	0.104	-0.09	-0.472*	1						
employee/ workplace engagement	0.425*	0.148*	-0.03	-0.327*	-0.224*	1					
diversity	0.234*	0.664*	0.281*	0.087	0.211*	0.182*	1				
photos	-0.171*	-0.05	0.042	0.228*	-0.088	-0.194*	-0.1	1			
links	0.340*	0.132*	0.059	0.065	-0.09	0.016	0.173*	-0.161*	1		
graphics	0.018	-0.04	-0.11	0.155*	-0.217*	0.224*	0.057	-0.254*	0.277*	1	
videos	0.115	0.063	0.054	-0.169*	0.218*	-0.141*	0.008	-0.403*	-0.07	-0.585*	1

*** p<0.01, ** p<0.05, * p<0.1

Regarding the type of posts topics that can trigger more public participation, the results show that for the fast-moving consumer goods industry, the hypothesis that the topics that are consistent with the company's cause will attract public engagement on Weibo cannot be supported, since not even a single post from a sample company in six months is business-related. Topics that are not so in line with the company's business, specifically, education, health, environment/energy, and public policy, could, to some extent, promote public participation. Especially for education-related topic, it effectively attracted more likes ($\beta = 2.77$, IRR = 15.99, $p < 0.001$), comments ($\beta = 3.09$, IRR = 22.02, $p < 0.001$), and shares ($\beta = 5.07$, IRR = 158.70, $p < 0.001$). Topics such as R&D and employee/workplace engagement have a negative impact on public participation. Especially for employee/workplace engagement, its negative effects are reflected in likes ($\beta = -3.18$, IRR = 0.04, $p < 0.001$), comments ($\beta = -3.85$, IRR = 0.02, $p < 0.001$), shares ($\beta = -6.27$, IRR = 0.00, $p < 0.001$). Finally, with regard to the impact of content topics on public participation, it is interesting that diversity-related topic has a positive impact on likes ($\beta = 1.50$, IRR = 4.46, $p < 0.001$) and comments ($\beta = 0.47$, IRR = 1.60, $p < 0.001$), but has a negative impact on shares ($\beta = -1.34$, IRR = 0.26, $p < 0.001$).

Regarding the message formats, the results show that links, graphics, and videos can all promote public participation, to different degrees. Among them, the positive effect of videos is the most obvious, while the effect of links is the weakest. Videos can roughly attract 18 times the likes ($\beta = 2.86$, IRR = 17.51, $p < 0.001$), 10 times the comments ($\beta = 2.26$, IRR = 9.55, $p < 0.001$), and 73 times the shares ($\beta = 4.29$, IRR = 72.82, $p < 0.001$). In addition, photos have a weaker positive influence on likes and a negative influence on comments and shares. The details are shown in Table 2.

Table 2. Poisson regression results for effects of content topics and message formats on public engagement

IVs	Categories	DVs					
		Likes		Comments		Shares	
		β (SE1)	IRR(SE2)	β (SE1)	IRR(SE2)	β (SE1)	IRR(SE2)
Message Topics	education	2.77(0.011)	15.99(1.011)	3.09(0.029)	22.02(1.029)	5.07(0.036)	158.70(1.037)
	health	0.58(0.018)	1.79(1.018)	1.05(0.053)	2.85(1.054)	1.87(0.063)	6.47(1.065)
	R&D	-1.95(0.017)	0.14(1.017)	-1.75(0.043)	0.17(1.044)	-4.43(0.069)	0.01(1.071)
	environment/energy	1.18(0.011)	3.25(1.011)	1.86(0.029)	6.42(1.029)	4.27(0.036)	71.74(1.037)
	public policy	0.03(0.011)	1.03(1.011)	0.92(0.029)	2.52(1.029)	3.11(0.036)	22.38(1.037)
	employee/workplace engagement	-3.18(0.012)	0.04(1.012)	-3.85(0.043)	0.02(1.044)	-6.27(0.067)	0.00(1.069)
	diversity	1.50(0.022)	4.46(1.022)	0.47(0.061)	1.60(1.063)	-1.34(0.067)	0.26(1.069)
Message Formats	links	0.24(0.004)	1.27(1.004)	0.10(0.010)	1.11(1.010)	0.95(0.005)	2.58(1.005)
	photos	0.26(0.006)	1.30(1.006)	-0.35(0.014)	0.70(1.014)	-0.61(0.007)	0.54(1.007)
	graphics	1.76(0.011)	5.84(1.011)	1.84(0.028)	6.30(1.028)	3.45(0.035)	31.53(1.036)
	videos	2.86(0.012)	17.51(1.012)	2.26(0.029)	9.55(1.029)	4.29(0.035)	72.82(1.036)
Total Wald χ^2 (df =)		710428.383		74142.662		426893.668	
Total pseudo R2 (%)		0.368		0.310		0.352	

Note: N = 226. If β is negative, it means that compare to do not implement the certain strategy that independent variable indicates, these of this strategy has a negative impact on the dependent variable, stakeholder engagement. IRR represents the ratio of the difference in DVs between a group and its reference group. SE1 = robust standard error of coefficient; SE2 = robust standard error of the IRR; *p < 0.05, **p < 0.01, ***p < 0.001.

5 Discussion

As for content topics, previous studies have shown that the importance of the consistency between the topics of the contents a company posts and communicates and its business [45, 46], which, however, cannot be supported by the results of this study, since there is no business-related content posted and even R&D-related topic has a negative effect. Topics, such as education, health, environment/energy, and public policy, having no obvious connection with the main business of the sample companies, have triggered public participation. In addition to the impact of differences in the business context, industry characteristics may be another reason. Abitbol and Lee also pointed out that for some industries, the focus of stakeholders is not always related to the business of the company [14].

For FMCG companies operating in China, the customers and other stakeholders of these companies are mainly individuals, which means they tend to focus more on topics related to education and health to meet their personal development needs. <The outline of the national medium and long-term education reform and development plan (2010–2020)> points out that basic education derived from the masses will constitute a new driving force, new direction, and new characteristics for the development of China’s education policy development [47], which reflects the importance and necessity of universal education. In addition, the goal of further promoting educational equity [47] makes people pay more attention to the education-related topic and the distribution of educational resources. Similar to the topic of education, in the background of healthy China, people’s attention to health needs to be rooted in basic life [48], which also reflects the attention and promotion of the health-related topic on the state and society

level. Such measures also make the concept of health deeply rooted in the mind of everyone. Furthermore, for stakeholders, some common topics are very important [14], which are reflected in this study as environment/energy and public policy. The reasons may be the same as topics of education and health. Issues related to environment/energy and public policy affect people's lives, and people's understanding of the concepts of environmental protection and related issues are also increasing.

Another possible reason contributes to the fact that the study results do not support H1 could be under the specific business environment in China, the impact of company-cause fit on public engagement is not always positive. This may, to some extent, explain why the companies do not post CSR information related to their business. Zasuwa pointed out that the high degree of consistency between social undertakings and corporate business may arouse consumers' suspicion [49]. For example, Drumwright showed that when the relationship between the two is too close, consumers may think it is opportunism [50]. Such behavior may affect the company's reputation negatively. And the research conducted by Yoon, Gürhan-Canlı, and Schwarz showed that a company with a bad reputation blindly tries to correct its image by insincerely supporting a cause that is consistent with its business will only backfire [51]. The research conducted by Becker-Olsen, Cudmore, and Hill also proved that the high degree of consistency between the company's CSR activities or publicity and its business can make consumers lessen the consideration of CSR itself [32]. The findings of these previous studies can also explain why H1 is not proven in this study from another perspective.

Besides, the results show that some message formats of CSR-related content can indeed affect public participation [14], which could, to some extent, support H2. Specifically, content containing more links, graphics, and videos can get more likes, comments, and shares, and could be considered as user-friendly. Such a result supports the findings of previous studies that compared with text information, the publication of multimedia content can trigger more responses [41, 52]. Graphics and videos can more vividly convey the content the company wants to express and can attract users better. Users will also pay more attention to those posts containing some visual elements [14]. Therefore, companies could consider adding visual elements to the information posted online to promote public participation [14].

6 Conclusion

6.1 Theoretical and Practical Implication

This study has a contribution to both academia and management practice. The findings of the study fill the gap that scholars' previous attention to the relationship between CSR and public participation in China's specific business environment is neglected. It also illustrates that the view that CSR-related information consistent with the company's business can attract more public participation is not always tenable, which may be related to industry characteristics, the specific business environment, and some other factors. Moreover, the study points out that for FMCG companies operating in China, posting the information with topics such as education, health, environment/energy, and public policy can help the company obtain more public participation and enhance the CSR influence. Regarding dialogic strategies, the research results support the hypothesis that

user-friendly information formats could help obtain more likes, comments, and shares, promote public engagement [53], and point out that in terms of management practice, links, graphics, and videos are considered as user-friendly.

Overall, this study not only explores the CSR content topics that can stimulate public participation but also discusses how to post these topics more effectively. More CSR involvement will help the company achieve financial success [54]. Therefore, publishing CSR-related content on the social media platform, such as Weibo, to improve stakeholder engagement and its own CSR influence will help the company gain financial success.

6.2 Limitation and Future Research

The study has some limitations, the most obvious of which is related to the selection of sample companies, especially the sample size. We only selected companies from the FMCG industry for data collection and analysis, which may make the final results be affected by both business context and industry characteristics. Also, larger sample size may be able to cover more CSR-related topics, which should be explored as deeply as possible in this study. In future research, researchers can select more industries for comprehensive research according to the criteria mentioned in the third section, methodology. Besides, when conducting data collection, we found that some CSR-related contents posted by the companies are difficult to be classified into one or several categories, meaning the classification result is affected by the subjective judgment of us. Additionally, the study follows the method commonly used by previous scholars to describe the degree of stakeholder engagement by the number of likes, comments, and shares obtained by the posted content, which is not rigorous enough, since there is a certain difference between public participation in the network environment and the real world. The data obtained related to likes, comments and shares are objective, and cannot fully reflect the public engagement caused by stakeholders' subjective emotions, which means sentiment analysis is especially worthy of further discussion.

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Earned Income Tax Credit in the US and Its Inspirations for China's Personal Income Tax Reform

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Abstract. The personal income tax is an important tax tool for regulating income distribution. In order to alleviate the poverty of low-income people and further promote equity, it is necessary for China to further reform the personal income tax. This article introduces the details, operation mode and eligibility criteria of the US Earned Income Tax Credit, and analyses its effects in alleviating poverty, encouraging employment, reducing crime rates and maintaining marital stability. The article also discusses the feasibility of the EITC policy in China and provides a new idea for the reform of China's personal income tax, taking into account the current situation of China's personal income tax reform and social security policies for the low-income group.

Keywords: EITC policy · Personal income tax · Low-income groups

1 Introduction

It has been 40 years since China began to levy personal income tax in 1980. With the continuous reform and opening up, China's economy has been developing rapidly and tax revenues have been increasing, while at the same time the problem of uneven income distribution has become more and more serious. In 2018, the average value of net income per capita of low-income group households nationwide was RMB 3,775, while the average value of net income per capita of middle and high-income households was RMB 32,443, with a difference of 7.6 times between the two [1]. Not only in China, the issue of income inequality has long been of great academic concern worldwide, and low-income groups have been a focus of attention in various countries, with a specific SSI policy [2], Low-Income Housing Policy [3], and an Earned Income Tax Credit (EITC) policy involving personal income tax credits in the US.

Progressive personal income taxes and corporate income taxes reduce income inequality [4]. In China, personal income tax has always been regarded as an important tax tool for regulating income distribution, and its reform is of great significance. For a long time, China's personal tax reform has relied on raising the exemption amount for salary income to ease the pressure of reform, attempting to replace the overall reform through small fixes [5]. Until 2019, China implemented a new round of personal income

tax reform, which has made an overall design of the tax system. Firstly, the concept of comprehensive income was added, including four major categories of income: income from wages and salaries, income from remuneration for labour, income from remuneration for writing, and income from royalties, which will be combined to calculate individual income tax. Secondly, the change to annual income tax calculation for comprehensive income has reduced the cost of calculation and collection while better maintaining the principle of fairness in tax burden and improving the negative impact of the previous monthly collection method on people with unstable monthly income. Thirdly, the original “one-size-fits-all” deduction model has been changed and the scope of deductions has been expanded, i.e. the deduction for comprehensive income has been expanded from RMB 3,500 per month to RMB 60,000 per year. In addition to the deductions for social security and provident fund under the original tax law, the deduction has been expanded to six major deductions, including: social security insurance premiums such as basic pension insurance, basic medical insurance, and unemployment insurance, as well as housing provident fund, children’s education, continuing education, medical treatment for serious illness, housing loan interest or housing rent, and expenses for supporting the elderly. At the same time, the tax brackets applicable to the lower tax rate for comprehensive income were broadened and the tax brackets for business income were adjusted. These measures are important milestones in the history of China’s personal income tax reform, but there are still immaturities that need to be further improved so as to better perform its tax function.

The reform of personal income tax also inevitably faces the problem of measuring between fairness and efficiency. The personal tax reform in 2019, although effective in reducing taxes, has limited effect in strengthening fairness. Firstly, the scope of comprehensive income is limited, basically only items related to labour income are included, and there is inequity in the setting of tax rate tiers. After the new personal tax reform, China’s comprehensive income is taxed at a 7-tier progressive tax rate ranging from 3% to 45%. Compared to the 5%–35% progressive tax rate for business income, there will be a situation where a working class individual with the same income and an individual applying the business income tax rate will end up paying different amounts of tax. For example, if an individual sets up a studio and converts his labour remuneration into business income, the tax rate is 10% for comprehensive income and 20% for business income with the same annual taxable income of 100,000 yuan; if the annual taxable income is 1 million yuan, the tax rate is 45% for comprehensive income and 35% for business income, which is unreasonable. Secondly, although special deductions have been added after the reform, they are simply divided and are not related to personal or family income, especially for elderly support expenses, which are not related to the income of the elderly dependents or whether the taxpayer really needs to support the elderly, but only the age of the elderly as a condition for allowing the deduction. The impact of the deduction on tax liability is not related to income [6]. Finally, China’s latest personal income tax law still does not take into account the regional and household income situation, which varies from region to region in terms of economic development and price levels. In addition, there are differences in family structure, marital status and social security coverage among tax subjects, leading to differences in the actual cost of living, which makes the same provisions differently affect various tax subjects [7].

Therefore, the reform of China's tax law should continue to explore in depth the ways and types of deductions to further reduce the tax burden on the middle and lower income groups and to achieve tax equity. This article will provide some ideas for the future reform plan of China's personal income tax by comparing and analysing the US earning income tax credit policy and its effects from the perspective of China's current tax law situation and national conditions.

2 Earned Income Tax Credit Policy in USA

2.1 Key Contents of the Policy

The EITC is the largest cash-transfer program for lower-income families at the federal level [8]. In the US federal government's personal income tax system, if a taxpayer qualifies, he or she can deduct the calculated credit directly from the amount of tax paid, and receive a subsidy when the credit is greater than the amount of tax due. The EITC is therefore both a tax policy and a welfare policy.

More specifically, the EITC is a family-based tax credit with different credit rates depending on the number of children, labour income and marital status of the family, and the process can be divided into three stages. The first stage is the incremental stage of the tax credit, during which the credit is increased as the family's income rises. The second stage is the maximum tax credit stage, in which a household with a labour income that increases or decreases by one dollar has no effect on the tax credit it receives, which means it receives the maximum amount of tax credit. The third stage is the declining tax credit stage, in which the amount of tax credit received decreases at the rate of the credit as the household's labour income increases, until the tax credit is \$0.

With regard to their eligibility, applicants for the EITC policy need to meet a number of conditions. Firstly, applicants for the EITC must have earned income, including wages, salaries, tips and other taxable income, as well as gross income from business self-employment and farm self-employment, or in the case of joint filings, at least one spouse with earned income. Secondly, applicants without children are required to meet more conditions than those with children, and the income amount requirement varies depending on the number of children eligible for each family. Thirdly, married couples must file jointly and may not file separately. Fourthly, to qualify for the EITC, in addition to meeting the basic requirements, applicants must complete and submit a tax return, even if they do not owe any tax or are not required to file a tax return, and file an EITC return to obtain a tax refund.

In short, there are two main features of the EITC that are widely recognised by academics. First, only taxpayers can enjoy the EITC, which means that only those who have a minimum income and pay taxes can receive the benefits of the EITC [9]. Secondly, the EITC works through the tax system rather than the welfare system, and is usually in the form of a tax rebate, so there is no need to set up separate institutions and staff to administer it, and the administration costs are relatively low.

2.2 Policy Effects

EITC policy, as a new type of social welfare policy, can cover all people below the poverty line, with incentives for low-income families to work their way out of poverty as

the core. Through the tax credit system, it not only has the effect of regulating distribution through taxation, but also has a clear impact in promoting employment, alleviating social problems such as poverty, crime and marriage, with positive externalities.

Encouraging Employment. The EITC policy has encouraged a large number of people to participate in the workforce, especially single mother families. In female-headed families, employment rose by 14 percentage points, or 20%, from 1993 to 1999. Weeks worked rose by 7.2 weeks per year, or 24%, over the same period [10]. In terms of the operational model of the EITC policy, each additional dollar of income earned during the phase-in phase results in a certain amount of additional credit until it reaches its maximum, which can motivate groups that are able to work but not engaged in the labour force to participate in work, as well as incentivise low-wage workers to increase their hours of work. For women, especially those with a high school degree or less, even small week-to-week cost fluctuations, such as the need to stay home with a sick child, or transport costs, can lead to a reduction in labour supply when the net return to work is low. The implementation of the EITC policy increases the opportunity cost of their withdrawal from the labour market. These women still transitioned between employment and non-employment within the year, but less frequently than before [11]. The EITC policy has therefore significantly increased labour market participation, particularly by prompting a large number of single mothers to take part in the workforce.

Alleviating Poverty. Previous data shows that between 1996 and 2005, the percentage decrease in child poverty attributable to EITC generally increased (the highest percentage in 2005 was 19.5), while the percentage decrease remained relatively stable [12]. In 2010, among Americans of all ages, the EITC lifted more than 6 million persons out of poverty, and 3.1 million were children [13]. This shows that the EITC policy has made a significant difference in alleviating poverty, especially for poor children. Escaping poverty is not only good for children's well-being, but also for their physical health, better education and more opportunities to work for higher incomes when they become adults. At the same time, other policies, such as the CTC programme established in 1997, food stamps and the minimum wage system, provide additional assistance to people on low incomes. Thus, the EITC policy, together with these policies, has played a great role in helping families escape poverty, especially in alleviating child poverty and maintaining basic living expenses for families.

EITC is Likely to Have Other Benefits as Well. The problems associated with low income are usually crime rates, marriage rates, etc., in addition to employment as mentioned above. Although the relationship between wage rates and crime is difficult to disentangle (due to the many factors that affect crime rates), researchers have found that lower wages for less-educated people are associated with higher crime rates [14]. By implementing the EITC policy, it will enable this group of people to gain more security in their lives, while providing them with an incentive to participate in work to declare their taxes, which could theoretically reduce the number of people who commit crimes in order to survive and lower the crime rate.

Financial factors are an important factor in the marriage rate and the EITC policy of filing jointly will give couples a higher tax credit than filing separately, which will reduce

the low income barrier to marriage while avoiding the marriage penalty and helping to maintain the stability of marriages. It has also been shown that the significant increase in income support provided by the EITC has encouraged first-time births, although the estimated effect is small [15].

3 Implications of the EITC Policy for China

3.1 Current Domestic Policy

In China, the existing social welfare protection system for low-income people is The Minimum Living Security policy. As a Chinese citizen, as long as the per capita income of a family is below the minimum living security standard for local residents, they have the right to receive basic material protection from the local people's government in the form of a cash grant. In addition, low-income families also enjoy assistance in terms of housing policy and can apply for public rental housing and low-cost housing. The basic deduction expenses already mentioned above and the special deductions for personal income tax, although not policies specifically targeted at low-income people, also have a tax-reducing effect to a certain extent and ease the pressure on low-income people. However, research shows that the 2019 personal income tax reform will significantly reduce the income redistribution effect of personal income tax in China, with the MT index falling from 0.01273 to 0.00505, a drop of 60.33% [16]. The main reason for this is that the uniform criteria set by our 2019 reform policy does not distinguish between low-income and high-income groups, resulting in situations such as the deduction of more pension expenses for high-income groups than for low-income groups.

3.2 Inspiration for Policy Models

China should consider a new model to better balance efficiency and fairness, to enhance the effect of tax reduction, and to take advantage of the new model to regulate income redistribution and promote social equity, rather than just refining the existing policies and standards. In this regard, we can learn from the EITC policy, which abolishes the flat-rate deduction and sets the eligibility threshold for the deduction, and sets different stages for the tax credit, making it appear as an inverted "U" curve, playing the role of "raising the low, expanding the middle and controlling the high". This will help to maintain social equity while meeting the basic needs of low-income families. At the same time, China has not implemented a family-based filing system, except for children's education, where the deduction is fixed at RMB 1,000 per month per child, and other deductions are still a single fixed amount. In this regard, the EITC policy takes into account the actual burden of each family in a more reasonable way by setting different credit rates at different stages of the credit based on the number of children, labour income, and marital status of the family. It is also worthwhile for China to consider these detailed provisions in order to design reasonable tax incentives specifically for low-income groups and to achieve greater horizontal and vertical equity in taxation.

3.3 Advantages of the Policy Effects

In terms of policy effects, the current social security system and tax policies that provide relief to low income earners have only had the effect of reducing the burden on low income earners, but have not promoted their employment. However, the EITC policy has the effect of providing employment incentives for low income people in two ways. On the one hand, in order to qualify for the tax credit, low-income earners must be involved in the workforce, earn income and file tax returns. On the other hand, for those whose income is in the progressive stage of the tax credit, increasing their income from work will result in a higher credit and further increase the motivation of the worker. If China were to set similar entry thresholds and gradients, combining welfare with work, it would push welfare recipients into the job market, prompt them to work in exchange for welfare, and foster their motivation to become self-reliant, fundamentally improving the plight faced by low-income people. This in turn will have a positive impact on social issues such as helping poor children, reducing crime rates and maintaining marital stability.

4 Discussion

The United States is a country with a well-established tax system, with direct taxes as the mainstay and a high level of public awareness of taxation, whereas China is still at a stage where both direct and indirect taxes are important. If the EITC policy were to be directly transposed to China, there would be difficulties both in terms of the system and its operation, and it may not be suitable for China's national conditions. However, as the EITC policy works through the tax system, it saves administration costs and China does not need to invest too much money to build a new issuance platform. And China's tax system has continued to improve in recent years, with the official tax administration and personal tax declaration system application issued by the State Administration of Taxation coming into use at the end of 2018, which facilitates the process of declaring tax payments for the population, while providing a query service where taxpayers can check their information collection, declaration, tax payment and tax refund and other business processing, increasing taxpayers' sense of participation in paying taxes and thus enhancing their awareness of paying taxes. Therefore, it is feasible for China to learn from some of the concepts of the EITC policy. Based on the national situation, China can learn from its experience in dealing with equity and efficiency, promoting employment and fighting poverty, and further reform its personal income tax policy from the model.

There have been many discussions in the academic circle on the design of China's individual income tax system, the choice of tax units, the role of regulating income distribution and the function of fairness. Some scholars believe that in recent years, the State has implemented a greater policy of tax reduction and fee reduction, while the rapid development of China's economy has further weakened the regulation function of the original individual income tax on social income distribution, and the reform of individual income tax is also extremely necessary [17]. At the same time, there are also imperfections in our personal income tax policy on special additional deductions that need to be improved, such as the establishment of a family-based taxation system and the specific analysis of the criteria for special additional deductions [18]. This article takes a more nuanced perspective, analysing the operational model and effects of the

US EITC policy from the perspective of low-income groups, and provides an idea for future personal income tax reform in China, i.e. a policy of setting up special personal tax deductions for low-income groups, while combining the feasibility analysis with the new changes in the current domestic tax collection methods and propaganda to illustrate the logical feasibility. However, due to the lack of data on the implementation of similar tax policies in China, the article is unable to assess and measure this idea from a quantitative perspective. It is possible to further elaborate on how to conceptualise and formulate an EITC policy applicable to China based on the Chinese context and relevant policy content, as well as to establish an effect assessment model, collect and process data, and analyse the effects and potential problems after implementation, all of which are directions that can be continuously researched and explored in the future.

5 Conclusion

The EITC policy has provided a new way of thinking for China's personal income tax reform. It has largely alleviated poverty among low-income people, encouraged employment and played an important role in social issues such as crime rates and marriage. The EITC policy is also less costly to implement and administer, as the credit is returned to the worker in the form of a tax credit. The credit for poor people with different incomes follows an inverted "U" curve, which is conducive to promoting equity and realising the income adjustment function of personal income tax. In these respects, by learning from the EITC policy, China can improve the current situation of China's tax reduction policy weakening the income distribution function of personal income tax, focus on the cooperation between the tax credit policy and other social security policies, and include the consideration of family-based declaration, to promote the improvement of China's personal income tax system.

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Research on Brand Communication Strategy of Wuzhen Drama Festival from the Perspective of IMC Theory

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Abstract. In recent years, due to the limited quality drama resources in China, many drama festivals have the problems of assimilation, formalization and uneven quality. How to build the brand management mode of drama festival and combine it with art management and marketing has become an inevitable problem in the development of drama art. Based on IMC, Integrated Marketing Communication Theory, this essay will analyze Wuzhen Theatre Festival as a case, and provide effective suggestions for the sustainable development and operation of Theatre festival in China. Based on the audience-oriented consciousness, Wuzhen Theatre Festival produces diversified high-quality content, constructs clear brand image to promote the cross-border communication of drama art, and gradually improves the effect of mass communication by standardizing its own image identification concept. Based on the theory of integrated marketing communication, this paper makes a general survey of the brand construction methods of Wuzhen Theatre Festival, analyzes the ways of attracting audience participation and explores the path of the popularization of drama art.

Keywords: Integrated Marketing Communication (IMC) · Wuzhen Drama Festival · Brand construction

1 Introduction

In recent years, due to the limited high-quality drama resources in China, many drama festivals have the problems of convergence and formalization of content and uneven quality. How to build the brand management mode of drama festival and combine it with art management and marketing has become an inevitable problem in the development of drama art. Based on IMC, this paper will take Wuzhen Drama Festival as an example to analyze and provide effective suggestions for the sustainable development and operation of Chinese Drama Festival.

‘Drama Festival’ originated from abroad at first, and like all celebrations, it is full of vitality. In today’s popular and urbanized world, it belongs to a modern ‘primitive tribe’ that experiences life. As a kind of cultural festival, drama festival often requires the selected venue to have rich cultural connotation, set a fixed date, and present a series of unique holding modes. Wuzhen, as a water town in the south of the Yangtze River, is

based on the brand positioning of ‘Jiangnan Town, Mengli Water Town’ and adheres to the protection concept of ‘repairing the old as before’, which makes the local tourism develop newly, and Wuzhen Drama Festival gradually enters the public’s field of vision. Up to now, Wuzhen Drama Festival has been successfully held for seven times. Wuzhen Drama Festival can be regarded as a platform for the exchange of drama art, which conforms to the tide of times integration and the trend of cross-border integration in the new era, and combines tourism culture with theater drama, so that the development and operation mode of the drama festival gradually changes from the appreciation of the masses to the dissemination of mass culture. Wuzhen Drama Festival can be regarded as the main force in the process of cultural Wuzhen construction. Organizers effectively carry out brand integration marketing communication, which has risen rapidly in recent years, creating an internationally renowned drama festival brand and showing its great vitality [1].

2 Literature Review

In the late 1980s, the basic concept of IMC was put forward by Keith Reinhard, then president of the American Federation of Advertising Agencies, and John O Toole, executive director, in conjunction with Professor Donschulz of the Meldy School of Journalism of Northwestern University.

Integrated Marketing Communication (IMC) is a hot research field in marketing and advertising, which unifies all communication activities related to marketing conducted by enterprises, and enables enterprises to convey unified communication information to customers. The core idea of IMC is to meet the needs of customers through the communication between enterprises and customers, determine the unified promotion strategy of enterprises, coordinate the use of various means of communication, and give full play to the advantages of different means of communication, so that enterprises can realize the low cost of promotion and publicity, and form a promotion climax with high impact.

With the change of marketing environment, a group of scholars who studied advertising, public relations, promotion and marketing began to study IMC. A large number of schools began to include IMC in degree courses, and trained a large number of IMC research experts. Their works with different styles greatly enriched the theoretical research results of IMC [2]. Since then, the concept of IMC has been spread in the world, and has gradually evolved into the communication strategy of many companies. The concept of IMC first appeared in China in 1995, and Professor Lu Taihong first systematically analyzed the theories closely related to integrated marketing communication, and made case analysis. With the promotion of social development, more and more experts and scholars in the industry have begun to conduct in-depth research on the integrated marketing network communication strategy [3].

Since then, IMC has been popularized and developed continuously, and gradually evolved from theoretical analysis on paper. More and more industries have integrated it into practice and application. At present, China’s Integrated Marketing Communication Theory has not yet formed a universal practical mode, and its theoretical framework still needs to be improved. The practice of IMC in China’s domestic market needs further

research and improvement. With the development of the times, the integrated marketing theory needs to be combined with social progress, conform to the tide of development of the times, and especially need to transform into a marketing model suitable for local application and development in China, and combine it with China's national conditions to better promote industrial development.

3 Probe into the Brand Construction Path of Wuzhen Drama Festival

In this paper, through case study, aiming at the brand marketing strategy of Wuzhen Drama Festival, a localized drama festival in China, we sum up the reasons for its successful development from niche to the public's field of vision. Combining IMC theory, we analyze from the aspects of brand construction and marketing communication path, and analyze how drama develops from niche art to mass and gradually enters the public's field of vision. Explore the future marketing mode of the drama festival, and put forward some suggestions for the innovative development of the drama festival in the new era.

3.1 To Create a Variety of High-Quality Content Based on Audience-Oriented Awareness

IMC emphasizes the establishment of consumer-centered audience-oriented consciousness, audience analysis, target groups and target markets. Audience-oriented refers to taking the audience as the center and defining the needs of the target population, so as to accurately establish the media positioning and communication principles suitable for the brand, safeguard the fundamental interests of the audience to the maximum extent, and meet the needs of the audience for obtaining various information. However, in our country, the audience-oriented consciousness is usually mechanically copied and over-rendered. Enterprises do not really understand and apply the audience-oriented consciousness to adapt to the development direction of their own brand construction, which leads to its drawbacks.

Wuzhen Drama Festival is supported by Wuzhen Tourism Co., Ltd. and sponsored by Culture Wuzhen Co., Ltd. In the process of brand formation and development, Wuzhen tourism industry combines tourism with culture and art with Wuzhen Drama Festival as the source, and takes 'Culture Wuzhen' as the construction concept, providing audiences with an art town that not only has beautiful scenery of Jiangnan water town, but also contains profound cultural details. In addition, the simultaneous Internet Conference, Wuzhen International Contemporary Art Exhibition and Wuzhen Drama Festival complement each other, and they are all based on the audience-oriented consciousness, and carry out innovation on the premise of meeting the audience's requirements, which makes the audience shine at the moment, and Wuzhen and its cultural industry are deeply rooted in the hearts of the people.

Every year during Wuzhen Drama Festival, Wuzhen Tourism provides tourists and drama lovers who come to participate in Wuzhen Drama Festival with one-stop strategies such as eating, living, traveling and watching dramas in scenic spots, which makes the audience no longer need to spend time and energy searching and making travel strategies

by themselves, but better immerse themselves in drama and enjoy the unique experience formed by the combination of drama art and traditional town life. More than ten hotels and homestays are scattered all over Xizha Scenic Spot in Wuzhen, and different decoration styles, price points and room types are presented in Wuzhen Tourism official website, which is convenient for tourists to choose the most suitable accommodation environment. Midnight Food Store, 24-h convenience stores, etc. guarantee the dietary basis of tourists during Wuzhen Drama Festival, and ensure that they can also have a hot meal after watching the drama in the middle of the night, so as to solve their worries and make them feel at ease in enjoying the drama. Wuzhen Drama Festival, as a carnival feast for dramatists, is a paradise for drama lovers. The 10-day drama festival every year attracts people who love drama and pursue art at home and abroad. Whenever this happens, Wuzhen becomes another destination for dramatists. In the design of the main structure of the drama festival, Wuzhen Drama Festival is also maintained and expanded according to the audience positioning, and has carried out relatively perfect basic work. Wuzhen Drama Festival creates various plate-type activities, and its main content is divided into 'Special Drama' unit and 'Ancient Town Carnival' unit. Among them, the special drama is that the artistic director of the current drama festival invites the world-class drama works to Wuzhen to present splendid interpretations to the audience, presenting a more diverse picture of world drama. On this basis, it provides a wider choice for different audiences, such as providing more professional performance stage and learning space for young dramatists, and creating a 'Youth Competition' section. In addition, setting up a 'Small Town Dialogue' section will establish a closer connection between outstanding dramatists and the public, so that audiences can sit around and talk face to face with dramatists, and conduct in-depth discussions on dramatic art. Moreover, the modules of the Drama Festival are becoming more and more abundant in each session. On top of the four basic sections, more diversified and communicative activities such as performance workshops, drama master classes, drama international seminars, drama readings, and youth summit of critics association of the International Drama Festival are added. During the annual Wuzhen Drama Festival, the whole town turned into a Utopia of drama, where only the audience could not expect it, and there was no unique atmosphere that Wuzhen Drama Festival could not create. Wuzhen Drama Festival is based on the concept of audience-centered, which not only brings the world's top quality plays to the audience, but also encourages a new generation of young people to bring their independent original works to the drama stage in Wuzhen, presenting the audience with a variety of drama artworks to choose from.

Different audiences will have different understandings and attitudes with the same communication content, and the audiences themselves can distinguish the companies that provide diversified plays, and then have psychological positioning for different theaters and different plays, and regard them as a brand [4]. The brand of Wuzhen Drama Festival is also the same. With content marketing as the cornerstone, the accurate positioning of theaters and plays that meet the audience's psychological expectations makes them carefully designed and built in the course of the festival, and plays drama works consistent with the brand image for the audience. These carefully designed and built processes are usually accompanied by the appearance of a series of brand communication activities, and the audiences have different influences on different brand communication activities

[5]. Wuzhen Drama Festival is rich in diverse activities, and its major sections widely contain the possible interests of different audiences, providing a wider choice for all types of drama lovers and creating a drama feast in an all-round way.

3.2 Cross-border Communication with Clear Brand Identity as the Goal

Kotler, an American economics professor and father of modern marketing, once said, 'The peak of marketing lies in the complete integration of 3I'. ('3I' refers to brand logo 'Identity', brand ethics 'intertrigour' and brand Image 'image'). By defining the brand logo uniquely and clearly, we can strengthen reliable brand ethics, build links for brand communication through multiple channels, Intergrity the communication process of brand image, and finally establish and form a strong brand image of the enterprise. The brand image positioning of drama festival refers to the marketing decision which is produced and carried out on the basis of the positioning of drama works and market, and which is integrated and determined by the cultural values, uniqueness and applicable marketing strategies of its own art brand. Brand image is often unique and easy to identify, which is conducive to the audience to identify the brand in the shortest time and enhance the brand value.

'Brand recognition is what brand marketers want to create and maintain, and it can arouse people's association and expectation for the brand's beautiful impression. 'Wuzhen Drama Festival brings together the most influential professionals in the domestic drama market at present, which constitutes an extremely prominent and easily recognizable brand symbol, and satisfies certain commitments of enterprises to consumers. The jury of Wuzhen Drama Festival is composed of Huang Lei, Huang Lei, Lai Shengchuan, Meng Jinghui, Tian Qinxin, Naizhu Ding, Shi Hang, Zhou Liming and others, and the Arts Committee is composed of He Huan, Liu Heng, Li Liqun, Pu Cunxin, Sun Honglei, Xi Meijuan, Yu Hua, Yuan Quan and others. They are undoubtedly the leaders of domestic drama art in terms of personal artistic achievements and social influence, and their combination shows. In this way, the celebrity effect also attracts a group of 'fans' who can't be underestimated for Wuzhen Drama Festival. The drama audience is no longer just professional drama workers and lovers, but more ordinary people have the opportunity to learn about the existence of Wuzhen Drama Festival. In addition, Wuzhen Tourism Co., Ltd. invited Rene Liu to be the spokesperson of Wuzhen's image, and filmed and produced promotional films, so as to create the image of Wuzhen as a livable town in the south of the Yangtze River. Celebrity effect has attracted a huge audience, which gives more people the opportunity to know and participate in the drama feast. It enriches the audience level of Wuzhen Drama Festival and makes it more meaningful. It also makes Wuzhen Drama Festival highly professional and takes into account the benefits brought by its brand construction and communication.

In the process of corporate brand formation, Wuzhen Drama Festival combines brand identification with audience training, which not only deepens the brand identity of Wuzhen Drama Festival, but also attracts more potential audiences, thus promoting the growth of cultural consumption. In addition, Wuzhen Drama Festival combines the development trend of trendy Internet and new media, expands various communication channels, and integrates various media. Wuzhen Drama Festival has set up an official website and built a new media matrix on several new media platforms, such as WeChat,

Weibo, Tik Tok, bilibili, Xiaohongshu and Douban. While building its own brand and shaping its brand image, it has also established the most direct and effective communication with the public through the network, so that the business philosophy that the brand wants to convey and the information that the public wants to obtain can reach the audience directly through the platform. In Wuzhen Drama Festival, the communication content and communication tools are ingeniously integrated, and at the same time, the brand integration strategy of vertical and horizontal integration is established. Besides the audience interactive communication among major new media platforms, the organizer feedback mechanism is introduced, and the direct interaction between official accounts and fan audiences and the interaction among fans are convenient for them to get feedback. On the other hand, Wuzhen Drama Festival is also well known by more and more people.

In addition to building a communication matrix on the mainstream new media platform, Wuzhen Drama Festival is cross-border combined with multi-industries, integrating the communication process by means of tourism + drama, variety + drama, and promoting the drama together. Wuzhen, Tongxiang, where Wuzhen Drama Festival is held, has an excellent geographical advantage, which is the core area of cultural and economic development in the Yangtze River Delta region. The relatively independent water town ring also provides favorable conditions for the development of local art industry and the re-creation of regional cultural economy. While developing its main industry tourism, Wuzhen Tourism Co., Ltd. gave attention to the development of cultural industries such as Wuzhen Drama Festival, which promoted the integration and complementarity of Dewu Drama Festival and local tourism, and ingeniously transformed some tourists into audience objects of Wuzhen Drama Festival. In turn, fans of Wuzhen Drama Festival also expressed their yearning for Wuzhen through various platforms of Wuzhen Drama Festival, and promoted the development of local tourism in Wuzhen as tourists during the annual drama festival. As the preferred leisure way for a large number of young people to relax and decompress at present, the combination of drama and variety has undoubtedly made an unprecedented cross-border, attracting more audience attention. When the information disseminated by the enterprise is consistent with the information in the audience's brain or the information interacts with external sources, the brand communication efficiency established by the enterprise will be improved [6]. Whether it is drama + tourism or drama + variety show, it is in line with IMC's integrated marketing concept, building brand identity, attracting public attention and promoting communication.

3.3 Improve the Communication Effect by Standardizing the Concept of Image Identification

In the process of brand image construction and brand logo construction, enterprises need to clarify their core values and positioning first, and then coordinate and integrate various resources, so as to promote the standardization and systematization of brand construction and realize the IMC concept of 'one voice, one image' [7]. Wuzhen Drama Festival establishes a theme every year, and cooperates with leading figures in various sectors of society. Through system restriction and standardization, it ensures the smooth cooperation and accurately reflects its own value and core positioning. Every year, according

to the established subject, Wuzhen Drama Festival invites domestic famous designers to provide the main visual poster design, and spreads the brand culture by selecting the audience's most direct sensory point-of-vision, and spreads the brand image with posters with great sense of design.

Brand image construction and logo construction are usually accompanied by value transmission. Audience is not the creator of value, but the active decoder in the process of brand value transmission [8]. Different communication channels and media usually have different communication characteristics, and different audiences and different communication needs need to adopt different communication methods to meet the communication effects required by enterprises. In the process of account operation and maintenance of all major platforms, Wuzhen Drama Festival publishes content according to different media platforms and different emphases, adjusts its content according to the characteristics of platform users, adapts to the tonality of different platforms, and produces works suitable for platform development and push. It makes full use of the platform to position itself and promote itself, so as to avoid duplication and consistency of content. Wuzhen Drama Festival usually updates and publishes the most authoritative and timely information in its official website, making official website the main platform for the public to fully understand information and the representative of network media communication of Wuzhen Drama Festival. Unlike official website's single sharing information dissemination characteristics, Wuzhen Drama Festival has invested a lot of time and energy in operating mainstream new media platforms in recent years. At present, WeChat of Wuzhen Drama Festival has cultivated a huge audience, and its pushed information and communication methods are more life-oriented, which conforms to the reading habits of current WeChat users. At the same time, Tik Tok and bilibili serve as the video communication platform of Wuzhen Drama Festival, setting up different content orientations and interacting with the public. Tik Tok focuses on publishing short videos, such as 30-s shearing of Wuzhen Drama Festival plate and sharing of food exploration shops in Wuzhen scenic spot. With the help of the short and fast rhythm of Tik Tok, Wuzhen Drama Festival is out of the circle, making more and more audiences know Wuzhen Drama Festival. Bilibili focuses on making and publishing long videos, which are updated more frequently than Tik Tok, and the content is more lively. Weibo often interacts with the public by launching activities and topics, bringing tag, and the audience will intentionally or unintentionally help the secondary dissemination of the brand content of Wuzhen Drama Festival through corresponding interactive forwarding, thus more powerfully promoting the construction of the brand image in the public consciousness. Through these interactive platforms, the audience can further understand the relevant contents of Wuzhen Drama Festival, which is conducive to shaping its own brand image and enhancing brand communication. In addition, Wuzhen Drama Festival not only makes the dramatists 'variety', but also shows the true nature of drama through variety, standardizes the brand image of drama and enhances the communication effect. Watching variety shows is one of the favorite ways for young people to relax and decompress. Wuzhen Drama Festival combined with iQIYI to create the first drama variety show in China, which was officially launched on the online video platform in January 2021. Taking Wuzhen as the shooting place, the program focused on the artistic creation, live performance and life of Chinese dramatists, and recorded the whole process of life rehearsal of eight professional and

'minority' dramatists here, thus creating an artistic and immersive experience atmosphere. At the same time, by using the visual montage technique of switching back and forth between drama and life scenes, it combined the obscure drama art in the usual public cognition with the entertainment of variety shows, and enlarged the charm of drama to the audience, making it both literary and artistic. Minority cultural variety show is the continuation of culture under the background of the change of media environment and the development of Internet technology. Drama New Life collides minority culture with popular variety show, and promotes the formation of multidimensional cognition of drama culture through scene presentation and scene shaping. Before the combination of drama and variety shows, there were precedents that minority cultures such as hip-hop, Bel Canto, and talk show had been popularized and 'broken the circle' through the form of reality show. 'Drama New Life' narrowed the distance between drama and the public, and further provided a new reference train of thought with reference value for the popularization of minority cultures [9]. Wuzhen Drama Festival skillfully extends the concept of 'drama' by means of variety, and narrates the life of drama through the screen lens in the media form that the audience likes and is the most acceptable. Taking eight drama people as the epitome, the whole drama production group's love for drama industry is conveyed to the audience, causing resonance, so that more audience can see the talents and bright spots of drama workers.

The prosperity of drama culture is indispensable to innovation and value transmission. It is not limited to form, but based on cultural heritage and understanding of life, through the diversity and professionalism of Wuzhen Drama Festival, it brings a heavy sense of drama history, interprets the artistic understanding and display of contemporary dramatists, and conveys correct values to the audience and maintains the brand image.

4 Discussion and Conclusion

The penetration of drama into modern life is immeasurable. Just like the integration of tradition and modernity in Wuzhen, the holding of drama festival has a direct impetus to the development of local culture and society. Wuzhen Drama Festival is based on audience-oriented consciousness, which produces diversified fine content, builds a clear brand image to promote the cross-border communication of drama art, and gradually improves the mass communication effect by standardizing its own image identification concept. Based on the theory of integrated marketing communication, this paper makes a general survey of the brand construction methods of Wuzhen Drama Festival, analyzes its attraction to the audience and explores its popular path of drama art.

Summarizing the successful experience of Wuzhen Drama Festival, we can see that only by following the noumenon law of mass communication, constantly enhancing their audience-oriented consciousness, establishing the target market with the help of audience's subjective initiative, formulating the appropriate communication direction and principles, establishing the brand image and integrating and standardizing the communication, can enterprises ensure their steady development and gradually move towards success.

Although there are some shortcomings in the development of Wuzhen Drama Festival, it is now fully applicable to provide development guidance and reference for other

drama festivals in China. Only by aiming at prospering the drama career, cultivating drama creative talents, improving the artistic level of drama works and expanding the drama market, and combining IMC, formulating the correct communication strategy and exploring the most suitable development concept, can the development of Wuzhen Drama Festival help China's drama art become more popular, enhance the national artistic quality and promote the social art tide.

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The Impact of BYTEDance's Development and Strategy on the Information Industry

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Abstract. With the rapid development of Information technology, the distance between people to people become more and more closer. Information technology allows people to contact with other at anytime and anywhere, which makes people life colorful. Especially the social media softwares are now frequently used by people around the world. Those new media now are not just a way to contact with people, but people could use it do various things. Therefore, this article investigates the most popular social media application's company, which is Tiktok' company, ByteDance, in order to analyze their strategy and why they become dominant in the market. The article uses Porter Five Forces to learn about their competitive rivalry in the market and Product lifecycle to find which stage is the company current in. The result shows that ByteDance are in the growth stage and thanks to ByteDance first-mover advantages which allow it become dominant in the market. No only that, the article also predict the development of ByteDance future and indicate that the future of it is would be fantastic.

Keywords: ByteDance · Social media · Porter five forces · Product lifecycle

1 Introduction

New Media is changing with the technology development, everything that related to internet or online communication could be considered as new media [12]. In contrast, the old way to gain information such as reading the newspaper is seems as old media. It is obvious that the new media is gradually become the main stream in current era. The new media are exist everywhere in people's life, on TV, on mobile Phone, on computer and so forth. Social media is the representative of new media, which allow people to contact, to share. Moreover, social media are the main product for people to entertain themselves.

Social media are experiencing a dramatic development now since it is popular with not only young people but older people also become rely on this. There are various social media platform are gradually emerge into the market, some did well in attracting people but some cannot draw people's attention and forgotten by people. But there is one social media are well-known around the world, which is Tiktok or in Chinese called "You Yin". Tiktok's company is ByDance, it is not the first video-sharing platform, but

it is the most successful one. Hence, it is important to learn about how they dominant the market and how they marketing themselves to be such successful.

Since it is an information era now, people's life are strong cohesive with those technologies. So it would be helpful to know about the development of some information technology company in order to better predict the future trend in terms of the new media. This article takes ByteDance as an example to investigate how the strategy of a company influence its market competitiveness by using some specific competitiveness analysis method such as Porter 5 Forces and Product lifecycle, which help consumer learn about how a company could become competitive in a market and thus earns a large portion in that market.

All in all, social media have strong influence on people's life, ByteDance is the best example to do the analysis to learn about the new media marketing strategy. By using Porter Five Forces and Product Lifecycle to investigate which analysis the company competitiveness in many different situation and the article also mention their future development at the end.

2 Literature Review

ByteDance is one of China's most influential high-tech information technology companies. It was also named "the world's most valuable start-up" [1]. Its occupies a large place in China, but the products are also widely used in the world. Its product TikTok was the most downloaded of any video-sharing software in 2020 [2]. So ByteDance will become a mainstream company in the information industry in the future. Its products have a large possibility of becoming the most widely used social media platform in the future.

ByteDance focuses on the development of information technology. With Tiktok, Toutiao, Xigua video, and other social media and video sharing software as its main service products, it provides high-quality video content and information. At the same time, its products have a place in the online education industry, the game industry, and the food delivery industry. ByteDance target audience is people who are adept at using mobile phones and other electronic devices and committed to social media as a tool for leisure and entertainment.

ByteDance occupied a large portion of the high-tech communication industry. The company, founded in 2012 and officially launched Toutiao in the same year, started financing Toutiao in 2013 and continued to grow and invest in the following years (investing in The Indian versions of Toutiao "Dailyhunt" and Imaginechina in 2016). Douyin was launched in September 2016, Tiktok and Vigo Video was launched in 2017. ByteDance mainly focuses on online social media services; the company is now developing fast and continuously expanding its business areas [3].

Their mission is inspire creativity, enrich life and claim to build a global platform for creation and communication. Their target consumer are mainly concentrated on teenagers and young adults.

3 Data and Methodology

Porter Five Forces is a method to analyze a company's advantages and drawbacks, it could use to identify the makers structure so that the company could determine their market strategy. There are five parts of Porter Five Forces: the Bargaining Power of Buyer, the Bargaining Power of Suppliers, Threats of substitutes, the Threats of New Entry and Competitive rivalry [10]. This model could be applied in many economic structure, so the article use this method to analyze the market competitive environment of ByteDance to better understand their strategies that how they increase their competitive advantages.

Product lifecycle is another method to analyze a company. There are four states in product lifecycle: introduce, growth, maturity and decline. The product lifecycle could help people predict the potential profits of a product in the future [7]. About the Product lifecycle, ByteDance is in the growth stage. They are expanding its market in various areas. Although ByteDance has gained significant market share, it still expands its international market and promotes other development areas such as food delivery [5], game [8], AI chips, etc. [13]. They want to become more competitive and attract more users.

4 Discussion and Analysis

4.1 Porter Five Forces Analysis

According to porter five forces of ByteDance competitiveness in market, the Bargaining Power of Buyer of ByteDance is high, because advertising is a key part of ByteDance income revenue, and Douyin is the largest video software in China. Many advertisers and people want to use this platform to propagate their products. Also, the Bargaining Power of Suppliers is high since consistent supply of high-tech program such as data analysis and security is very crucial to ByteDance. Threats of substitutes is high also because other high-tech companies that existed for many years might easily imitate ByteDance products. However, the Threats of New Entry is low due to its first-mover advantage. It earns a large portion of the market already. Hence, later company could not quickly surpass the popularity and influence of ByteDance. Therefore, the overall Competitive rivalry is medium. Although ByteDance is mature and has a large market share, and it's hard for other companies to compete with it. But established companies may try to copy Douyin to gain an audience.

4.2 The Uniqueness of ByteDance

ByteDance's success is due to its strong uniqueness and user-friendliness. Compared to other platforms, people only need to scroll a finger to watch a video on Tiktok. People don't need to choose a particular video to watch, but Tiktok will automatically push content that users may be interested in according to their preferences (likes, comments, shares), which undoubtedly brings great convenience to users [9]. And its time slot allows users to take advantage of the fragmented time for entertainment and relaxation. Not only that, it is not limited to video sharing software, and it is multi-functional

software. It can share its daily life, communicate with friends, and sometimes even act as a search engine and e-commerce shopping platform [6]. Besides Tiktok, ByteDance's other products, such as Toutiao, also push interesting content to users based on its sophisticated calculations. ByteDance also provides content related to users' cultural domain based on where they live [9]. This not only increases user interest but also makes people more engaged with the product. ByteDance's success in internationalizing Tiktok as a company in a transition economy is due to its creative business model: the move up of value chain and innovativeness [11].

To sum up, ByteDance's success in capturing a significant market share can be summarized as follows: First, it is due to its unique features, which are the combination of social networks and video sharing platforms. Secondly, Douyin took the lead in the domestic experiment and got a good response, then tested and upgraded, and finally pushed to the foreign market to ensure the user experience and the use of functions [9]. Finally, the precise prediction of user preferences, which ensures a high degree of user engagement.

4.3 Current Strategy of ByteDance

The current strategy of ByteDance is to scan the commercialization and frontier trends of major domestic and foreign Internet segments and key companies, and explore new business models and opportunities. Conduct in-depth research and analysis on critical commercial realization areas, develop business plans, provide suggestions for business growth and follow up the implementation. Daily monitoring and data analysis of various business indicators of the business team, and give corresponding solutions. Follow up the existing business development trend and provide business strategy suggestions based on industry development and data analysis [4].

5 Conclusion

ByteDance is influential in the world today, and its rapid growth cannot be ignored. Based on porter's five Forces, ByteDance has the advantage of Buyer power and the threat of new intruders. Thanks to its first-mover advantage, advertisers and Internet celebrities are eager for such a big platform to promote themselves, and more and more celebrities and news media have joined Tiktok. Other media unmatch the popularity gained on Tiktok, and the cost of switching platforms is high. Also, user engagement is exceptionally high. Because of its uniqueness and precise grasp of user preferences and its considerable number of users, it isn't easy to surpass quickly. Furthermore, ByteDance does not limit itself only to social media platforms. They have a place in the educational and game industries and plan to enter the food delivery market. They cover a wide range of areas, and each product can attract a variety of different users.

Therefore, ByteDance is a great example to inspire other companies to increase their market advantages. Other companies should more focus on catch users, to catch their preference precisely and offer more convenient experience when the users are using their products. They could uses some advanced technology such as users' data analysis to better know about the users preference and provide them their favorite content. This

could help the users more and more rely on their products and increase the products' unique. Moreover, other companies can also expand their product range when they reach a certain number of users like ByteDance. This could help them better promote and increase user engagement.

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Influence of Covid-19 on Consumption Related Industries of US Stock Market

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Abstract. Plenty of scholars have made great contributions to asset pricing theory and continue to try to find the best model to obtain the average return of stocks. This paper evaluates the influence of COVID-19 on the consumption related stocks of the US stock market and explores the possible reasons by using the Fama-French 5 factor model. The results indicate that three industries related to consumer goods have significant changes in the Fama-French **five** factor model before and after COVID-19. The most obvious change is the smoke industry. Besides the SMB factor, the four factors have increased significantly. It is worth noting that the sensitivity of food, beer and smoke industries to MKT factor has increased significantly after the epidemic, which makes the consumer related industries more closely connected with the market. At the same time, redundant factors inevitably appear in the research, such as HML factor in food industry, SMB factor in smoke industry and HML, RMW and CMA factor in beer industry, which provides a reference for the investment in these industries.

Keywords: Fama-French 5-factor model · COVID-19 · Consumption-related industry

1 Introduction

The outbreak of the novel coronavirus pneumonia came unexpectedly at the beginning of the 2020, which has a major impact on the normal operation of the global economy, especially for some industries. In the course of human development. Infection diseases usually have a great influence on economic and social development in a certain time and space, and even have a more far-reaching impact, which will inevitably affect the stock market. The wild swings in financial markets were caused by gloomy expectations about the global economy. The U.S. stock market has been hit four times in a row, leading to one of the most tragic crashes in history. Stock markets prices in other major European and American countries have also fallen by 25% in a month, turning into a bear market.

American scholar William sharp and others developed the capital asset pricing model in 1964. It largely investigates the connection between the expected rate of return of assets and risky assets in securities market and the way equation price is generated. It to a great extent explores the connection between the normal pace of return of assets and risky assets in security market and how balance cost is produced. It is the foundation of present

day monetary market hypothesis, broadly utilized in venture choice and undertaking monetary administration. The capital asset pricing model is based on Markowitz model, in which the conceptions of Markowitz model are inbuilt. Afterwards, a three-factor model was published by Fama and French in 1993. Later, these two people found that on top of the above risks, there is also a profit level risk. The level of investment can generate excess returns for individual stocks, and a five-factor model was published in 2013.

There are some articles studying the affect of COVID-19 on the stock market from different angles. For instance, Salisu, ebuh and Usman conducted research on a specific industry - the oil industry. They provide some rudimentary results on the behaviour of oil-stock nexus during the pandemic. Thanks to data constraints, a panel value-at-risk model was constructed to perform short time series dimensional analysis while aggregating stock price data for some countries (cross sections) more severely affected by Novel Coronavirus-19. Salisu, Ebu and Usman modeled shocks and cross-shocks to oil and stock prices and found that the impact of novel Coronavirus-19 post-release shocks on oil and stocks was more significant, although the former had a greater impact. In addition, the Panel Logit model is used to assess the probability of negative returns for oil and equities during the pandemic. The probability of negative returns for oil and equities was higher before the announcement than after it. As shown by the impulse response function, the negative returns recorded in the latter period seem likely to be driven by panic/uncertainty in their respective markets [1]. Because of Coronavirus on arising markets, Topcu and Gulal checked into the effect of COVID-19 on arising securities exchanges between March 10 and April 30. Results show that the adverse consequence of pandemic on rising securities exchanges has continuously fallen and started to drop away by mid-April. In the field of territorial order, the effect of the episode has been the most noteworthy in Asian developing business sectors, However, emerging markets in Europe have encountered the least. Likewise, official reaction time and the public authority's boost bundle will be basic to counterbalance the effect of the episode. In order that they can understand the growing effect of the pandemic over time, the sampling period, in addition to the full sample, was divided into three subsamples. The Driscoll-Kraay estimator is used [2]. Baker, S.R. et al. concentrated on the extraordinary financial exchange response to COVID-19. Past pandemics have left only a slight traces on the U.S. stock market. There is evidence that government regulations on business movement and deliberate social removing, which play a great role in the service economy, are the main reasons why the US stock market reaction to COVID-19 has been far stronger than in previous pandemics in 1918–1919, 1957–1958, and 1968. The method is to quantify the contribution of COVID-19 to the overall volatility of the US stock market [3]. Harjoto and Paglia studied the stock market reactions to the strike and animation caused by covid-19. As a result, COVID-19 has had a negative impact on global stock markets, especially in emerging markets and small companies. Contrasted and other created nations and developing business sectors, the US stock markets has encountered a positive and unusual bounce back brought by the Federal Reserve's improvement plan. The positive and strange gets back from the improvement plan were acquired by huge American organizations as opposed to little ones. The MSCI AXWI stock index (MXWD) was used as a market benchmark for developed and emerging markets and was only used in the United States

and developed countries outside the United States. The S & P 500 index is used as a market benchmark for large cap stocks (MXUSLC) and small cap stocks (MXUSSC) [4]. Xu checked into the dynamic response of stock returns to unprecedented changes in COVID-19 -19 cases and the uncertainty associated with pandemic. He used the data from Canada and the United States. As a result, in general, the increase in COVID-19 -19 cases had a negative impact on the stock market. In addition, in the Canadian case, the increase and decrease of stock returns are asymmetric. This lopsidedness is brought about by the adverse consequence of pandemic vulnerability. Furthermore, vulnerability antagonistically affects the US financial exchange. Nonetheless, the size is little [5].

Some scholars have investigated the effect of COVID-19 on the specific market, or the application of the Fama-French 5-factor model in specific markets. Connor and Sehgal examines Indian stock markets empirically. There is evidence that market, size and book value factors are ubiquitous in Indian stock returns. Connor and Sehgal tracked down that the cross-sectional normal yield is clarified by the danger openness of these three variables, not simply market factors. In addition, there is mixed evidence that parallel market, scale and Book P/E ratio factors exist; there is no responsible connection between the common risk factors in earnings and those in stock returns. There is no mindful association between the normal danger factors in profit and those in stock returns. In a word, the empirical results are reasonably corresponding to the Fama-French three-factor mode. The stock price data includes the month end adjusted stock prices of 364 companies from June 1989 to March 1999. Based on these prices, the monthly yield series can be observed up to 117 times [6]. COVID-19 crisis may impact on Asian stock markets through Alana and Quiroga's statistical characteristics of three Asian financial markets: Southeast Korea composite index, Japan Nikkei 225 index, and China's Shanghai, Shenzhen, Shanghai and Shenzhen 300 index. Using the fractional integral method, based on the result table of daily data, tomorrow's jing225 index has the transient effect of mean regression and impact [7]. As for the comparison between Fama-French three-factor model and Fama-French five factor-model, Bergram and Goransson compared the interpretation rates of three asset pricing models related to the excess return of Swedish stock market. The factors of each model are also evaluated in more detail. Capital asset pricing model, Fama French three factor model, Carhart four factor model and Fama French five factor model are used. The results show that the performance of FF5 is better than that of cffm and its predecessor FF3. In addition, FF3 and cffm perform quite well in explaining portfolios classified by size and B/m, while they generally perform poorly in explaining portfolio changes classified by size and operational profitability or investment. The outcomes show that Fama-French five-factor model is better and more consistent [8]. For the exact trial of Fama-French five-factor model, Fama and French concentrated on worldwide business sectors, uniquely, the four areas NA, Europe, Japan and AP to test the five - factor asset pricing model. The variations of 5-factor time-series relapse were utilized. Normal stock returns for North America, Europe, and Asia Pacific increment with the B/M ratio and benefit, and are contrarily identified with venture. As in Japan, the connection of normal returns and B/M is solid, yet normal returns show little connection to benefit or venture. A 5-factor model that accelerates productivity and in-garment variables to the three-factor model of Fama and French (1993) to a great extent ingests the examples in normal returns [9].

Horváth and Wang examined the application of the Fama-French model in COVID-19. Horváth and Wang evaluated the execution of Fama French model in the U.S. stock market in time of the chosen events by investigating the R2 of this model. They found that the impact of the bubble of internet economy is statistically significant in R2 growth model. During the 2008 financial crisis, the R2 of Growth Portfolio decreased rapidly. In this event, the latest new round of COVID-19 epidemic has led to a sharp decline in R2. In addition, they found that all parameters of beta model are unimportant in GMM model. The purpose is to examine the model in Fama-French (2017), so Horváth and Wang selected 10 stocks from their growing portfolio data from January 1990 to March 2020. Because the monthly rate of return and FF factor are mostly used in the literature, this study adopts the monthly report system. Six value weighted portfolios based on size and book value were used in the second data. Fama French three factor model and GMM model were used. Also, they track down that all beta model boundaries are irrelevant in GMM model. The design is to test the model in Fama and French (2017), so horváth and Wang chose 10 stocks from their development portfolio data from January 1990 to March 2020. Since the month to month pace of return and FF factor are mostly used in literature, this review takes on the month to month report framework. The subsequent information utilizes six worth weighted portfolios dependent on size and book esteem, six worth weighted portfolios dependent on size and speculation, and six worth weighted portfolios dependent on size and functional benefit (likewise determined consistently). Fama French three factor model and GMM model were utilized [10].

This paper will empirically examine the impact of Covid-19 on consumption-related industries in the US stock market. In accordance to Fama-French five factor model, the coefficients and some statistical parameters will be obtained to analyze the change caused by Covid-19.

2 Method

With respect to the methodology, this paper uses the capital asset pricing model, Fama-French three-factor model and Fama-French five-factor model.

2.1 Capital Asset Pricing Model

The CAPM represents the correlation between systematic risk and expected return of assets, particularly stocks. it is broadly used in finance to fix a price for risky assets as well as to calculte expected returns of assets,with the risk of the assets and risk-free rates given.

$$E(r_i) = r_f + \beta_{im}(E(r_m) - r_f) \quad (1)$$

where $E(r_i)$ is the expected rate of return of assets, r_f is the risk-free rate, β_{im} is beta coefficient, which is the systemic risk of asset, $E(r_m)$ is the expected market return for market. $E(r_m) - r_f$ is market risk premium, which is the discrepancy between expected market rate of return and risk-free rate of return.

2.2 Fama-French Three-Factor Model

In 1992, Fama and French concentrated on the components that decide the variety in returns of various stocks in the U.S. stock markets and tracked down that the market beta value of stocks can not clarify the distinctions of profits of various stocks, while the market esteem, the book P/E ratio and P/E ratio of recorded organizations can clarify the distinctions of stock returns. In this way, Fama and French accept that the above overabundance return is an effect on CAPM β Compensation for unreflected risk factors.

$$E(r_{it}) - R_{ft} = \beta_i E(R_{mt} - R_{ft}) + s_i E(SMB_t) + h_i E(HML_t) \tag{2}$$

where R_{ft} represents the risk-free rate of return at time t , R_{mt} is the market rate of return at time t , R_{it} is the return on asset i at time t , $E(R_{mt}) - R_{ft}$ is the market risk premium, SMB_t is the Small minus Big of Size factor at time t , HML_t is High minus Low of simulated portfolio return rate with book-to-market factor.

2.3 Fama-French Five-Factor Model

$$E(r_{it}) - R_{ft} = \beta_i E(R_{mt} - R_{ft}) + s_i E(SMB_t) + h_i E(HML_t) + r_i E(RMW) + c_i E(CMA) + e_i \tag{3}$$

where, $E(RMW)$ is the divergence of high and low earning stock portfolio, $E(CMA)$ is the diversity of high and low reinvested company stock portfolio.

where, $E(RMW)$ is the error between the profits of a high and low procuring stock portfolio, $E(CMA)$ is the inconsistency between the profits of a low and high reinvested organization stock portfolio.

3 Results

The stock returns data were adopted from Kenneth R.French’s data library. The sample period is from 3 June 2019 to 30 November 2020 and is divided into two periods of equal length based on whether an outbreak has occurred. This study examines the impact of COVID-19 on the consumption-related sector in the US stock market. Using the method of linear multiple regression, it validates the performance of five different factors in the FF 5-factor model on the stock returns of American consumption-related industries. Among them, the consumption-related industries selected in this paper include food, beer and cigarette industries.

A multivariate regression analysis novel coronavirus pneumonia was used to illustrate the data set of consumption related industries, including the data set before and after the outbreak of the new crown pneumonia. The following table lists the estimated coefficients and t - statistics of five factors before and after infection in COVID-19 (Tables 1, 2 and 3).

Table 1. Regression results of Food industry before and during Covid-19

Variable	Coefficients		t Stat	
	Before Covid-19	After Covid-19	Before Covid-19	After Covid-19
MKT	0.616	0.747	12.208	28.416
SMB	-0.187	-0.021	-1.976	-0.305
HML	-0.075	-0.085	-0.772	-1.494
RMW	-0.406	-0.403	-2.548	-3.352
CMA	0.911	1.012	4.947	6.700

Table 2. Regression results of Beer industry before and during Covid-19

Variable	Coefficients		t Stat	
	Before Covid-19	After Covid-19	Before Covid-19	After Covid-19
MKT	0.092	0.182	1.671	5.716
SMB	-0.207	-0.087	-2.003	-1.030
HML	-0.151	-0.039	-1.436	-0.568
RMW	0.286	0.269	1.642	1.854
CMA	-0.185	-0.001	-0.920	-0.005

Table 3. Regression results of Smoke industry before and during Covid-19

Variable	Coefficients		t Stat	
	Before Covid-19	After Covid-19	Before Covid-19	After Covid-19
MKT	0.566	0.626	4.927	12.845
SMB	0.033	0.069	0.152	0.535
HML	0.077	0.249	0.348	2.366
RMW	-0.494	-0.661	-1.362	-2.970
CMA	1.162	1.193	2.772	4.263

4 Discussion

4.1 MKT

The MKT coefficient and significance of the three consumption-related industries have increased after the outbreak of the epidemic, which shows that the epidemic makes the yield of the consumption-related industry more related to the fluctuation of the whole U.S. market and more sensitive to the market. Before and after COVID-19, the MKT factor had significant statistical level in the food and cigarette industry, but not significant in the

beer industry. Overall, the performance of the consumption-related industry is sensitive to market changes, and the occurrence of the epidemic makes this sensitivity increase. With the increase of the overall volatility of the U.S. financial market, its systematic impact on the industry can not be ignored. One possible reason is the rise in consumer and commodity futures prices as a result of the pandemic. Data indicates that from June to July 2021, the overall CPI of food in the United States rose by 0.7%, and food prices increased by 3.4% year-on-year.

4.2 SMB

SMB measures the previous excess earnings of small stocks relative to large stocks. In the food and beer industry, the statistical significance of SMB factor has changed from significant to insignificant, while the cigarette industry remains insignificant, which reveals that the size of the stock has no great impact on the yield of the cigarette industry, and there is no “scale effect” of small companies.

The novel coronavirus pneumonia makes the market value of consumption-related industry significantly lower, indicating that the smaller enterprises in this industry have not received serious damage from the new crown pneumonia, and even have a narrow gap with the larger market companies. During an epidemic, tobacco is not the first thing people need. For the food and beer industries, take the meat processing industry as an example, several meat processing plants such as Smithfield and Tyson in the US have been closed recently. It is reported that the overall meat processing capacity of these factories has decreased by more than 20% due to the impact of the epidemic. Tyson Foods, as the largest meat company in the United States, has also published an advertisement in a number of media, the most eye-catching headline is “The Food supply chain in the United States is breaking”. COVID-19 has had a negative impact on the food industry as a whole.

4.3 HML

The HML coefficient measures the historical excess return of high book to market ratio relative to low book to market ratio. Except for the cigarette industry, the HML factor of other industries maintained the non significant state before the epidemic. The HML coefficient became 0.249 after Covid-19. The HML coefficient is positive, and the sample fund prefers to allocate value stocks with high book value rather than growth stocks. The positive growth of HML indicates that the market valuation is low, and people have lost optimism about the cigarette industry compared with before the pandemic.

One possible reason is that on January 2, 2020, the U.S. Food and Drug Administration issued a ban, and all mint and fruit flavored atomized e-cigarettes will be fully sold in the United States from now on. The ban on the sale of e-cigarettes in many U.S. states led to a sharp drop in the share price of the e-cigarette sector.

Another possible reason is that during the New Coronavirus epidemic, cigarette sales in major US tobacco companies showed a downward trend. According to a survey by Nielsen, a well-known consulting organization in the United States, Philip Morris American tobacco company was the most affected. Its sales fell by 4.2% in April 2020; Followed by Reynolds tobacco, whose sales fell by 1.6%; ITG brands LLC’s cigarette

product sales fell 2.8%. In this regard, Nielsen also conducted a survey of convenience stores. The data show that the sales of cigarette products in American convenience stores decreased by 3.7% in April.

4.4 RMW

The RMW coefficient represents the relative movement of stocks relative to earnings premium. RMW factor in beer industry was not statistically significant before and after the epidemic, indicating that the profitability premium is not an important factor. The RMW of the food industry is significantly negative before and after the epidemic, indicating that the speculation of the food industry is strong.

This may be related to the popularity of the substitute food track, which affects people's investment in the traditional food industry. Another possible reason is the surge in food demand. According to North American Doctor, the COVID-19 pandemic has brought the US economy to a standstill, and tens of thousands of people are unemployed in Massachusetts and across the country. According to the Boston Globe, the astonishing pace of layoffs and holidays has led to a surge in demand for the services of food banks, storerooms and food aid organizations. With the arrival of a new round of epidemic, American consumers also began to rush to buy food.

4.5 CMA

The CMA coefficient represents the difference between the returns of conservative investment companies and active investment companies. In the food and cigarette markets before and after the epidemic, the income of conservative investment companies was significantly higher than that of active investment companies. However, in the beer industry, this difference has not been significant.

This is because stocks with conservative investment styles are safer in a recession. According to novel coronavirus pneumonia epidemic demand, the US economy dropped 4.8% in the first quarter of this year, according to the data released by the US Department of Commerce in April 29th, the biggest drop since the financial crisis. Even so, most analysts still believe that the US economy has not yet bottomed out.

5 Conclusion

In this paper, the FF three factor and five factor model are adopted to analyze the stock price changes of the US consumption-related industry before and after COVID-19, including the food, beer and tobacco industries. On the whole, the biggest change in the consumption-related industry is the smoke industry. Its HML and RMW factors have changed from no significant before the epidemic to significant after the epidemic, and the significance of MKT and CMA factors have increased, indicating that the epidemic has increased the sensitivity of the cigarette industry to most factors in the FF 5-factor models.

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Valuation Analysis of Delta Airlines Based on ROPI Model

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Abstract. In the sudden coronavirus epidemic, 2020 has become the year of darkness for the entire global airline industry, which is facing the combined adverse and severe impact of an unprecedented decline in travel demand and a deep global economic recession. This research conducts a comprehensive stock examination of Delta Airlines, as one of the tops four U.S. airlines, through a combination of SWOT analysis techniques and Residual Operating Income (ROPI) valuation model, to explore whether Delta is significantly undervalued by the market in light of the huge impact on the airline industry from COVID-19. Based on the results of the study, the purpose of this paper is providing a demonstrate of the future growth potential of Delta Air Lines and to give recommendations for investment in the company's stock.

Keywords: Evaluation · ROPI model · Airlines company's industry

1 Introduction

Over the last century, the airline industry's fast expansion and technological advances have not only made it possible for the public to travel more quickly and safely, but they have also changed the way commodities are transported, providing more benefits and convenience to people. With the process of globalization and the deepening of economic and business activities between countries, the airline industry is playing an increasingly important role in the development of the global economy. After entering the new century, with the integration of major mergers and reorganizations, about 80% of the U.S. airline market has been separated by the "four giants", including American Airlines, Delta Air Lines, United Airlines and Southwest Airlines.

The U.S. aviation industry has maintained a robust trend in recent decades, but the coronavirus outbreak in late 2019 broke that trend. With the ease of human-to-human transmission of the disease, various travel restrictions have been imposed, and many international partial route closures, as well as domestic flight demand, also face a precipitous plunge for a time. For 2020, international passenger demand fell the most, by 75.6% compared to 2019; while U.S. domestic demand fell 48.8% year-over-year; and in air cargo, total demand for freight decreased by 10.6% compared to last year [1]. In addition, according to a recent release of the International Air Transport Association (IATA) World Air Transport Statistics (WATS), the air transport industry has already lost

more than \$126 billion in 2020 due to the impact of the pandemic on air travel demand. Over the past year, the stock price became the most realistic reflection of the survival of the U.S. airline industry. The stock price of American Airlines fell 45%; United Airlines fell 51%, and Delta Air Lines fell 31%, the biggest drop since the 2008 financial crisis [2].

Even though no one knows exactly when this pandemic will end, a promising outcome has arrived in the U.S. airline industry at the end of 2020. The U.S. government knows the importance of the airline industry to a national economy, and if all U.S. airlines were to enter liquidation and bankruptcy proceedings, it would disrupt the U.S. market and even the global supply chain and related businesses. So, even though these policies would increase the national debt, the U.S. government has provided a financial lifeline and other forms of support for the airlines. For example, on Dec. 27, 2020, former U.S. President Donald Trump signed a new \$900 billion crown bailout bill, which includes \$15 billion in payroll assistance for U.S. airline operators. The CARES Act, which took effect in March of this year, provided \$25 billion in payroll support to U.S. passenger airlines [3]. Also, in addition to the policy assistance given to the airlines, travel restrictions and recommendations began to ease as the mass vaccination campaign unfolded and vaccinations became more widespread worldwide, with travel on domestic U.S. airlines rebounding first. Finally, the airlines began to recall employees and implementing self-help options to survive crisis, such as doing promotions, cutting executive pay, implementing voluntary furloughs and early retirement programs.

One event occurred last spring, as fears of the pandemic peaked in the U.S. community, when Warren Buffett's Berkshire Hathaway sold all its shares in the four largest US airlines, an investment that also raised some skeptical voices. For example, former U.S. President Donald Trump accused legendary investor Warren Buffett of being wrong to sell airline stocks in the White House speech on June 5, 2020. Theron Mohamed, who is a veteran journalist writing for Markets Insider and Business Insider, in an article published in March, he noted that the investment strategy cost Warren Buffett and his Berkshire Hathaway Inc. About \$5 billion dollars [4]. Also, Maneenop and Kotcharin examined the short-term impact of the outbreak on 52 publicly traded airlines around the world, they confirmed that traders in Western countries overreacted to information about the pandemic compared to traders in other countries around the world [5]. Overall, this event prompted me to examine whether Delta Airlines, the airline company Warren Buffett was most bullish on and owned the most stock in before the outbreak, is still worth investing in.

In general, analysts use valuation models to establish the basis for pricing various transactions by accurately evaluating the intrinsic value of a company or its activities, which is profitable by capturing the spread. For example, analysts typically utilize the outcome of a company's valuation to determine whether the current market value of the company's stock is justified or undervalued. Moreover, one of the most important preparations when valuing a firm is to gather information and make assumptions about the company's operations. Therefore, before using the valuation model, we need to analyze the current situation of the company. Then, in the case that the analyst concludes that the company's stock price is undervalue, the analyst will offer a purchase-based proposal to the investor or sell the company's stock instead. Similarly, the purpose of this paper is to

assess whether the market price of Delta Air Lines, one of the top three U.S. airlines, is reasonable in the context of the impact of the coronavirus (COVID-19) outbreak and to give an investment recommendation based on the conclusion of the research.

The rest part of this paper is structured as follows. In the methodology section, this paper will give a brief discussion of the research methodology. The paper will use SWOT analysis to analyze the present position of Delta Air Lines and the ROPI model to evaluate the company's worth in the discussion section. Finally, conclusions and investment recommendations are provided based on the discussion.

2 Methodology

To evaluate the company, preparatory work will be done using the SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis, which will help us summarize all aspects of its internal and external conditions. This overview will allow us to understand the company's value and strategic drivers to improve the accuracy of Delta's valuation while enhancing the prediction of Delta's financial behavior.

Warren Buffett says, "Only when the tide goes out do you discover who's been swimming naked." So, this paper will make an NLP analysis of the latest Delta Airlines annual report (10-k) MD&A section, and its two other competitors, American Airlines (AAL) and United Airlines (UAL). Firstly, the data of 2020 annual reports obtained from the official website of the SEC for three companies, which is also called the 10K. The MD&A section reflects the company management's attitude concerning the existing situation and problems of the company, so this section is also the most frequently read section of the annual reports by investors. Then the NLP method is adopted to analyze the sentiment in the MD&A section of the annual report. Analyzing its sentiment helps us to get a deeper understanding of management's attitude towards the company and to verify the veracity of the reported data. Moreover, the word cloud is also established. These approaches will provide a better basis for valuation of Delta Air Lines (DAL) by comparing the results of the NLP analysis with its related materials and making assumptions based on Delta's current situation.

After collecting the above basic information, Delta's intrinsic value will be evaluated using the Residual Operating Income (ROPI) Model. There are many ways to assess the intrinsic value of a stock, such as relative valuation techniques, or the more sophisticated discounted cash flow (DCF) and ROPI models. By reading a lot of papers with information about valuing airlines, I found that using the discounted cash flow method for valuing airlines is a common way for scholars in general. However, DCF is not applicable when a company's cash flow is unreliable or uncertain, or if debt and working capital play fundamentally different roles [6]. Conversely, the ROPI is more adaptable to changes in the economic environment, such as the entry of new rivals, the expansion of competition among companies in the industry, or unpredictable events. At the same time, the ROPI model expresses the concept of value creation, focusing on profitability and asset turnover. There are five steps to apply the ROPI model to stock valuation as follows. The first step that needs to be done is to forecast and discount ROPI for the horizontal period. The next step is the forecast and discounted ROPI for the terminal period. The third step is that the present value of the horizontal and terminal periods is

summed; then added this sum to the current NOA to obtain the firm (enterprise) value. The fourth step is subtracting the net non-operating (NNO), along with any noncontrolling interest, from firm value to yield firm equity value. The final step is to divide the value of the firm's equity by the number of shares outstanding to yield a stock value per share.

3 Discussion

3.1 SWOT Analysis of Delta Air Lines

Delta Air Lines (NYSE: DAL) defines itself as a leader in safety, innovation, reliability and customer experience of U.S. global airline service company Delta has maintained an outstanding reputation over several decades. Delta has been transforming and reinventing itself since its merger with Northwest Airlines twelve years ago, and a swot analysis can help us peek into the mysteries of the world's leading airline.

Strengths

Delta's Vast Global Network and Large Fleet. As one of the largest global and U.S. airline companies, Delta is expanding its global network through equity ownership and joint operations with leading airlines in Brazil, Mexico and the United Kingdom. At the same time, as a founding (premier) member of the SkyTeam alliance, Delta and its alliance partners together serve more than 140 countries and 900 destinations worldwide, an extensive alliance network that enables Delta to provide customers with a more seamless global travel experience. This network of flexible aircraft is made possible by Delta's large, industry-leading fleet of more than 1,100 aircraft of varying sizes and capabilities. Having its own fleet provides Delta with significant cost savings, such as tax breaks, compared to multiple airlines in the airline industry [7]. Also, Delta has implemented a fleet simplification strategy to improve operational efficiency and provide a better passenger service experience.

The Delta Brand. The Delta Brand is a comprehensive reflection of an airline's business performance and social influence, as well as a symbol of the airline's efforts to build its core values and communicate them. Delta has always embraced "honesty, integrity, respect, perseverance, and servant leadership" as its core values and has earned an award-winning reputation for customer service, such as being awarded for three consecutive years for providing the best overall experience [8]. And, in 2021, Delta was the only airline on TIME's list of the 100 most influential companies. Also, Brand Finance, a UK-based brand valuation agency, released the "Top 50 Global Airlines Brand Value 2021" list [9], ranking Delta Air Lines No. 1. Delta's exceptional brand reflects the trust and confidence it continues to earn from its customers through operational excellence, first-class service and a commitment to ensuring the health and safety of its customers. Overall, brand excellence creates a positive social image for the airline, while increased customer loyalty provides tangible benefits to the airline.

Delta's Other Strengths. Delta is distinctive in a certain number of major areas, such as asset management, international partnerships and supply chain. As we mentioned in

our analysis of Delta's vast Global Network, Delta has achieved a virtual integration with a strong partner by acquiring foreign airlines in order to layout. In order to provide a stable fuel supply and reduce fuel costs for the company's global operations, they acquired the Trainer refinery outside of Philadelphia, now managed by Monroe Energy, a wholly owned subsidiary of Delta. It secures about 80% of Delta's jet fuel needs. Then there is the fact that Delta has its own aircraft maintenance team, and the company can better control its operating costs. This can be reflected in the aircraft maintenance repair expenses, when we compare the expenditure of Chinese and American airlines in this area, and found that last year, the U.S. side of the spending cut significantly, the Chinese side of the increase rather than decline. Delta Air Lines dropped from \$1.7 billion in 2019 to \$800 million in 2020, a 53% drop, as opposed to AIR CHINA, which increased its aircraft maintenance and repair spending from \$6.1 billion to \$6.4 billion, which represents a 5% increase over the previous year.

Weaknesses

Singular Source of Revenue and High Operating Costs. Although Delta has a vacation wholesale subsidiary, Delta Vacations, and Monroe Energy, Delta's primary source of revenue is airline ticket sales. Passenger revenue accounted for 89% of total operating revenue before the outbreak and more than 75% after the outbreak. Therefore, for Delta, which has a simple revenue stream, revenue is vulnerable to cyclicity and other significant decreases in airline travel demand. Secondly, in comparison with airlines in the U.S. airline market, Delta's 2020 Operating cost per available seat mile (CASM) is 22.01 cents higher than American's 19.39 cents and United's 17.68 cents. Delta's 2020 annual report concluded that a number of factors have exacerbated Delta's Non-fuel unit costs have increased, including reduced demand due to the COVID-19 pandemic and significant fleet and product investments. The same factors that Delta summarized for itself are the same as those faced by other carriers, so a comparison of CASM can also prove that Delta's operating costs are higher than those of its competitors.

Over-Reliance on North American Markets. Delta's South American market share and expansion rate is lagging behind its competitors. Although Delta has formed alliances with other national carriers and its network serves destinations in other parts of the world, the company's primary focus is on the North American market. Delta has put more than enough dependence on the revenue sourced from the North As a result, this also puts Delta at a competitive disadvantage outside of the North American market and makes it vulnerable to any negative fluctuations in North America, such as regional economic downturns, political unrest, and social changes [10].

Opportunities

Leveraging Advanced Technology to Enhance the Customer Experience. Delta's Fly Delta app is a great example of how advanced technology can be leveraged to improve the customer experience. It's easy to search, compare and book flights, manage personal profile, view upcoming travel, and check in domestic flights in advance, thus making it easier and efficient for people to plan their flights and save time. Also, as a result of

the epidemic, many airlines have introduced new technologies ranging from contactless solutions to digital health passports and ultraviolet light and autonomous cleaning robots that will play an important role in driving the recovery of the air transport industry. In the long run, these new technologies will open up endless possibilities. 5G, mobile terminals, artificial intelligence, experience design and other new technologies can be applied to enrich the touch points and service methods between airlines and passengers. Efficient operation models and precise service methods can bring huge benefits to the whole industry. The utilization of these new technologies is driving Delta's future development trend to transform towards digitalization.

Supersonic Flight is Coming Back. United Airlines is planning to purchase up to 50 Boom Overture supersonic jets from the Boom Supersonic, a supersonic aircraft manufacturer, for commercial use by 2029, according to CNN. The return of supersonic passenger flights can make long flight times shorter and allow people to travel more conveniently. Ms Savitt said Boom's research suggested passengers wanted speed and that faster planes could "deepen human connections and make better business relationships". Today, the wealthiest travelers may favor private business jets, says Dr Gratton, and the return of supersonic aircraft could meet this huge business aviation market. According to estimates, the global market demand for supersonic airliners is about 100 to 200 per year, and in terms of fares, it is estimated that the "Overture" supersonic airliner should cost as much as a business class ticket on a regular airliner, which is 1.5 times higher than an economy class ticket. For Delta, which has always been a leader in the airline industry in terms of product and service segmentation, branded value-added tickets and strong sales power, this is an opportunity to create differentiation and adapt to different passenger service needs.

Logistics Requirements. The epidemic has given rise to the globalization of the "stay-at-home economy", and cross-border e-commerce is expected to see continued rapid growth. The epidemic is the catalyst for the prosperous development of cross-border e-commerce, and online shopping has become a major trend of global consumption, and e-commerce sales have grown by leaps and bounds. While industry capacity was reduced during the epidemic, it drove a significant increase in Delta's cargo revenue. Delta also generated cargo revenue by operating pure cargo charters (i.e., using aircraft in the company's fleet that were not being used for passenger transportation at the time). The explosion of e-commerce under the epidemic reflects the change in consumer perceptions and forms of consumption worldwide, and the growth in demand in the e-commerce industry may be highly sustainable, driven by a new round of consumer upgrades. Therefore, Delta can reduce the loss to the company due to the epidemic by developing its freight business.

Threats

"Black Swan Event". Airlines are clearly asset-heavy operations, with one aircraft costing tens of millions of dollars, and with huge operational costs and interest on debt, the company's tolerance for risk is significantly lower than in other industries. The external factors such as unforeseeable security events and terrorist attacks might potentially

threaten the daily operation of Delta as those events could not be avoided. Examples include the aviation disasters, the September 11, 2001 attacks, severe acute respiratory syndrome (SARS) and the ongoing the COVID-19 pandemic all have a negative impact on airline stock prices [5]. As well as these “Black Swan events” are difficult to predict in terms of the magnitude and duration of their negative impact on the future.

Competition. The competition in the global airline industry has always been extremely fierce, and the competition in the airline industry is mainly reflected in routes, fares, operational reliability, customer service and loyalty programs. The Internet has also created greater price transparency, reducing margins. Such intensive competition creates a threat for the Delta Air Lines, whose main competitors in the U.S. airline market include Southwest Airlines, American Airlines, and United Airlines. Even though Delta has earned many number one titles in everything from passenger experience to customer service, from operational performance to workplace culture, it ranked third place in the domestic market share of major U.S. airlines from January to December 2020.

3.2 NLP Analysis Result

The results of NLP analysis are shown in Table 1 where Net Tones are all negative, which means that all three management believe that their performance in 2020 is not optimistic. However, the Net Tone of DAL is the highest while the Net Tone of UAL is the lowest, which means that the management of DAL is more confident about their performance in the future than the other two airlines.

Table 1. Sentiment analysis of MD&A.

	Positive tone	Negative tone	Net tone	Uncertain tone
UAL	0.314%	1.179%	-0.865%	1.535%
AAL	0.368%	1.062%	-0.694%	1.362%
DAL	0.836%	1.394%	-0.557%	1.394%

By creating word clouds, we can facilitate the filtering of large amounts of textual information and visually highlight the trending words based on frequency. Figure 1 shows it for UAL, AAL, and DAL for MD&A reports. The word COVID appeared in all word clouds, but the size of it in the word cloud was not as large as I expected. The reason for this can be attributed to the fact that they are already familiar with COVID19 and they have their own strategies to deal with this epidemic. By the comparison of the words, not surprisingly we found that the word “cost” and “operation” are the most frequently used words in DAL’s MD&A report. In the SWOT analysis part, this paper has mentioned that one of Delta’s weaknesses is excessive operating costs. DAL is right to choose a cost-cutting approach to continue its operations, because DAL’s operating costs are indeed too high compared to its competitors.



Fig. 1. Word cloud results (UAL/AAL/DAL)

3.3 Assumption of Financial Information

The text above summarizes the collection of basic information about the airline industry and Delta, with an analysis of where they are now and what they may face in the future. Now the one of the most important preparatory tasks in valuing a company is gathering information has been done, and the next step is to make assumptions about the company's future operations based on the information gathered above.

Horizon Period and Terminal Year. The conclusion from the Morgan Stanley and the International Air Transport Association (IATA) article is that the current market consensus it will take Until 2024 for the U.S. airline industry to return to pre-COVID-19 levels. Besides, based on the previous SWOT analysis of Delta, it is concluded that as a leader in the U.S. airline industry, its net sales growth rate was at a relatively stable figure before the outbreak. Therefore, when the U.S. airline industry returns to its previous level in 2025, Delta's net sales growth rate will also return to a relatively flat state. Based on the above findings, assume that the length of the horizon period is 4 years and 2025 is the beginning of its terminal period and the total forecast periods will be 5 years.

Net Sales Growth Rate. According to the March 18, 2021 report in Flight International, U.S. airlines have added about 250 passenger aircraft to their operations in recent months, while beginning to receive new aircraft. The current inventory of U.S. airlines is being restored to service at varying rates. Therefore, I believe that the net sales growth of the three companies will increase significantly in 2021 compared to 2020, so the net sales growth rate of 2021 will be projected separately. According to Delta's annual report, I found that its Total operating revenue is composed of three parts: Passenger revenue, Cargo, and Other operating revenue, so in order to get the net sales growth rate of 2021, we should first forecast Delta's Passenger revenue growth rate, Cargo growth rate, and Other operating revenue growth rate separately. Finally, we sum up the total revenue of 2021. Finally, we can get the total operating revenue of 2021 and figure out the net sales growth rate of 2021.

At first, I have used the results of the NLP analysis above to rank the magnitude of passenger revenue growth for the three companies next year, in the order of Delta Air Lines, American Airlines and United Airlines, and secondly, based on the IATA publication Recovery Delayed as International Travel Remains Locked Down, 2021 passenger numbers are expected to rise 62% from a sluggish 2020. If we take 62% as the middle American Airlines' passenger revenue growth rate for next year according to the ranking, then a 3% growth rate is added to Delta's passenger revenue growth rate as the top-ranked airline. In addition, according to the transcripts of a meeting between Delta Air Lines and J.P. Morgan Industries in March of this year "Delta Air Lines said

that compared to their major competitors, they have generated more passenger revenue than their major competitors”, proved the viability of my idea.

Therefore, it is assumed that Delta Air Lines’ 2021 passenger revenue growth rate is 65%. As mentioned in the Opportunities part of the SWOT analysis, during the epidemic Delta had the act of generating cargo revenue by turning some of its passenger planes into cargo planes after removing the tables and chairs. This is why the difference between Delta’s Cargo revenue in 2020 and before is not significantly. So, I think Cargo revenue growth in 2021 will be the highest of the next 5 years, and then it will level off again in the next 4 years. Therefore, assuming the Net sales growth rate in 2022 to 2024, Cargo’s revenue rate will not be singled out again. The same assumption is also applicable to other operating revenue. Are calculated to be 27,010 million in 2021, representing a 58% increase in net sales.

The Net sales growth rate for 2022 to 2024 is predicated on the assumption that after the big rebound in Net sales growth in 2021, Net sales growth will return to the level of 2019 in a comparatively stable and large form. Therefore, our operating revenue per company in 2024 is equal to that of 2019. However, considering the inflation, we cannot directly copy the total operating revenue of 2019 into our Total operating revenue of 2024, so we use the annual inflation rate from 2020 to 2024 provided by statista.com to calculate the future value of 2019 total operating revenue in 2024. The following formula was then used to calculate Delta’s net sales growth rate for the three years.

$$\text{Net sales growth rate} = \sqrt[3]{\frac{2024 \text{ Total operating revenue}}{2021 \text{ Total operating revenue}}} \quad (1)$$

As a result, we assume that Delta’s annual net sales growth rate is 24.67% from 2022 to 2024.

Terminal Net Sales Growth Rate. A positive terminal growth rate indicates that the company will grow in perpetuity. At this stage, the terminal growth rate can be used as a reference for the average GDP growth rate. Then, a terminal growth rate above the average GDP growth rate indicates that the company expects its growth to outperform the economic growth forever. Therefore, we use the (GDP) growth rate in the United States from 2015 to 2025 data provided by statista.com to calculate the average GDP for 2021–2025. The calculation process is as follows.

$$3.08 + 2.94 + 2.26 + 1.9\% + 1.83\% \approx 2\% \quad (2)$$

Eventually, I use the calculation result of 2% as an assumption for the Terminal Net sales growth rate.

Cost of Capital. As Delta Air Lines has no preferred stock, the cost of capital is made up of two components.: Cost of Equity and Cost of Debt. Firstly, we use CAPM model to calculate the cost of equity. The company’s beta is obtained from yahoo finance website. The US 10-year treasury rate is used as risk free rate. We also assume that the risk premium is 5%. Then, we can calculate each company’s cost of equity. Then, we can calculate company’s cost of equity. Secondly, we use company’s 2020 10-k filing’s Debt Note to calculate cost of debt. There are many different types of debt of a company,

we just take the average of each debt interest rate and multiple the weight of each debt to get the cost of debt. Thirdly, we calculate equity and debt weight. As for the equity weight, we use daily stock price at December 31, 2020 to multiple the shares issued and outstanding at that day to get the market value of the stock. When it comes to the debt weight, we use the number of total secured and unsecured debt. Then we get company's financing weight. Finally, company's cost of capital is 6.48%.

Income Tax Rate. Although the effective income tax rate of each company in each year is a little different, it is not far away from the U.S. federal statutory income tax rate 21%. In this case, we assume that the company use the income tax rate 21%.

Income Statement and Balance Sheet Items. There are many items in income statement and balance sheets which need make assumptions in next 5 years, it is difficult for me to adjust them one by one, so I use the following three methods to help us forecast each item for each year.

1. There are a lot of accounting items which have a steady proportion of net sales in previous years, so I assume that those items proportion will not change. For example, the accounts payable and receivable always account for 6% of net sales. The only thing I need to do is to forecast the net sales, then use the 6% to multiple the net sales. Finally, we will get forecasted accounts payable and receivable.
2. For some steady accounting items, I just assume that the number will not change in following years. For example, Delta's Goodwill is always around 9,700 million dollars, so I forecast Delta's goodwill will not change in following 5 years.
3. Some companies have their own specific accounting policy, so I have to read the 10-k filing to find those specific items. For example, the long-term debt future maturities are different for each year. Another example is about the value of intangible assets, which should minus each year's amortization expense.

Overall, we have done the forecasting part of financial information. The following Table 2 shows that we have used in valuation part.

Table 2. Assumed items for applying the ROPI model.

	DAL
Forecasts periods	5
Terminal year	2025
2021 Net sales growth rate	58%
2022–2024 Net sales growth rate	24.67%
Terminal Net sales growth rate	2%

(continued)

Table 2. (continued)

	DAL
Statutory tax rate	21%
Beta	1.51
Risk free rate	1.72%
Risk premium	5%
Cost of Equity	9.27%
Equity weight	47.99%
Cost of Debt	4.45%
Debt weight	52.01%
Cost of capital	6.48%

3.4 Valuation Analysis

Based on previous assumptions of different accounting items and reported data of 2020 financial statements, we calculate the NOPAT and NOA of DAL in coming five years respectively, showing in the table below (Tables 3 and 4).

Table 3. NOA and NOPAT of three companies from 2020 to 2025.

	\$ Millions	Reported 2020	2021 Est.	2022 Est.	2023 Est.	2024 Est.	2025 Est.
DAL	NOPAT	(9,922)	(4,268)	(2,660)	3,316	3,763	4,049
	NOA	14,930	13,890	16,130	20,773	21,282	21,625

Table 4. ROPI model of DAL.

\$Millions	2020 reported	2021 Est.	2022 Est.	2023 Est.	2024 Est.	Terminal year [2025 Est.]
Net sales growth		58%	24.67%	24.67%	24.67%	2.00%
Net sales	\$ 17,095	\$ 27,010	\$ 33,673	\$ 41,981	\$ 52,337	\$53,384
NOPAT	\$ (9,922)	\$ (4,268)	\$ (2,660)	\$ 3,316	\$ 3,763	\$ 4,049
NOA	\$ 14,930	\$ 13,890	\$ 16,130	\$ 20,773	\$ 21,282	\$ 21,625

(continued)

Table 4. (continued)

\$Millions	2020 reported	2021 Est.	2022 Est.	2023 Est.	2024 Est.	Terminal year [2025 Est.]
ROPI Model:						
WACC	6.48%					
ROPI (NOPAT-[NOA _{beg} × r _w])		(5,235)	(3,560)	2,272	2,417	2,670
Discount factor		0.939	0.882	0.828	0.778	
Present Value of horizon ROPI		(4,916)	(3,140)	1,882	1,880	
Cum Present Value of horizon ROPI		(4,294)				
Present Value of terminal ROPI		46,403				
NOA		14,930				
Total fum value		57,040				
Less (plus): non-operating obligation		13,396				
Less: NCI (non-controlling interest)		–				
Finn equity value		43,644				
Shares outstanding		647				
Stock value per share		67.46				

The ROPI model was used to evaluate Delta Air Lines, and the results are shown in the table below. The estimated value of DAL is 67.46 dollars respectively, while the 200-day moving average of DAL is 44.79 dollars. The estimated stock value of Delta is the furthest from exact value, indicating that it be most undervalued. Moreover, compared to historical data since April 20th 2018, Delta's price maintained 50 to 60 dollars before the COVID-19 pandemic outbreak. Therefore, I think Delta has the potential and probability to increase.

4 Recommendation and Conclusion

Firstly, it was concluded that Delta Air Lines is the most undervalued stock after comparing its valuation results with current market prices. And through the analysis above we discovered that the Delta Air Lines has good prospects for both the post-epidemic era

and in the future after the recovery of this epidemic. It is the first time that Delta has committed to the diversification of its revenue streams and has started to continuously pursue innovation and business development to achieve its diversification strategy. Moreover, Delta Airlines has the best reputation among the three major U.S. airlines and has always focused on providing superior service. With the Customer Loyalty Program and the fleet simplification strategy, Delta has not only gained a large number of loyal customers but also improved operational efficiency. With the goal of serving more destinations across the globe, Delta is constantly extending its global network to more countries and routes in the future. Also, Delta was the first U.S. airline to resume service to China and the United States after COVID-19. By the end of March 2021, Delta has resumed four U.S.-China routes, while UAL and AAL have resumed only two U.S.-China routes. The increasing number of passengers will help bring confidence to the capital markets and allow the stock price to climb. Overall, Delta has a clear direction for development and its business model offers the possibility of implementing its strategy.

Although recently, the Ministry of Health of Colombia confirmed the detection of another variant of the new coronavirus “Mu” in the nation on September 2, after the “Delta” virus. We’ve seen Delta’s shares fall from \$45 to \$46 in March and April to \$38 to \$40 today. Proponents of Buffy’s liquidation of airline stocks argue that the airline industry is in too much turmoil and no one knows when the outbreak will be over in this long run, and therefore it would be appropriate to sell their airline stocks. Based on the results of the above analysis, however, Delta Air Lines is still a very worthwhile company to invest in.

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The Problem in Protecting Environmental Refugees Under International Law

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Abstract. Climate change has led to a lot of environmental disasters and many of these disasters have destroyed homes of many people. This trend has been a new phenomenon around the world—environmental refugees. Environmental refugees are different from conventional refugees as they are caused by climate change. As a result, International Human Rights Law cannot protect environmental refugees because of the limitation of human rights, International Environmental Law cannot be used, as it is highly political or the refugee law cannot help environmental refugees because of the definition of conventional refugees. As those three areas of law cannot help, alternative methods about how to protect environmental refugees by international cooperation need to be discussed.

Keywords: Environmental refugees · International Human Rights Law · International Environmental Law · Refugee law

1 Introduction

In recent years, climate changes have had impacts on all continents and across the oceans. Changes include water resources in terms of quantity and quality and negative impacts on crop yields [1]. Drastic climate change has forced habitants to leave their homeland which has become inhabitable. The report of the Intergovernmental Panel on Climate Change has confirmed this trend: ‘one of the gravest effects of climate change may be those on human migration’ [2]. Furthermore, because of the severity of environmental issues, for example, rising sea level will submerge some low laying areas and some lands will become arid, most migrants in this situation usually lost their property and they have no access to gain a stable job. So, these people usually live a miserable life like the refugees and they are called environmental refugees.

Environmental refugees should be a global concern not only because of their low-standard life but also because of the astonishing number of them. Current observation suggests that changing climate has caused a large volume of displacement [3]. While the exact number is hard to observe because climate refugees do not have a clear legal status and the phenomenon of ‘climate-induced migration’ [3], one of the most cited figures observed by Stern shows the number of environmental migrants is 200 million by 2050 [4]. Such a huge number of environmental refugees will impose a burden on the

countries with the habitable territory. Ergo, the protection of environmental refugees is a global concern.

There has been a large number of researches are concerned with environmental refugees. Some of these researches are based on the statistics and comparing the difference between developed and developing countries [5]. There are also some regional studies [6]. There are also some experts who are trying to solve this issue by international law [7]. Based on the researches of these predecessors, this essay aims to compare the features of international law and environmental refugees and try to find out what is the real problem in protecting environmental refugees under international law.

As environmental refugees are refugees caused by environmental problems, this issue is about three questions: What sort of basic rights of human beings are recognized in the international community? How the international community will react to environmental issues? What is the right of refugees? In modern international law, there are, *prima facie*, three areas of law that can answer these questions: International Human Rights Law, International Environmental Law, and refugee law. However, by comparing features of environmental refugees and those areas of law, this essay will discuss whether these traditional tools including International Human Rights Law and refugees law used by the international community can be employed to help environmental refugees need further analysis. Furthermore, since, the issue of environmental refugees is caused by environmental problems, the function of International Environmental Law needs to be discussed. If those three areas of law cannot help, this essay will discuss possible alternative methods at the end.

2 Problems in Protecting Environmental Refugees Through Human Rights Law

Protection in law presumed that there are some pre-existing legal rights because the law can only help those whose legal rights have been violated. Furthermore, someone's rights need to be protected also means that it is the others' duty not to violate it. So, to ask law for protection successfully, there must be possible defendants who have violated their duties.

In environmental refugees' issue, since Human Rights Law is an important source of rights that can protect people from severe political, legal, and social abuses [8], there is a presumption that environmental refugees can ask Human Rights Law for help. This presumption means that firstly, environmental refugees enjoy rights under Human Rights Law, and secondly, someone has infringed these rights. However, such conditions cannot be met because of the features of Human Rights Law.

To clarify the rights of environmental refugees under Human Rights Law, the features of Human Rights Law should be analysed because a specific right in an area of law derives from the attributes of this area of law. While the exact features of Human Rights Law are still in discussion: there are discussions about whether human rights are inalienable, whether they should be or 'mirroring' moral rights or it should be defined in terms of serving some sort of political function [8], foundations of human rights disclaimer some concrete features of Human Rights Law. Human rights at the international level can be created by enactment, custom, and judicial decisions [8]. For example, Article 4 of the

European Convention for the Protection of Human Rights and Fundamental Freedoms prohibited slavery and forced labour [9]. Since the appearance of environmental refugees is a new issue, there will be no enactment, custom, or judicial decisions directly concerned with them, but they can be protected by some general principles like every human being has the inherent right to life [10]. Furthermore, according to Morsink, human rights are not only derived from legal practice but people are born with rights that human rights are somehow innate or inherent in human beings [11]. So, environmental refugees have human rights as human beings and these rights are defined by general principles in international law. From such a point of view, it seems that International Human Rights Law can give full protection to environmental refugees, as it will treat them as human beings and protect their basic rights as humans. However, some theories of Human Rights Law prove such presumption is wrong.

Firstly, protecting human rights is not always the priority. Knox argued that states had enjoyed a wide range of discretionary power when keeping balance between the fiscal burden of protecting environment and the benefits of harmful activities to the environment [12]. In environmental refugees' issue, many countries will stand idly by it because the harm does not happen within their borders and they would get nearly nothing if they chose to help those environmental refugees in danger in other countries.

Secondly, lots of rights in International Human Rights Law can only be achieved in progress. For example, Article 11 of the International Covenant on Economic, Social, and Culture Rights identifies the right to adequate food, clothing, and housing [13], however, these social rights are not absolute, because the governments of many countries are impotent to supply necessities to environmental refugees within their borders. As a result, environmental refugees can argue that they should enjoy some social rights according to the international declaration, whereas, such an argument is unlikely to be realized in practice because their government is unable to provide it, so it is useless.

Thirdly, there is the problem of 'threshold' in International Human Rights Law. Bodansky argued that there is a minimum threshold about who can make a claim and which rights the government must therefore protect [7]. Henry Shue has explained this principle: "basic rights are the morality of the depths. They specify the line beneath which no one is to be allowed to sink" [14]. It is hard to recognize whether all the environmental refugees are in such a situation because there are 'climate-induced' environmental refugees who leave their homeland for a better life rather than to chase a chance for survival. In this regard, it is hard to decide the level of 'threshold' and whether human rights law should intervene with it. Ergo, the general principles in international law cannot protect environmental refugees.

Finally, even though environmental refugees have rights under International Human Rights Law, there is the problem of 'who should take the responsibility' in the human rights dimension. According to Hohfeld, there are four fundamental legal conceptions: right, privilege, power, and immunity. Right is an ability to claim something from the government, privilege is a kind of liberty, power is the ability belongs to legislators to change duty, and immunity is the right that cannot be changed [15]. The argument that 'International Human Rights Law can protect environmental refugees' means these refugees can claim a right rather than arguing the rights of environmental refugees is an immunity because they are asking help from others rather than protecting themselves.

However, the tragedies of these refugees are the action of nature rather than a specific government. So, they cannot make a claim because there is no specific body who should take responsibility.

As a result, International Human Rights Law cannot protect environmental refugees because they do not have rights under International Human Rights Law and even if such rights were created in the future, there would still be the question of ‘responsibility’.

3 Problems in Protecting Environmental Refugees Through International Environmental Law

As International Human Rights Law is incapable of protecting environmental refugees, considering this problem was caused by climate change, the probability of employing environmental law should be discussed. However, this approach is problematic, either.

Firstly, although Bodansky has argued that environmental law takes a more absolutist stance by banning some harmful activities than human rights law [7], which can cure the problem of ‘discretionary power’ of government in the human rights dimension, this approach is still faced with the problem of ‘threshold’: the UNFCCC defines its objective in terms of a maximum threshold level of greenhouse gas concentrations, above which dangerous climate change would occur [16]. The UNFCCC will not try to solve every problem. This ‘threshold’ becomes a barrier deterring the effect of International Environmental Law. Besides, this ‘threshold’ is hard to identify because climate change has a global effect, so it is impossible to have a unified standard around the world.

Secondly, International Environmental Law reflects a noticeable ‘political’ character, [7] meaning that this regime is more like a political forum that each country exchanges their suggestions to sign a protocol. So, environmental law depends on reciprocity and is grounded in the need for mutual action [17]. Ergo, when there are no reciprocity treaties between different countries about environmental refugees, environmental law cannot help them.

Thirdly, the political character of International Environmental Law makes it hard to be enforced, because institutions established by international human rights treaties are composed of lawyers or other experts, while the institutions established by international environment agreement aim to “direct the implementation and evolution of the regime, meaning that their primary task is to solve problems in realpolitik [7]. Such feature makes the institution established in environmental law not to concentrate on law but the relationship between parties and they have no sufficient ability to handle the problem that has not been discussed by parties because they are unable to extend the existing protocol to protect environmental refugees. As a result, environmental refugees, as a new problem, cannot be solved by these committees.

The ratifying problem of the Kyoto Protocol in the U.S.A can illustrate this political feature of International Environmental Law. President Bush repudiated Kyoto Protocol because he believed that this Protocol exempted 80% population including China and India and it would harm the U.S economy [18]. Besides, this repudiation is also the requirement of the Byrd-Hagel Resolution which forbids the U.S to be a signatory of the Kyoto Protocol if the treaty would ‘mandate new commitments to limit or reduce greenhouse emission’ or would seriously harm the economy of the U.S [19]. Ergo, the

U.S is still not a signatory of Kyoto Protocol. This example shows that International Environmental Law is hard to be enforced as some countries' signing power are limited by domestic law and, more importantly, it is highly political because a country will enter into an international agreement only when domestic politicians are satisfied with what this country can get from the agreement. Thus, International Environmental Law cannot protect environmental refugees because accepting environmental refugees will enhance the economic burden of accepting countries. The attitude of many developed countries will be the same as the U.S in the Kyoto Protocol issue.

So, International Environmental Law cannot be used to protect environmental refugees because of the problem of threshold, its political feature and it is hard to be enforced.

4 Problems in Protecting Environmental Refugees Through Refugee Law

It has been discussed that International Human Rights Law and International Environmental Law cannot be used. Since they are homeless refugees, refugee law should be discussed.

Refugee law provides refugees a tool to escape fear. It can protect environmental refugees if it can be used, however, there are some problems.

The primary problem is that environmental refugees are not refugees according to the definition of refugee law. According to the United Nations 1951 Refugee Convention, the refugee problem is caused by human-made tragedies [20]. However, the environmental refugee problem is caused by climate change which is not directly implemented by humans. So, even though the predicaments of environmental refugees are the same as convention refugees, they are not refugees under refugee law.

To cure this problem, there are two different proposals. The first proposal is to extend the notion of 'refugee' so that refugee law can protect environmental refugees [21]. However, this proposal cannot help more refugees because the refugee quota is fixed [22] in accepting countries, so accepting environmental refugees means that these countries will accept less conventional refugees. Besides, as discussed before, there is a large volume of 'climate-induced' environmental refugees and it is hard to distinguish between the people who migrate to just improve their life standard and who have to migrate to survive. So, this regime cannot help environmental refugees who need help efficiently. Furthermore, the refugee law usually has a presumption that most refugees will return to their homeland when the humanitarian disaster disappears, but in the problem of environmental refugees, as indicated by Intergovernmental Panel on Climate Change, rising sea levels are unavoidable and low-lying island State are thus very likely to be entirely uninhabitable long before their full submersion [23]. In this regard, some atoll countries' territory may vanish forever, meaning that the islanders have to live in another place for a long time and this problem was never confronted in international law. This means that to protect these islanders there needs to be some permanent measures rather than the temporary measures designed in the refugee law. So, just extending the scope of conventional refugees cannot solve the problem of environmental refugees.

The second proposal is to establish a stand-alone convention to confront the issue of environmental refugees [24]. However, such an approach means that the accepting countries or the countries without the bother of environmental problems have to take the burden of accepting refugees, and if considering the burden of cost, it can be assumed that these countries will not sign the new agreement unless these accepting countries believe that the expense of protecting environmental refugees is worthwhile.

Furthermore, both proposals will result in a large number of immigrations. This large-scale population movement will harm the cultural identity of environmental refugees as their traditional community will disappear. The change of Inuit culture has shown the relationship between traditional culture and traditional residential areas. *The Guardian* has reported that the hunting culture is dying in the Inuit community because of climate change [25]. There was also a petition arguing that the global warming caused by the U.S has changed the culture of Inuit [26]. Although this petition was denied, it has shown that traditional culture has to change when environment has changed in the residential area. So, refugee law is faced with the disappearance of cultural identity in environmental refugees issue if international community only pay attention to the living condition of environmental refugees.

So, refugee law has the potential to give the environmental refugees some protection, while the problems of definition and the disappearance of cultural identity are hard to be solved.

5 The Protection of Environmental Refugees in the Future

Even though International Human Rights Law sets out the fundamental standard of rights of environmental refugees as human beings, International Environmental Law has shown how the international community will react to climate change and refugee law has regulated the issue of refugees, these three areas of law are incompetent to react to the new phenomena of environmental refugees as they are not designed to solve the problem of environmental refugees. Considering these problems in international law, we should discuss some possible alternative methods to make international cooperate in handling the issue of environmental refugees.

Firstly, countries with serious environmental problems can learn from the experience of Kiribati. This country, to avoid rising sea levels submerge its territory, bought a block of land in Fiji to serve as a refuge, furthermore, with international help this land can be used as a commercial farm which can help the economic growth of Kiribati [27]. This approach overcomes the difficulties that some islands will be submerged and their territories will disappear on the earth because citizens of these countries can convert to the new lands to keep exist on these lands.

However, this approach is not suited for less wealthy countries as they cannot afford to buy the new land. Tuvalu, whose land will be uninhabitable in the next 50 to 100 years [28], is a good example. The economy of Tuvalu is substantially reliant on foreign aid, [29] meaning that the government of Tuvalu cannot afford to buy new land, as its financial situation is fragile. So, those less wealthy countries and the international community should find alternative methods to protect environmental refugees.

Secondly, considering the deficit of less wealthy countries, the best way to help environmental refugees is to establish a new, independent international level committee

like UNHCR which can deal with the challenge of increasing environmental refugees, however, wealthy countries would not sign a new agreement which will hugely increase their financial burden. Although it is hard to find a proper way to protect environmental refugees directly, finding a way that can delay the occurrence of environmental problems is possible. By implementing International Environmental Law, climate change will be controlled in a tolerate scope meaning that the true number of environmental refugees in the future will be less than the estimated number. To reduce the risk of climate change, implementing International Environmental Law is an indirect way to protect environmental refugees.

6 Conclusion

Having discussed International Human Rights Law, International Environmental Law and, refugee law, it can be concluded that those three areas of law cannot help environmental refugees as they are not designed to respond to this new global phenomenon, however, those law sets the standard of living conditions of human beings, how the international community will react to the climate change and how would international community will help if environmental refugees were recognized as refugees under refugee law in the future. Of course, there are problems in all these three possible approaches and alternative methods need to be discussed.

However, no matter wealthy countries help developing countries to buy new land or the international community agrees to establish a new institution to regulate needs great international cooperation and developed countries will have to take the fiscal burden. These two proposals are only possible in theory. Ergo, we are not sure whether those methods will be employed by the international community in the future, thus more researches about how to fix the mismatching features between environmental refugees and International Law are necessary.

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Salesforce and Possible Future of Its Industry

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Abstract. This paper analyzes one of the leading SaaS providers Salesforce.inc using the SWOT method, and provides a relative valuation of the company to determine its position in the market. With those, this paper takes a insight on the SaaS industry as a whole and discusses its possible future development ways. Taking one leading company, I tried looking for connections and reflections it can give to other SaaS competitors. This paper concluded that although we need time to see solutions of problems that the SaaS providers are facing, for now the industry shows mostly positive trends and aspects that may be an indicator of future investment.

Keywords: Salesforce · SaaS · Investment

1 Introduction

SaaS, or “Software as a service”, is a concept that has become increasingly popular since the start of the 21st century. The emerging SaaS industry provides various company workers with online, free, and instant customer-oriented workspace for online software’s easy accessibility. In 2020, under a global economy harmed significantly by the outbreak of the COVID-19, online communication met a soured demand as most workers must embrace “remote working”, a way of working through the use of the Internet while workers can stay in their home. Companies need a more specialized and flexible online platform for building applications that connect workers together to suit their need, and it must also integrate a well-developed frame that links clients and agents. I found Salesforce (CRM) as one of the leaders in this industry which can provide insights in terms of its focus on software development, market ambition, and stability in running the business machine. Salesforce hosts an application customers can access online that operates on a “pay-as-you-go” subscription-based business model. It aims to provide a platform accessible from any device that allows marketing, sales, commerce, service, and IT teams to work as one.

This paper intends to discuss the value Salesforce provides to itself as a listed company and future investment opportunities that lie within the SaaS industry. Investors like me have wondered whether this new emerging business chain has a value towards the market, because being recognized by the market is an important step towards maturity. In the future, the SaaS model and subsequent technologies may generate value to society. General development directions of SaaS companies in the future may be reflected by one

of its leader companies, Salesforce. This paper is analyzing Salesforce as an example that can provide valuable insights to its industry. This investigation may be referred to when investors are making investment decisions.

The first section analyzes aspects of the company through its market behavior and report data. The next section discusses the potentials and drawbacks of the SaaS industry. The part after demonstrates a relative valuation of Salesforce to other companies in the SaaS industry. Conclusion is provided at the end.

2 Research Review

Researches have been done in discussing the topic of SaaS industry's ability and possibility. From the perspective of basic technological IT part, SaaS providers are "in fact offering a service that is significantly different from anything that the IT industry has seen in the past and the result is a compelling value proposition for subscribers" [1]. The author of this article addressed the novelty of the newly emerged SaaS industry at its IT scale. It proves that SaaS providers are exploring a new field that has large potentials which can generate new value judgements within customers. In terms of the pricing of their products, study illustrates that "SaaS companies are relatively heterogeneous in the way they price their products and the pricing practices of SaaS providers within the same size and product type could differ sufficiently" [2]. The paper shows variations within companies that are in the same industry in terms of their pricing strategies and product types. It reveals that it is almost impossible to conclude the industry as a whole with all these variations, which set the base of this paper since I am analyzing one company with implications over the industry. Some problems that the SaaS providers are facing have also been introduced by several research studies. For example, cybersecurity has always been a concern, as authors warned "the future development of SaaS should focus on the design of data security and assurance for SaaS applications and transactions" [3]. There are concerns in other areas, such as worries of data authority protection and its possible violation to laws. "As the fines are so high, and the likelihood of providing cloud services without being in some violation of the Directive is so low, the likely outcome is that cloud computing will not grow as quickly nor innovate as rapidly as it could" [4]. General concerns are around the SaaS industry, but in this paper, I will go into one specific company and discuss its weaknesses and threats to see if there is anything that can be applied to the industry as a whole. All these researches above have set the foundation of investigations in this paper.

3 Analysis

This paper employs a SWOT business analysis model, S for strength, W for weakness, O for opportunity, and T for threat. Data are selected from open-to-public online financial securities information and governmental financial report savings. Representative data that provide indication of aspects of the company are chosen and listed with logical connection to illustrate a possible trend, which the analysis is based on.

3.1 Company Analysis

Strength Lies Within CRM. The strength of Salesforce shows partly in its overall stock trend. Salesforce entered the market in 2004. During the overall 17 years the stock (CRM) shows a comparatively stable trend going upward, with few big harms or skyrocketing moments. As a leader in the SaaS industry, it has a market share of 19.5% globally. It now has a market capitalization of 242 billion USD and ranked #39 in the world stock market, making it hard for most manipulators to manually guide its stock price going up or down. It also performed well from the perspective of its basic market indexes, with a PE ratio of 52.57 and a positive 4.74 EPS at a historically low point about a half of the value in 2020 in general. Noticeably, the turnover rate is relatively high as recorded in July, 2021, at a value of 12.91%. The decreasing PE ratio under a high turnover rate shows the company's well earning ability in general. However, the data also poses a threat that once Salesforce fails to keep its earnings increasing, traders in the market have the possibility of losing faith. Going deeper than indexes, the company itself shows a good performance based on its financial statements. Evaluated from its annual report established on January 31, 2021 [5], there are several factors showing its performance. Firstly, the deferred tax assets have quadrupled over the course of 20–21, meaning that it could have possible profits from future tax benefits. Secondly, the net income has skyrocketed from 126M to 4072M USD as a year-on-year growth possibility due to the large demand during pandemics. The retained earnings have tripled, representing a good return rate for stockholders. Additionally, the cash & cash equivalents have grown by 50%, boosting the flexibility of the company in expanding its service or in financial manipulations. Other data generally shows a stable, increasing trend, with few or no big losses.

Clear Weaknesses. The weaknesses are visible. As a company that focuses on the field of consumer relationship management, it is a wonder if its business scope is large enough to keep on expanding. In other words, will it have enough space in the current field to allow the company to keep growing? When CRM grows bigger, and once there is a damage on the cloud services the company is relying on (either because of an attack on security or sector drop-down), will salesforce be ready? Deriving from salesforce's 2020 report, its income was almost all from subscription and support services, with a few other products. From the current view, there is only a hope that salesforce will develop into other fields, widen its business scope, to hedge this kind of risk. Moreover, Salesforce is in a sector filled with intense competition. Large rivals such as Microsoft's Teams and Oracle are just behind Salesforce a little bit in their market. Good news is, Salesforce adheres to stay with the subscription payment mode instead of selling licenses to customers like Oracle does, which in a way helps it in the competition because paying for subscription can prevent one-time, huge payment from the customers' perspective and in turn allows the company to enter a larger market where individuals take dominance.

Threats Within Opportunities. There are important threats coming majorly from opportunities that the company need to deal with. The first one is cybersecurity. In a system that CRM aims to provide, how to keep all the information safe and private becomes a serious concern of both companies and customers. Since the software does not have a real application, with all information stored in the cloud, the server must

be unbreakable in order to prevent dangerous losses. But recently with a lot of ways to increase security level online such as P2P technique and block chain, the issue may be considered solvable. Another threat will be intense competition. Other companies, Microsoft, for example, has a mature online workspace platform of Microsoft Teams, and it is only seeing a growth both from demand and due to its extremely well compatibility as most personal computers are using Microsoft Windows as operating systems. It is crucial for Salesforce to increase their product attraction to keep its leading place in the market. We can see the company trying to expand its services to keep its leading position from its acquisition of Slack Technologies starting from December, 2020. Slack is a leading company in the online cloud workspace industry that has products similar to Microsoft Teams. Slack has a market share just above Microsoft in this area, and in general Slack is easier to set up, looks cleaner, and requires less fees than Teams, making it more favorable to small companies. Salesforce has spent \$27.7 billion in the acquisition, leading to worries that their cash flow will be influenced, but so far there is no such observation. Salesforce completed the acquisition in July, 21, 2021, and with slack tech. Salesforce has become more clients-friendly, with investors seeing positive prospects. However, whether CRM will realize its anticipated benefits on the acquisition remains a risk factor. Since their product gains profit by customer subscriptions, the company needs to constantly provide new value to attract subscribers.

3.2 SaaS Industry Analysis

Strength Within Opportunity: Positive Trend. Starting from strengths, the industry of SaaS provides new insights into increasing the overall ease and convenience for both clients and agents. In particular, the reduced time to benefit since software is ready-to-go without installation at all time, high scalability and integration for the availability of integrating multiple SaaS offerings together, and lower costs of only subscription fee (IBM). With growing technologies and the increasing power of computers, SaaS is seeking a way to replace traditional service models. Cloud services that focus on consumer relationship management also have strong prospects. “We see an incredible 42% of the U.S. labor force now working from home full-time,” says Nicholas Bloom, professor at Stanford’s School of Humanities and Sciences, “this enlarged group of work-from-home employees now accounts for more than two-thirds of U.S. economic activity” [6]. This provides a strong demand for a reliable online cloud system that could keep workers in touch with their customers, which is the area Salesforce is working on. Given the fact that several large companies such as Adobe, Amazon, and Facebook have already offered remote work, it is likely that in the near future more and more companies would have an option for their employees to work from home. From the companies’ perspective, allowing employees to work from home also reduces the cost of renting a workspace in an actual building, which can be a strong motive for them to accept a new online consumer relationship management product.

Weakness and Threat: Unstoppable Competition and Region Limits. As stated above, this industry is intense with competition, since there are a few ways for a single company to be outstanding. The lack of innovative means can result in rivalries between

existing large corporations, and with relatively high elasticity of this industry, it is difficult for a single competitor to take the lead. Since the SaaS mode disables customers from modifying the basic construction of the online software, many people are concerned with the safety and privacy of online software as a service. Also, corporations in the SaaS industry find it hard to enter markets outside of a certain region. For example, Salesforce itself is difficult for Chinese companies to adopt, since it takes a lot of effort for Salesforce to suit the needs of customers abroad due to the way SaaS work. Quoted from a Chinese employee whose company is considering whether to purchase some Salesforce services, those services are “unknown whether it will fit well into the local community.” Moreover, although Salesforce has been seeking chances of entering this market since 2019 when it established partnership with Alibaba (BABA.N), the largest Chinese e-commerce company, the law calling companies to store their data inside Chinese border and implementation standards are “fast moving and they created a great deal of uncertainty for organizations operating in China... in terms of how to get compliant and at the same time support one of their most important overseas markets.” Says Olive Huang, a CRM sector tracker [7]. Overall, only time could tell how far the industry is going to expand within the globe.

3.3 Valuation

Company Name	EV(in \$M)	EBITDA (in \$M)	EV/EBITDA	P/E
Salesforce(CRM)	231,950	5,530	41.94	54.93
Adobe(ADBE)	307,320	5,730	53.63	56.93
Oracle(ORCL)	289,500	17,950	16.13	19.59
Microsoft(MSFT)	2,240,000	80,820	27.72	37.84
Intuit(INTU)	147,360	2,860	51.52	70.04
ServiceNow(NOW)	121,840	633	192.48	728.74
Dynatrace(DT)	17,760	132	134.55	248.42
Square(SQ)	124,900	433	288.45	244.08
Alphabet(GOOG)	1,760,000	75,550	23.3	30.38
Industry Avg.			82.972	149.095
			Estimated EV	Actual EV
Salesforce(CRM)			458,835	231,950
			Estimated Price	Actual Price
			706.7103	260.368

Fig. 1. Calculation chart of relative valuation of 10 representative SaaS companies

Two multiples - EV/EBITDA and P/E are used to value the selected company. These two multiples are widely used, and can provide valuation based on the perspectives of both enterprise and equity. The peers I selected are mainly cloud space, customer and seller-oriented service-providers in SaaS industry, all with positive profit derived from the latest financial report: Salesforce (CRM), Adobe (ADBE), Oracle (ORCL), Microsoft (MSFT), Intuit (INTU), ServiceNow (NOW), Dynatrace (DT), Square (SQ), and Alphabet (GOOGL) (see Fig. 1).

From the comparisons of both the Enterprise Value and Price per Share, Salesforce seems to be underestimated by the market.

4 Conclusion

Salesforce, as one of the leaders in its industry, has a good, positive prospect both from the company's performance itself and the outside factors benefiting the industry as a whole. The underestimation of Salesforce again proves that it probably has a future. However, the company is currently in a transition period, and the acquisition of Slack.Inc can be regarded as a step toward company expansion with unknown results in the long term. Whether Salesforce can utilize this opportunity to make itself outstanding among all the competitors remains a risk factor. Conclusively, as SaaS company Salesforce has been relatively successful in its own industry. The business model of Salesforce can demonstrate some implications on the industry's future. The core of traditional SaaS model is still customer relationship management, and Salesforce illustrates that focuses on improving customer experience of company's products could be a future goal of other companies. Conversely, the shortage of Salesforce of lacking other business factors could be a warning towards other companies in SaaS industry. Expanding business factor could be promising, but it is also important to watch for any excessive dangers coming from the unknown. SaaS industry is still considered to be a new type of business model, but for now it is showing mostly positive views.

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An Examination of Foreign Exchange Market Efficiency Through the Case of RUB/USD Spot Rate

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Abstract. The Efficient Market Hypothesis is controversially debated in the context of stock and foreign exchange markets. This paper explores the various methodologies used for testing market efficiency in the foreign exchange market and discusses their specifications and limitations. It then follows the procedure of Random Walk Hypothesis testing and conducts the weak-form efficiency test on the RUB/USD spot exchange rate market, attempting to contribute a particular perspective to the contemporary discourse of foreign exchange market efficiency. The study results demonstrate that while the fitted model coefficients reveal some semblance of random walk behaviors in the chosen spot exchange rate market, the relatively high serial correlation in the residual errors suggests inconsistency with the hypothesis. The study then concludes that further research should be conducted on the benchmark assumptions and model specifications under which the market efficiency is to be validated when investigating foreign exchange market efficiency.

Keywords: Foreign exchange · Market efficiency · Random walk

1 Introduction

The fundamental analysis and technical analysis are two major categories of market analysis approaches. While fundamental analysis scrutinizes the economy, industry, and individual companies, the technical analysis explores recurring trends and patterns throughout the historical data. Both approaches have demonstrated their particular advantages respectively, but the important question lies in when and where to conduct each type of analysis. The conventional way to understand the appropriateness of the market approaches is to verify market efficiency based on the Efficient Market Hypothesis (EMH) proposed by Eugene Fama (1970).

It has almost become customary for all studies exploring mechanical trading to begin with introducing the EMH because it serves fundamental importance for any type of technical analysis. Its hypothesis that there is zero equilibrium expected profit in a random walk-efficient, or in other words, weak-form efficient market provides a theoretical foundation for technical models. To investors who wish to optimize their investment portfolio by maximizing expected return and minimizing risks, the EMH is

also relevant in the sense that it illustrates the relationship between risk and return and explores a potentially inefficient arbitrage opportunity.

To be more specific, the EMH hypothesis asserts that security prices are informationally efficient in a strong-form efficient market, that is, the historical prices of a stock incorporate all public and private information of itself. This is typically rejected on an experimental basis because it is improbable for perfectly strong efficient markets to exist due to potential legal barriers to private information. On the other hand, in semi-strong form efficient markets, security prices are claimed to be accurate reflections of all historical changes and public information. Both fundamental and technical approaches are ineffective in terms of producing excess profit for the traders. Last but not least, the weak-form efficiency assumes that security prices solely reveal past information. A weak-form efficient market is unsuitable for technical analysis because the future prices follow a random walk process (Fama 1970). The determination of specific types of the market requires further testing, but it can be generally interpreted that a risk premium¹ exists if and only if the market involves inefficiency.

Even though EMH was universally accepted in the economics and finance academia in the early years, there has been some controversial debate over the theory's validity throughout the past decades. For instance, in the context of stock markets, critics of the EMH have examined size effects, seasonal effects, excessive volatility, short-run effect versus long-run return reversals of stock prices, drawing attention to external forces, the so-called anomalies, that also played a role in the relation between market efficiency and stock price behaviors (UK essays). The emergence of behavioral economics and finance, which studies the psychological aspect of financial markets, also explains security prices from a perspective that was untouched in the EMH. Evidence suggests that Fama's account of market efficiency was perhaps an oversimplified model of reality.

What about the foreign (forex) exchange market? Does the forex exhibit some form of efficiency and does the EMH hold in the forex market? The exchange rate market is a more sophisticated and globalized one than the stock market because it is under a more complex conglomeration of diverse forces. This study attempts to examine the efficiency of the RUB/USD market by selecting an appropriate model for testing and interpreting the results while taking the contention over EMH into account. To accomplish the goal, we need to first discuss the EMH and efficiency testing methods in the context of the forex market.

2 Testing Methodology

To determine market efficiency, we need to test whether participants in the market can systematically earn an excessive risk-adjusted return. If the market is efficient, the expected difference between the real and expected return at time $t + 1$ should be zero. This rule of thumb is represented by the following equation.

$$E [s_{t+1} - s_{t+1}^* | \Omega_t] = 0 \quad (1)$$

¹ A risk premium is equivalent to the excessive rationally expected return in the forex market on a risk-adjusted basis.

In the forex market, s_{t+1} represents the logged return, or the spot rate at time $t + 1$, while s_{t+1}^* is the expected spot rate, which can be substituted by the future spot rate forecasted using the optimal model under available information at time t . Ω_t represents the complete information² at time t (also denoted as I_t in some literature). This is tested jointly with the Rational Expectations Hypothesis³ (REH), which assumes that expectations are functions based on information sets.

The forex market efficiency can thus be tested by analyzing the forecast residual errors. The major challenge to the method, as Kallianiotis proposes (2018), is finding the optimal forecast model to minimize residual errors such that they do not convey information. The ARMA(p, q) could be an appropriate model to forecast the exchange rate and is determined by Eq. (2). However, it is still difficult to theoretically verify the optimality of the ARMA model and determine and justify the differencing, autoregressive, and moving average parameters.

$$Y_t = c + \Phi_1 Y_{t-1} + \Phi_2 Y_{t-2} + \dots + \Phi_p Y_{t-p} + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \dots + \theta_q \varepsilon_{t-q} \quad (2)$$

The conventional tests of market efficiency in the forex markets can be divided into two schools of thought, either to test historical information of exchange rates based upon an assumption of equilibrium condition, such as the Purchasing Power Parity (PPP) and the Uncovered Interest-Rate Parity (UIP), or to identify an inefficient arbitrage opportunity, including but not limited to spatial arbitrage, put-call-forward arbitrage, or covered-interest-rate arbitrage. The majority of the early studies on market efficiency have chosen the former, testing under a particular perspective of the forex market equilibrium.

For instance, the UIP states that any excessive expected return from speculating currency exchange rate should be countervailed by the interest rate differential between the countries of the quote and base currency and is governed by the following equation.

$$E(s_{t+k} | \Omega_t) - s_t = i_t - i_t^* \quad (3)$$

s_t and s_{t+k} represent the spot exchange rate recorded at time t and $t + k$; i_t and i_t^* are the nominal interest rates of the quote and base currency. Assuming the EMH holds, a market is efficient if only if Eq. (1) is satisfied. It is important to be aware that the UIP might not hold in some market conditions and such reasons have to be addressed. This serves as a major challenge to testing market efficiency under a hypothetical equilibrium condition.

Furthermore, under the Unbiasedness Forward Rate Hypothesis (UFRH), one can use the k -th period forward spot rate available at time t , denoted by $f_t(k)$, as an unbiased predictor for the future spot rate.

$$E(s_{t+k} | \Omega_t) = f_t(k) \quad (4)$$

Then together with the Covered Interest-Rate Parity (CIP) condition which assumes that the interest rate differential is in equilibrium with the difference between spot and

² In reality, Ω_t is the set of information available to the market participants rather than the true complete information, which is inaccessible to the public in most cases.

³ Market participants are rational and risk-neutral in the sense they base their decisions on profit-maximizing rationality, available information, and past experiences. So are these expectations.

forward exchange rates, we can further replace $(i_t - i_t^*)$ with $(f_t(k) - s_t)$. Therefore, we can also construct the following modified regression for testing. Assuming EMH and Eq. (1) hold, the residual errors of the forecast results should follow a white noise process ε_{t+k} ⁴.

$$s_{t+k} - s_t = \alpha + \beta(f_t(k) - s_t) + \varepsilon_{t+k} \quad (5)$$

For instance, this regression was tested in a study of USD/EUR market efficiency (Czech and Waszkowski 1970), which concludes that the USD/EUR market is inefficient based on the statistically significant negative slope parameter β in the conventional UIP regression and analyzing the orthogonality of the forecast errors. The more important discovery draws attention to the failure of assumptions of the UIP and REH and the potential causes behind it.

In addition, it is worth mentioning that there has been evidence demonstrating the failure of the UFRH. If we simply consider the fact that financial assets are not a perfect substitute when priced in different currencies, the forward spot rate could still be a biased predictor for the future spot rate (Levich 1989). As Levich further elaborates, it is inevitable that different specifications of the exchange rate equilibrium benchmarks, such as PPP and UIP, lead to different results regarding market efficiency. When interpreting the empirical results, it is almost impossible to determine whether a specification error of the equilibrium benchmark has played a role in the rejection of the market efficiency hypothesis. Such an issue has to be at least noted if not fully understood.

Other assumptions relevant to market efficiency include the Random Walk Hypothesis (RWH) and the Composite Efficiency Hypothesis (CEH). It is important to note that there is no absolute advantage of one over another, but the assumption specification must be evaluated when determining the testing methodology. This paper chooses to test the RUB/USD market efficiency under the RWH. The RWH asserts that the spot exchange rate behaves like a random walk process.

$$s_{t-1} - s_t = \varepsilon_t \quad (6)$$

This is a relatively simple one that is solely based on the prices of spot exchange rates compared to other models. Note that the random walk model is a special case of the AR(1)⁵ model. We can further fit the following autoregressive model (7) using the spot exchange rate data. Under the RWH, if we have the autoregression parameters $\alpha \approx 0$ and $\beta \approx 1$ and the error term as a white noise process, then we can argue that the random walk model fits the data well. Then presumably we have some evidence that the exchange rate is weak-form efficient and that technical analysis is undependable in the market.

$$s_t = \alpha + \beta s_{t-1} + \varepsilon_t \quad (7)$$

⁴ A White noise process $\{\varepsilon_t\}$ is a random process of random variables with the mean value of zero, constant variance, and no serial correlation. In mathematical notation, $E[\varepsilon_t] = 0$, $\text{Var}[\varepsilon_t] = \sigma$, autocorrelation function $\rho(\varepsilon_{t1}, \varepsilon_{t2}) = 0$.

⁵ The autoregression of order one.

3 Empirical Results

The dataset covers the monthly RUB/USD spot exchange rate, recorded on the last business of each month, from 01/31/2005 to 08/31/2021, and is sourced from the Refinitiv Eikon database (Fig. 1).

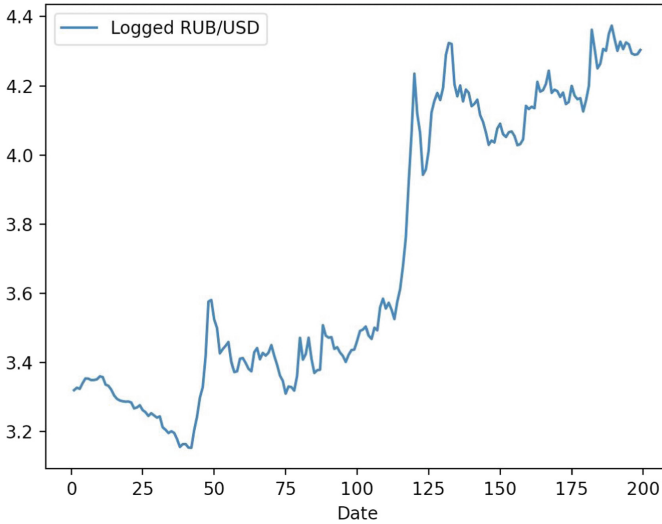


Fig. 1. Logged spot exchange rate of RUB/USD

Formulate an AR(1) model and split the dataset by a 3:1 training-to-testing ratio. The yielded coefficients of fitting AR(1) model with the training data are $\alpha = 0.0111$ with a p-value of 0.784 and $\beta = 0.993$ with a p-value of 0.000, meaning β is statistically significant while the constant term α is not, which is exactly wanted for the RWH to hold in the RUB/USD spot market. The coefficients are within the 90% confidence interval of statistical significance, meaning that we fail to reject the null hypothesis that the RUB/USD spot exchange rate is a random walk process.

$$s_t = 0.0111 + 0.993s_{t-1} + \varepsilon_t \quad (8)$$

However, a high serial correlation of the samples is observed in Fig. 2. The sample autocorrelation of lags greater than one remains far from zero and outside of the significance level. This lets us reject the hypothesis that the data is serially independent, which implies the intrinsic non-stationarity of the RUB/USD spot rate data, and possibly other spot exchange rates as well.

By conducting out-of-time cross-validation on the fitted autoregressive model with the testing set, we can further evaluate whether the random walk model serves some utility in predicting future values, or in other words, whether the future values follow the fitted AR(1) model (Fig. 3).

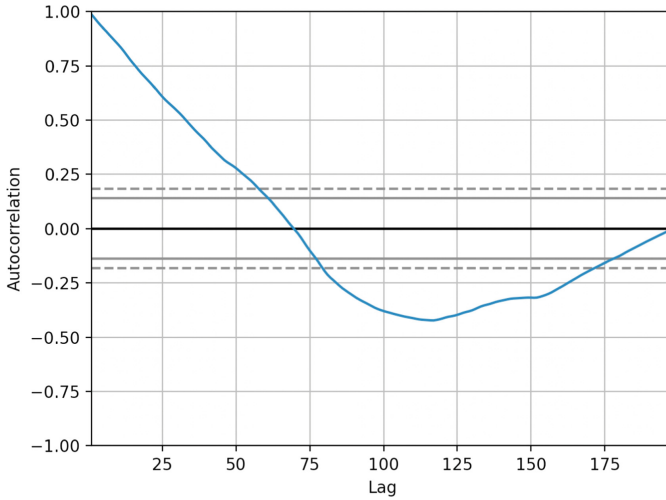


Fig. 2. Autocorrelation plot

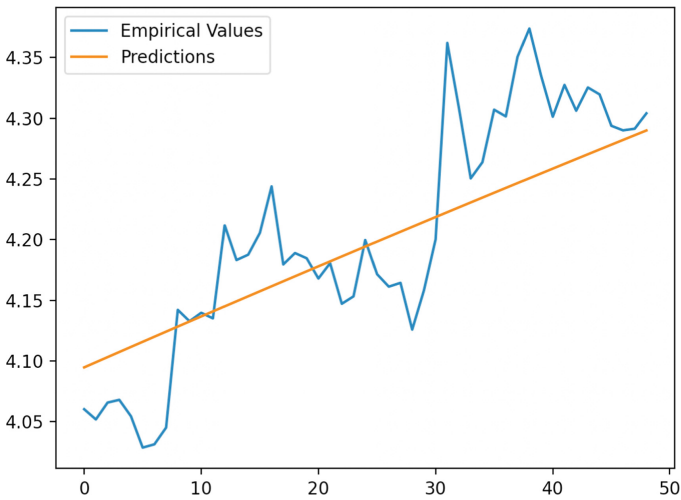


Fig. 3. AR(1) prediction results

We can observe that the fitted model captures the long-term trend. However, the model fails to describe the volatile behaviors over the last 50 periods because it is visible that the sample deviation remains large during non-dynamic prediction. This implies that even though we have a fitted autoregressive model with coefficients close to our expectation, its properties that resemble a random walk process might not remain unchanged in the future because the residuals seem to contain a relatively significant portion of unexplained information. To further understand this, we analyze the residual errors of the fitted model on the training set (Fig. 4).

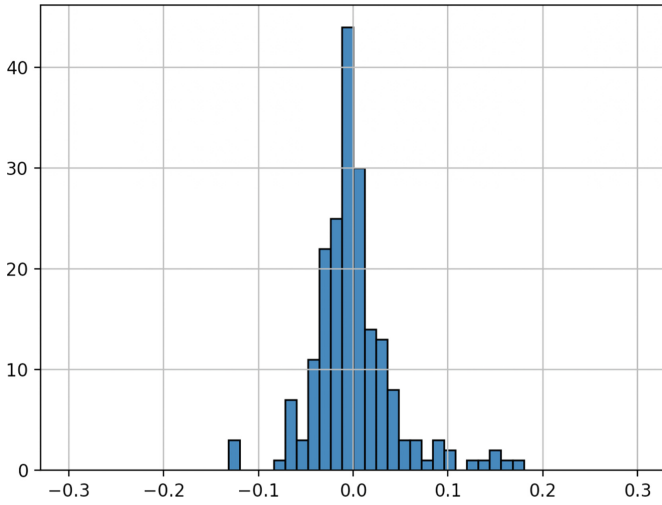


Fig. 4. AR(1) residual distribution

Despite that the standardized residual errors are roughly normally distributed with mean $E[\varepsilon_t] = 0$ and variance $\text{Var}[\varepsilon_t] = 1$ after rounding to the nearest hundredth, they do not appear to be serially independent or uncorrelated (Fig. 5).

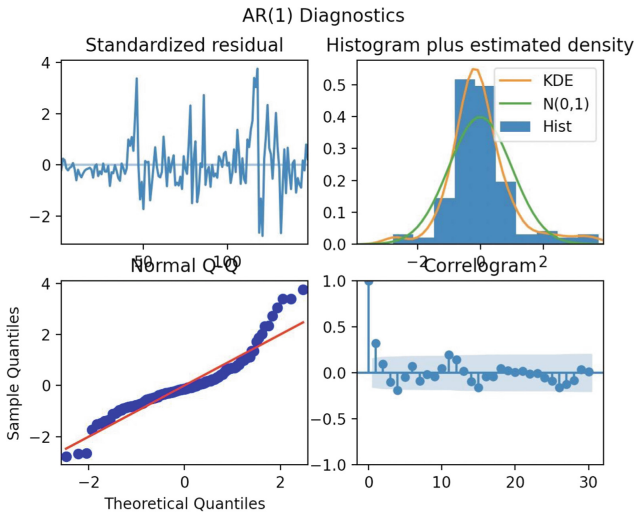


Fig. 5. AR(1) residual diagnostics

The highly volatile standardized residuals display non-uniform variance. The distributional histogram, the correlogram, and the Normal Q-Q plots all suggest serial correlation and unexplained heteroskedasticity in the residual errors. Indeed, conducting the Durbin-Watson test on the residual errors produces a test statistic of 1.357, which

hits the rejection interval of the null hypothesis of no serial correlation. It is important to acknowledge that additional differencing of the raw data certainly could have helped eliminate the serial correlation, but this provides us with some statistical evidence that the error term ε_t of the autoregressive model is not serially uncorrelated and thus does not qualify a white noise process, which violates the assumption under RWH. Therefore, the abnormal behavior of the error term implies a controversy of applying the random walk model to the RUB/USD spot market.

4 Conclusion and Discussion

The random walk testing of the RUB/USD spot market has produced interesting results. Assuming that the RWH holds, the autoregressive coefficients provide us with strong statistical evidence that the exchange rate is weak-form efficient. However, the high serial correlation of the spot exchange rates and the residual errors of the AR(1) model concerning lags greater than one, reveal the inherent non-stationarity of the data and potentially the inapplicability of the random walk model under such conditions.

In turn, we can also argue that the RUB/USD exchange rate does not behave as a random walk under the RWH because of the anomaly in the residual error term, but we are uncertain whether it is the specification error of the random walk model that is responsible for our rejection of the null hypothesis of weak-form efficiency. Therefore, the results can be interpreted in very different ways, which leads to the question of whether we can accept or reject the weak-form efficiency hypothesis based on the RWH.

One could potentially obtain more meaningful results by applying additional differencing on the dataset to reach stationarity, or by designing a model that better explains the serially correlated component of the data such as ARMA(p, q). Or the random walk model could be further complicated by adding additional drift parameters if appropriate. However, additional assumptions need to be made following that of the RWH and are beyond the scope and capability of this paper.

Overall, we cannot simply conclude weak-form market efficiency based on the random walk model as additional specifications and diagnostics tests must be addressed. The EMH has certainly been controversially debated, but the contention cannot be simply resolved by testing particular markets under simple assumptions. Further analysis should be directed at the validity of the benchmarks under which the EMH is to be tested and the appropriateness of the selected model relevant to the fundamental and statistical properties of the data to offer more insightful conclusions.

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The Impact of Negative Interest Rate Policy on Bank Loans

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Abstract. After the 2008 financial crisis, the central banks of many countries have successively adopted the unconventional monetary policy, that is, Negative interest rate policy (NIRP), to regulate the economy. However, the effect of the monetary policy has been controversial. This paper examines the impact of Negative interest rate policy adoption on bank loan behavior (Loan Quantity, Loan Quality and Loan Structure) in Eurozone countries and Non-Eurozone countries. Using a sample of 35 banks in the treated group and 65 banks in the control group during the period of 2012–2017, along with panel data analysis, this study finds evidence that the adoption of NIRP has a positive effect on the growth of loan quantity and improves loan quality. In addition, NIRP adoption can change the structure of bank lending. Therefore, Negative interest rate policy has a certain role in economic adjustment, and it can be considered to implement in specific situations.

Keywords: Negative interest rate policy · Loan quantity · Loan quality · Loan structure

1 Introduction

Negative interest rate policy (NIRP) is an unconventional monetary policy tool. The central bank lowers the nominal interest rate down to a negative value primarily to discourage banks from depositing their excess cash in the central bank. In July 2009, Sweden firstly implemented ‘NIRP’, declining its overnight deposit rate to -0.25% [8]. The European Central Bank (ECB) who followed in June 2014 decreased the deposit to -0.1% , considering that the negative interest was the key to break the vicious circle of Eurozone’s deflationary spiral - in which cash is held on during economic downturn because people are waiting for recovery. However, this kind of policy would ulteriorly weaken the situation by reinforcing people’s fears with insufficient liquidity [1].

It is observed from empirical studies on NIRP that the majority of scholars hold a negative attitude towards the efficacy of this policy [10, 14, 21]. This phenomenon could partially be explained by the situation that most studies focus on the absolute value obtained in statistical methods under a specific time series, while few studies may consider comparing the test results with the data from NIRP-adopter regions under

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the same time series to get the relative value. Therefore, our paper contributes to the literature by examining the changes in the quantity, quality and structure of loans in universal commercial banks and wholesale commercial banks in Eurozone relative to non-adopter regions during 2012–2017. Through this process, it acquires a conclusion to some extent opposite to the mainstream thesis.

The paper proceeds as follows. Section 2 reviews relevant viewpoints stated in previous literature on NIRP. Section 3 introduces the source of data and the methodology implied in our research. Section 4 presents statistical results with proper explanations. Section 5 summarises our discussion and explanation and provides a conclusion.

2 Literature Review

The impact of monetary policies on commercial banks is diverse and complex. As far as the eurozone is concerned, the European central bank can control the short-term market interest rate at a specific target, and then the change of interest rate level will undoubtedly have an impact on bank profitability and lending capacity [2]. In the period of positive interest rate, the correlation has been proved by previous literature [3, 13]. However, when the nominal interest rate falls to negative value, the impact may be different from the past. There are theories that indicate how unconventional monetary policies (UMP) can influence the bank lending behaviour. These theories emphasise the existence of market failure, which revises the standard results provided by Modigliani and Miller (1958) [15]. Kishan and Opiela (2000) [13] state that negative interest rate policy can affect bank lending given the adverse selection problems. It depends on the imperfection of the bank debt market, which can have an effect on banks' fund-raising opportunities called "bank lending channel" [20]. Based on the "bank lending channel" argument, monetary deflation influences bank lending behaviour due to the fact that the decrease in reservable deposits cannot be fully offset through releasing non-reservable liabilities [11]. According to Gambacorta and Mistrulli (2004) [11], investors should be paid for a "lemon's premium" because the bank debt market has zero friction and non-reservable liabilities generally don't take out an insurance policy. For this reason, bank capital plays a significant role in banking behaviour since it influences external ratings of banks as well as provides credit information for the investors.

In addition to the above impact mechanism, the negative rate policy can also increase bank deposits by improving banks' risk tolerance. Borio and Zhu (2008) [3] put forward the risk-taking channel of monetary policy explicitly for the first time after the outbreak of the mortgage crisis. They indicate that the impact of monetary policy on risk-taking is the relationship between monetary policy and financial stability. Low interest rate can have an effect on the bank risk measurement through its impact on value and cash flow [3]. In the beginning, the long-term low interest rate stimulates the value of assets and collateral, and then it can further affect banks' estimates of market fluctuation, default probability and default loss rate [1]. Meanwhile, the managers of banks can always have a fixed optimism that the market will sustain prosperity under the abundant liquidity, thus reducing the degree of risk aversion endogenously [14]. Therefore, loose monetary policies may improve the risk tolerance of banks. Also, balance sheets of banks will improve, and their leverage ratio will drop when asset values increase. The Improvements

of balance sheets are able to make banks more willing to lend and thus lead to higher risk-taking since the number of safe lenders is fixed on the whole [6]. Furthermore, Rajan (2005) [18] indicate that negative interest rate may lead asset managers to take more risks for reasons of contractual and behavioural systems. When interest rates are high, financial institutions can invest in safe assets to obtain the required recipients. When interest rates are low, they are encouraged to invest in risky assets to meet debt repayment needs [9]. In addition, the higher the return of safe assets, the higher absolute earnings the managers can get by investing in safe assets, which reduces their incentives to invest in high-risk assets. On the contrary, it is stated by Rajan (2005) [18] that fierce competition can encourage banks to hold more risky assets in order to make higher profits. Therefore, the combination of credit expansion and market competition may help banks to increase profits through relaxing credit standards [10].

However, most of the above studies on the negative interest rate policy stay at the qualitative level, and there is still a lack of quantitative research on the effect of the negative interest rate policy. Moreover, in the few quantitative studies, there is a lack of extensive selection of samples. The previous studies only have research on countries that have implemented the negative interest rate policy such as the Eurozone and Japan, which can cause estimation bias. In addition, the literature mainly shows that the negative interest rate policy has an impact on the savings capacity and savings structure of commercial banks. Whether this impact will influence the lending behavior of commercial banks and further affect the traditional monetary policy credit transmission mechanism is worthy of further study. Based on the analysis, the paper aims to investigate the impact of the negative interest rate policy on loan quantity, loan quality and loan structure by using empirical research.

This paper makes the following contributions. First, the negative interest rate policy is an unknown field both theoretically and empirically since it is implemented for a few years. Compared to existing literature, our analysis makes a significant contribution to examine empirically how negative policy rates affect banking lending behaviour. According to Rognlie (2016) [19], New Keynesian macroeconomic models can be one of the research methods to estimate the influence of negative policy rates; however, the theory does not take banking sector into account explicitly. There is little study considering the relationship between negative policy rates and bank lending behaviour. Also, we expand data sample by adding many different countries in NIRP adopter region and non-adopter region, thus making the experiment more convincing by setting up a control group. At last, we extend the study on the bank lending channel such as bank credit loans while previous papers mainly pay attention to the influence of liquidity provision and programs about asset-purchase [17].

3 Methodology and Data

3.1 Data

In order to control exogenous variable, sample data was restricted in bank types and area. Our sample comprises universal commercial banks and wholesale commercial banks from Eurozone countries and Non-Eurozone countries in Europe (Russia, Poland and the United Kingdom) in the period of 2012–2017. The source is Fitch Connect database.

The Eurozone countries which implemented negative interest rate policy in 2014 are the treated group and Non-Eurozone countries which maintained the same interest rate policy are the control group. That all banks are from European countries is for eliminating or diminishing different economic policies in disparate regions purpose. Moreover, since lending behaviours vary in different types of banks, we decided to choose one of these types, which are commercial banks, to analyse their lending behaviour.

There are 35 banks in the treated group and 65 banks in the control group, including three panels, Growth of Gross Loan, Imp. Loans (NPLs)/Gross Loans and Corp. & Commercial Loans/Gross Loan.

Panel 1 (Growth of Gross Loan) presents the quantitative statistics for bank lending. The Growth of Gross Loan show changes in gross loan between years, and the effect of NIRP implemented in 2014 on commercial banks can be revealed by changes in the growth rate of the gross loan.

Panel 2 (Imp. Loans (NPLs)/Gross Loans) presents the qualitative statistics for bank lending. A diminishing Imp. Loans/Gross Loans rate means the quality of gross loan is improving and thus can be used to show the influences of NIRP on the quality of banks' lending.

Panel 3 (Corp. & Commercial Loans/Gross Loan) presents the structure for bank lending. The two main types of loan in commercial banks are mortgages and corp. & commercial loans, therefore change in the ratio of corp. & commercial loans can be used to express the change in banks' loan structure to show NIRP's effect.

3.2 Methodology

In order to identify the effect of NIRP on banks' lending behaviors, referring to the research of Xiao and Kong (2014) [22], regression models are set to analyze the change of three panels after the implementation of NIRP.

First, we use model (1) and (2) to investigate the bank lending behaviors in Eurozone countries and non-NIRP affected countries separately and compare the results. The regression models are shown as follow:

$$Y1t = c + \beta1 * D1t + ut \quad (1)$$

$$Y2t = c + \beta2 * D1t + ut \quad (2)$$

where Y1 and Y2 represent the observations of banks of NIRP-affected and non-NIRP-affected countries respectively (measured by Growth of Gross Loan, Imp. Loans (NPLs)/Gross Loans and Corp. & Commercial Loans/Gross Loan) at time t ; D1 is a dummy variable that takes the value 1 at 2014 and after 2014, which is the year of the implementation of NIRP, and equals 0 before that period; $\beta1$ and $\beta2$ represent the change of Y1 and Y2, and that β is greater than 0 means Y shows a increasing trend after 2014, otherwise Y show a decreasing trend.

In the next step, we run a cross test with a similar regression model but different dummy variable to show the difference between NIRP-affected observation and non-NIRP affected ones directly. The regression models are as follow:

$$Y3t = c + \beta3 * D2t + ut \quad (3)$$

where $Y3$ represents all the observations (measured by Growth of Gross Loan, Imp. Loans (NPLs)/Gross Loans and Corp. & Commercial Loans/Gross Loan) at time t ; $D2$ is a dummy variable that takes the value 0 when $Y3$ is not affected by NIRP (means when $Y3$ represents observations of NIRP affected countries before 2014 and all non-NIRP affected countries observations), and equals 1 otherwise; $\beta3$ represents the change of $Y3$, and if $\beta3$ doesn't equal 0, we can believe that NIRP have effect on banks' lending behaviours.

4 Data Analysis

4.1 Loan Quantity

Table 1. The statistical result of growth of gross loans

	Eurozone	Non-EU	Cross
Multiple R	0.062802816	0.166892053	0.072396433
R Square	0.003944194	0.027852957	0.005241244
Adjusted R Square	-0.000844536	0.025347424	0.003577767
β (Coefficients)	54.44014286	-18.44696154	42.0376087
P-value	0.365168035	0.000937946	0.076399387
t Stat	0.907546635	-3.334153116	1.775042991

Table 1 demonstrates the changes in Growth of Gross Loan. The positive β of NIRP adopter region illustrates a growth trend in growth of gross loan after the implementation of NIRP in 2014. However, the P-value of this coefficient is greater than 0.05, implying that this result is insignificant. Therefore, we may draw a conclusion that there was no significant change in growth of gross loan after the implementation of NIRP. The result of the non-adopter region shows a significant decreasing trend around 2014. Since no critical interest rate policies that could potentially have influence on commercial banks' lending behaviours were implemented between 2012–2017, we have reasons to believe the decreasing trend in growth of gross loan is caused by other exogenous variables that are not related to NIRP, which means this decreasing trend can be regarded as a fixed trend over time. In addition, since there was no significant change in growth of gross loan in NIRP adopter region and an evident decreasing trend in Non-Eurozone countries after 2014, it is believed that NIRP has positive impact on the growth of gross loan of commercial banks. The result of cross test gives the same conclusion, that the NIRP-influenced growth of gross loan is significantly larger than the remaining ones, showing a positive effect of NIRP on the growth of gross loan.

NIRP is a quantitative easing monetary policy implemented by the central bank to stimulate the growth macroeconomic [5]. Since the policy is aimed at enlarging banks' lending scale by charging a negative interest rate on their excess reserves, our result indicates that NIRP achieved its desired effect.

4.2 Loan Quality

Table 2. The statistical result of Imp. Loans (NPLs)/gross loans

	Eurozone	Non-EU
Multiple R	0.066408	0.11132
R Square	0.00441	0.012392
Adjusted R Square	-0.00038	0.009847
β (Coefficients)	-1.15293	1.202115
P-value	0.338238	0.027937
t Stat	-0.95987	2.206461

Table 2 presents the results of the main tests of the banking lending quality, using Imp. Loans and Gross Loans in NIRP adopter region and non-adopter region from 2012 to 2017, in order to indicate the change of bank loan quality standards. The coefficient on the variables in NIRP adopter is negative, and its p-value equals 0.3382, which means we should reject the null hypothesis and it is statistically insignificant at the 5% level. However, the control variables in the Imp. Loans/Gross Loans regressions displayed in Table 2 have the positive sign and are statistically significant at the 5% level since the p-value equals 0.0279. Thus, the two groups are statistically different. The banks in non-adopter region have a higher Imp. Loans/Gross Loans ratio than banks in NIRP adopter region, and their loan credit standard is relatively lower. As a result, the monetary policy has a positive effect on bank loan behaviour. The countries implementing NIRP experienced an improvement in bank lending quality compared to those in non-adopter region did not follow this policy.

This result is consistent with the empirical conclusion from Darmouni and Rodnyansky (2017) [8]. They demonstrate that the negative interest rate policy may lead banks to carry out higher loan standards including leverage-based and risk-based. It is also in line with Berger and Udell (2002) [4] that banks take more formal actions for lending such as improving regulator supervision, controlling CAMELS ratings and raising the standard of assets classification. Therefore, the observed loan performance problems of banks are low due to the decrease of impaired loans.

4.3 Loan Structure

Loans in commercial banks can mainly be divided into two categories: mortgages and corp. & commercial loans. A mortgage is a loan secured by the borrower's property. It is used to raise fund to buy real property (like real estate), or for property owners to raise money for else purposes. Because the applicants are prevalingly individuals, the growth of mortgages to some extent represents the enhancement of consumer spending. Corp. & commercial loans are debt-based funding method typically for business to fund major capital expenditures from banks or to cover operational costs such as the purchases

of raw material and mountings or the trade by commodities [7], thus correspondingly related with commercial investment and employment rate.

Table 3. The Statistical result of corp. & commercial loans/gross loans

	Cross
Multiple R	0.2671
R Square	0.071343
Adjusted R Square	0.06979
β (Coefficients)	-0.19685
P-value	2.93E-11
t Stat	-6.77793

The result in Table 3 explains the change of the structure of bank loans. The ratio of corp. & commercial Loans to gross Loans was significantly reduced after the implementation of negative interest rate policy. Reversely, it implies that the occupation of mortgages in gross loan rose at the same time, which proves the existence of the crowding-out effect [8]: with the conduction of quantitative easing, mortgage lending may crowd out commercial lending simultaneously. Furthermore, in the negative interest rate environment, the bank's net interest income decreases with the decline of policy interest rate due to the destruction of the stable deposit and loan interest margin [17]. In order to maintain the overall profit level, commercial banks will increase non-interest income through commissions and various service fees. At the same time, banks will actively consider appropriate asset allocation and reduce high risk investment to avoid losses caused by the reduction of net interest income [6]. Therefore, the shifting of banks' lending resource probably suggests that during this period mortgages are relatively low risk in comparison with corp. & commercial loans and banks' investing attitude tend to be more conservative given the economic situation in recent years. This conjecture is highly consistent with our test result in Sect. 4.2, in which the quality of bank loans is relatively improved in NIRP-adopter countries.

5 Conclusion

To conclude, when the monetary policy is implemented by central banks, it has the potential to have a significant effect. This paper empirically investigates the impact of the negative interest rate policy on bank loan behavior by using data from NIRP-adopter countries and non-adopter countries. We identify that by analyzing Growth of Gross Loans in these two groups, NIRP adopter region experienced a higher growth of gross loan than non-adopter region. In addition, compared to those countries which did not follow the negative interest rate policy, NIRP adopter countries had a higher lending quality standard. The paper comes to the result by using Imp. Loans (NPLs)/Gross Loans as an indicator, and NIRP adopter region has a relatively low value. Also, it

changes the structure of bank lending, which reduces the ratio of corp. & commercial Loans to Gross Loans. Therefore, the central bank should pay much attention to the impact of its policies on bank loan behavior, and then their impact on the effectiveness of the monetary policy. In addition to the adoption of the Negative interest rate policy, there are countries comprehensively using unconventional monetary policy tools such as Forward Guidance. There may be interaction effects between different instruments, which have a common impact on the economy. Therefore, the central bank needs to consider combining the negative interest rate policy and other policy instruments into a framework for research in the future.

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The Overview of Indonesia's Exchange Rate Changes and Influencing Factors

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Abstract. Indonesia is the fourth most populous country and the 16th largest economy globally. The variability of the exchange rate, of which movements are a concern for regions, influences the economy significantly due to its essential role in the international currency market. Therefore, the exchange rate is worth being evaluated. Indonesia has experienced economic fluctuation after world war II. The domestic political and economic factors impress the IDR exchange rate a lot. 1997 Asian financial crisis influenced Indonesia's economy development profoundly, and thus led to the sharp depreciation of the IDR exchange rate. After the 1997 crisis, the IDR exchange rate has gone through mainly five stages of change: fluctuation, depreciation, stability, appreciation, and concussion with a generally depreciating trend. The changes related to several causes, covering the domestic policy, the global financial crisis, and the global economic condition. There is also some leading causes influence exchange rate such as domestic political and economic factor, the US dollar factor and the price of international petroleum.

Keywords: Indonesia rupiah · Exchange rate · Economic change · Financial crisis

1 Introduction

Indonesia, a developing country, is located in the southeast of Asia, composing 17506 islands to be the world's largest archipelago country. Indonesia is the fourth most populous country in the world, with a population of over 280 million. Also, Indonesia is one of the founding countries of the Association of Southeast Asian Nations and a member of the G20. Indonesia was the largest economy in ASEAN. Indonesia is the 16th largest economy globally [1]. Moreover, the variability of the exchange rate, of which movements are a concern for regions, influences the economy significantly due to its essential role in the international currency market [2]. Therefore, the IDR exchange rate has the value of being researched and evaluated.

Bank Indonesia is the central bank responsible for implementing exchange rate policies and managing foreign exchange reserves. The legal currency is the Indonesian rupiah, which cannot be used or transferred abroad. Except for some specific items, foreign exchange settlement is not allowed in Indonesia; Indonesia implements managed floating exchange rate regime, and the exchange rate is determined by the supply and

demand in the foreign exchange market [3]. Bank Indonesia is mandated with creating and maintaining rupiah stability. To achieve this goal, BI assumes essential responsibilities such as formulating and implementing monetary policy, promoting the construction of the payment system, supervising the banking system, issuing currency, formulating exchange rate policies, managing foreign exchange reserves, and acting as the lender of last resort [4, 5]. BI makes use of several monetary policy measures such as adjusting interest rate to control inflation; keeping the exchange rate consistent with fundamentals and optimized the intervention in foreign exchange market and treasury bond market to minimize the volatility of IDR; keeping liquidity; strengthening the construction of Global Financial Safety Net (GFSN), and strengthening the policy coordination to maintain economic stability and attractiveness of the domestic financial market, and ensure that the current account deficit is within a safe range [6].

After going through the early political issues and wars and the 1997 Asian financial crisis, which posed severe and prolonged adverse effects on the economy of Indonesia [7], the IDR exchange rate has gone through mainly five stages of change: fluctuation, depreciation, stability, appreciation, and concussion with a generally depreciating trend (Fig. 1).



Fig. 1. IDR exchange rate tendency (USD/IDR)

This paper will demonstrate the overview of the early factors relating to the development of Indonesia's currency, the impact of the 1997 Asian financial crisis and the trend of IDR exchange rate after the 1997 Asian financial crisis, and the impressive spot and reasons influencing the IDR exchange rate.

2 The Influencing Characteristic of Indonesia Currency Development Before 1997 Asian Financial Crisis

According to Perkins (2021) [1], Southeast Asia suffered a lot after World war II. In terms of Indonesia, the wars and political issues led to long periods of stagnation.

Indonesia declared its independence in 1945 and terminated the colony under Dutch in 1949. Simultaneously, President Sukarno proclaimed that international political affairs were responsible for the president and government, which led to the leave of Dutch and other foreign investors of Indonesia posing threats to its economy relating to politics. Additionally, the military rebellion in 1957 and controversy of the Lrlan Barat in 1958 became the main issues, which led to the political turmoil. The fiscal deficit has increased during that period, inflation has risen, and foreign exchange reserves have weakened. Apart from politics, the geopolitical risk can also lead to the long-run depreciation of the domestic currency. In the 1960s, the proxy war of the confrontation between Indonesia and Malaysia took place to prevent the states of northern Borneo from being incorporated into new Malaysia. Also, Indonesia set war with Dutch over the west of New Guinea. These geopolitical risks led to the depreciation of IDR [8]. Moreover, to maintain the balance between the Indonesian communists and the national army, President Sukarno declared a contest, which ended up with a bloodbath in 1965. During that period, the economy has been hit hard [1]. On the contrary, Indonesia's GDP increased by 6.5% while the GDP per capita grew at 4.4% from 1968 to 1996, which is politically stable [9].

3 The Impressive Event Affecting IDR – 1997 Asian Financial Crisis

The IDR exchange rate experienced the most significant fluctuation and depreciation during the 1997 Asian Financial crisis. In 1997, the currency speculation attacks raised the curtain on the Asian financial crisis, leading to the sharp depreciation of the exchange rate in the Asian economy [2]. The heavy corruption and foreign currency debts without hedging against foreign exchange rate risks were the reasons that brought the crisis to Indonesia [1]. During the crisis, Indonesia suffered the most dramatic depreciation and most from contagion [10].

According to the economists who support the floating exchange rate system, the floating regime may help avoid the financial crisis, and the fluctuation of the exchange rate may absorb some shock to reduce the pressure of change in the exchange rate [11]. Therefore, to recover from the 1997 Asian financial crisis, Indonesia emerged in the transition of its exchange rate regime. Indonesia canceled the pegged exchange rate system used before the crisis having the possible defect of triggering currency crisis and macro-economy instability caused by the mobility of exchange rate between USD and JPY. However, the free-floating exchange rate regime Indonesia adopted during the crisis also adversely affected its economy and caused sharp depreciation and fluctuation of IDR. Finally, Indonesia emerged in the managed exchange rate regime, which helped IDR tend to stabilize, and the volatility was significantly weakened [12].

To ameliorate the economy, Indonesia received help from the International Monetary Fund rescue program during the crisis. Under the assistance of the IMF, the Indonesian government made an effort to restimulate the macroeconomic stability and restructure the financial sector by launching both macroeconomic and microeconomic reform programs [7]. The adoption of the IMF program contributed to the speed and size of recovery from the financial crisis to some extent [13].

4 IDR Exchange Rate Tendency and Main Event After 1997 Asian Financial Crisis

With the follow-up impact of the 1997 Asian financial crisis, the IDR exchange rate experienced dramatic fluctuation, which was harmful to the economy development. In 2001, the economic growth rate was only 3.6%, the unemployment and inflation rates were 8.1% and 11.5%, respectively. The exchange rate between the Indonesian rupiah and the U.S. dollar fluctuated drastically and entered a two-and-a-half-year period of shock adjustment. IDR volatility was reduced from 2001 to 2002 because of the transition to managed floating exchange rate regime by Bank Indonesia, aiming at enhancing the BI's intervention to the foreign exchange market to prevent excessive fluctuation of IDR. The weakening of strong dollar policy also made an effort to reduce the volatility of IDR in 2002. In 2003, the economy recovered to some extent with the appreciation of IDR to reach 8285.

However, IDR began to depreciate continuously from 2003 to 2005. Even though president Susilo stabilized the turbulent political situation, which slowed down the depreciation of IDR, the world bank lowered the expectancy for Indonesia's economic growth in 2005, leading to fewer foreign investors, and the price of international oil increased sharply, forcing the government to raise the domestic oil price, which aggravated the depreciation.

After that, based on the stable condition, IDR gradually entered the state of slight appreciation and became the most stable monetary in southeast Asia, ushering the IDR's golden age from 2005 to 2008. The stability and slight appreciation were related to economy development, the stability of the economy, and the improvement of the external investing environment. Unfortunately, the international financial crisis took place in 2008, the exchange rate of Asian counties has fallen significantly, including IDR, which became the currency with the most significant decline after the KRW. To deal with it, the Indonesian government adopt the easy money policy, including reducing taxation and increasing fundamental investment, and the political stability contributed to the recovery of the IDR exchange rate. From 2011 to 2015, IDR began to depreciate because of the termination of quantitative easing monetary policy by the Federal Reserve in 2013 and the unoptimistic economic environment in 2015. From 2016 to 2018, IDR appreciated associated with the government's policy, such as stimulating the domestic investment and control inflation, which helped with Indonesia's economy. Until the COVID-19 pandemic, the IDR was stable after slight fluctuation [14–16]. During the pandemic, IDR depreciated sharply and experienced a dramatic fluctuation. Until August 8th, the IDR/USD ratio is 14350.

5 The Leading Causes of the Change of IDR Exchange Rate

According to Liu (2011) [14], several reasons lead to the change of Indonesia's currency, such as the domestic economy and politics, the U.S. dollars, the international oil price, and the natural disasters. This paper will discuss the U.S. dollar and the price of international petroleum in detail.

Marxist theory's dialectical relationship between politics and economy illustrates that economy is the basis of politics, politics is the concentrated expression of economy, and it is counterproductive to the economy. It reflects that political stability is one of the crucial prerequisites for economic development. Therefore, the stability of politics is associated with the expectancy of IDR by investors who will affect the USD/IDR ratio. Therefore, politics is a factor that will influence the IDR exchange rate is worth to be analyzed. Also, Mundell's (1963) and Dornbusch's (1976) classic analysis describes a world of perfect capital mobility in which flows of international capital are unlimited and where assets are denominated in domestic and foreign currencies, are perfectly substitutable [17, 18]. Under this circumstance, the fiscal policy will influence the exchange rate by the currency demand if a small open economy's exchange rate is market-determined. In addition, the exchange rate is a variable controlled and influenced by many factors. Sometimes accidental outbreaks will also affect the trend of IDR and change the exchange rate trajectory in the short term. Indonesia is a country that is prone to natural disasters such as earthquakes and tsunamis. Such natural disasters cannot be accurately predicted, but it does have a non-negligible effect on the Indonesian currency.

5.1 U.S. Dollars

The domestic economy and politics are essential factors that cause the changes in the IDR exchange rate. Apart from the domestic factor, the American economy also plays a vital role in affecting the IDR exchange rate. The United States, the world's largest economy, plays a decisive role in the international economy. Additionally, the financial market infrastructure and global trade are mainly based on U.S. dollars. Therefore, the balance of the international economy is associated with the central role of the U.S. dollar as a global currency [19]. According to McLeod (1983) [20], the dollar is also the major reserve currency globally. After the Asian financial crisis, countries in Southeast Asian have increased the reserve assets management to prevent the recurrence of the 1997 Asian financial crisis. Indonesia's foreign exchange reserves are primarily held in U.S. dollar deposits or U.S. dollar treasury bonds. If the dollar depreciates, it will directly lead to a substantial shrinkage of its foreign exchange assets, and fluctuations in the value of the U.S. dollar will inevitably cause an imbalance in the foreign exchange markets of Southeast Asia, leading to a severe depreciation of the local currency. Also, as Indonesia's largest trading partner and traditional export market, the United States is bound to affect Indonesia's economy and the price ratio between the Indonesian rupiah and the U.S. dollar. Therefore, the fluctuation of USD will influence IDR to a great extent. In addition, since 2018, as an important country along the Belt and Road and the trade partner relying heavily on both China and the USA, Indonesia is also influenced by the Sino-US trade friction [21]. According to Malliaris and Malliaris (2020), the yield

rate of the dollar is one of the determinants of the international oil price, which also plays a vital role in Indonesia's currency (will be illustrated in the next part) [22].

5.2 The Price of International Petroleum

Moreover, the global oil price changes are also the leading causes of the change of the IDR exchange rate. In recent years, with the improvement of the strategic position of oil, the fluctuation of international crude oil prices has increasingly exerted a significant influence on the world economy [23]. In the international market, crude oil is a product with relatively slight differences in quality, priced in U.S. dollars globally, aiming to raise the cost-effectiveness and efficiency of transaction and information transmission. In the fast-growing economy period, Indonesia relies heavily on energy, in which the domestic energy supply cannot fulfill its demand and depends on the import of petroleum [24]. Also, the high price of international petroleum will induce financial, social, and imbalance, particularly in those countries depending on the import of oil [25]. Therefore, Indonesia is very sensitive to fluctuations in international crude oil prices and enhances sensitivity for dollars. Changes in international oil prices affect the relative price ratio between the Indonesian rupiah and the U.S. dollar.

6 Conclusion

This paper first demonstrated the worth of researching Indonesia's currency, of which movements are a concern for regions, influences the economy significantly due to its essential role in the international currency market. Even though Indonesia is a developing country, it has the fourth-largest population and is the 16th economy globally. Then it discussed the influencing characteristic before the 1997 Asian financial crisis, primarily because of the after-war, political, and geopolitical issues. The 1997 Asian financial crisis impressed significantly on IDR. After the crisis, the IDR exchange rate experienced fluctuation, depreciation, stability, appreciation, and concussion with a generally depreciating trend. Finally, it illustrated the critical events relating to the IDR exchange rate movement. The main influencing factors of the IDR exchange rate including domestic economy and politics, natural disasters, U.S. dollars, and the international price of petroleum, which play an essential role in Indonesia's economy. This paper has some limitations, such as lacking updated data and recourses, mainly focusing on the changes before the covid-19 pandemic, which cannot fully reflect the current IDR exchange rate. Also, this research is a little bit general, with a short passage that does not discuss each part in detail. In the future, this paper will allocate the data and reference under pandemic and pay attention to the current changes and follow the latest trends.

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Sustainable Marketing with Consumer-Driven Strategies—The Case of Oatly

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Abstract. Generation Z, known as the sustainable generation, has transformed the consumption landscape. They tend to view consumption as an expression of identity and as a matter of ethical concerns. In addition, the COVID-19 pandemic has accelerated changes in consumer preference, demanding products that provide environmental, social, and economic benefits. Based on a literature review, marketing success often involves identifying and satisfying the right segments of the market. Sustainability marketing could be utilized as a competitive edge for brand differentiation. We conducted a marketing case study on the Swedish lifestyle brand Oatly. The brand considers sustainability the core of its business and has implemented consumer-centric marketing strategies. The Oatly case presented in this research includes assessing the dairy alternative landscape, market segmentation, products proposition, and consumer experience. To conclude, retail companies, especially food businesses, constantly face opportunities and challenges from the ever-changing consumption landscape. It is advisable to implement sustainable marketing with consumer-driven strategies to establish competitive advantage, brand differentiation, and brand loyalty in the long run.

Keywords: Sustainable marketing · Corporate social responsibility · Market segmentation · Consumer communication · Food businesses · Generation Z · Oatly

1 Introduction

The COVID-19 pandemic has changed people's lifestyles and purchase behaviors drastically. Consumers and companies are becoming more interested in making eco-friendly choices, especially for the food and fashion industries. Generation Z are emerging as the sustainability generation [1]. Companies have an unprecedented opportunity to prioritize sustainable business practices for the people, the planet, and the profit. In response, businesses must have a more profound understanding of their target consumers through market segmentation.

Due to the high demand for healthier and more sustainable food alternatives, Oatly, a Swedish oat-milk company, had experienced a shortage during the COVID-19 pandemic. In May 2021, the company has its market debut on New York Stock Exchange (NYSE), joining the notable Beyond Meat as one of the few plant-based public companies. Oatly

is the largest oat milk company. It is considered one of the uprising competitors in the dairy alternatives market. The brand views sustainability as its core business. Oatly publishes annual sustainability reports on its environmental impact. Being the first to release carbon footprint data on its package labels, the company also challenged the food industry to do so for consumer transparency [2]. Backed by thoughtful market segmentation, Oatly has built brand awareness and loyalty through unconventional and quirky marketing campaigns, aligning with target consumers' attitudes and lifestyles.

The purpose of this case study is to explore sustainable marketing strategies in the retail industry that are actionable and meaningful for the market segments. Consequently, these approaches could lead to product differentiation, brand awareness, and brand loyalty in the long run.

2 Literature Review

2.1 Definitions and Purposes of Market Segmentation

Professor of marketing Wendell Smith first introduced market segmentation in the mid-1950s. "Market segmentation is to divide a market into smaller groups of buyers with distinct needs, characteristics, or behaviors who might require separate products or marketing mixes" [3]. For companies to achieve superior performance and competitive advantage, it is essential to segment their market by identifying industry demand, targeting specific segments, and developing marketing mixes for each targeted market segment [4]. Marketers use segmentation to identify distinct groups of customers whose behaviors differ significantly from each other. According to Philip Kotler, since companies cannot connect with all customers in a diverse market, marketing success often involves identifying and satisfying the right segments of the market [5].

2.2 Main Bases for Segmenting Consumer Markets

Segmenting a market is not a linear process. To understand the market structure best, one must experiment with multiple segmentation variables alone and in combination [5]. There are four popular segmentation bases:

- Geographic segmentation (i.e., markets segmented by geographic region, population density, or climate)
- Demographic segmentation (i.e., markets segmented by age, gender, income, occupation, education, generation, etc.)
- Psychographic segmentation (i.e., lifestyle and personality)
- Behavioral segmentation (i.e., occasions, benefits, user status, and loyalty status).

2.3 Requirement for Effective Segmentation

Based on Kotler and Armstrong [5], not every segmentation is effective. Valuable market segments must be:

- Measurable. A segment can be measured for its size, buying power, and profile.

- Accessible. It is possible to reach and effectively serve the market segments.
- Substantial. It is profitable to serve the market segments.
- Differentiable. Conceptually, the segments are distinct and respond differently to different marketing mix elements and programs
- Actionable. Programs can be designed to attract and serve segments effectively.

2.4 Segmenting-Targeting-Positioning (STP)

Segmenting, targeting, and positioning (STP) is a marketing concept that summarizes and simplifies the segmentation process [6]. According to Phillip Kotler and Kevin Keller [7], effective target marketing requires the following:

- Identify and profile distinct groups of buyers who have different needs and wants (market segmenting)
- Enter one or more market segments (market targeting)
- Establish, communicate, and offer the right benefits for each target segment (market positioning)

2.5 Definitions Sustainable Marketing Strategy

There are various definitions associated with the term sustainable marketing. Brundtland's report, *Our Common Future*, coined "sustainability" [8]. Sustainable development is described as development that meets current generations' demands without jeopardizing future generations' ability to meet their own needs [8]. This report revolutionized the role of business in society by demonstrating that sustainability is founded on the 'Triple Bottom Line' concept, which considers people, the environment, and profit [9]. Dam and Apeldoorn [10] introduced the term sustainable marketing as the marketing within and supportive of sustainable economic development. Peattie and Belz [11] presented the term sustainability marketing as the building and maintaining sustainable relationships with customers, the social environment, and the natural environment.

2.6 Collaborating Sustainability into Brand Value for Brand Differentiation

Recent climatic changes are a cause of serious concern. They are forcing businesses to look at the issue of sustainability from a broader perspective and a long-term perspective [12]. Also, the perception of green brands is associated with higher-quality and more ethical practices [13]. Furthermore, Lowitt and Grimsley [14] reported that maintaining a balance in the three dimensions helps firms maintain competitiveness and differentiation even when market disruptions or changes in governance occur. Lowitt and Grimsley's [14] high-performance business model reflects the concerns of sustainability that can lead the business to growth, profitability, positioning, consistency, and longevity.

3 Methodology

The research method for this study is based on a single-case study. Qualitative case studies allow the analysis of a phenomenon within a particular context by using various data sources and exploring the phenomenon from different perspectives to reveal multiple aspects of the phenomenon [15]. This research attempts to expand and generalize market segmentation and sustainable marketing theories by implementing a case study. Oatly was chosen as the research object because it considers sustainability the core of its business, and the company is known for running consumer-driven marketing campaigns. The Oatly case presented in this research includes assessing the dairy alternative landscape, market segmentation, products proposition, and consumer experience.

4 Results and Discussions

4.1 Assessment of the Dairy Alternatives Landscape

Oatly is the largest oat milk company. It is considered one of the uprising competitors in the dairy alternatives market. Recent research shows that the global dairy alternatives market has a valuation of USD 20.50 billion in 2020 and a projection of a compound annual growth rate of 12.5% from 2021 to 2028. The momentum is due to growing plant-based consumers and increasing demand from those who are lactose-intolerant. The popularity is further driven by companies claiming their products are more sustainable. Soy, oats, almond, coconut, and rice are the primary sources of dairy alternatives. On a global scale, soy milk is the most consumed plant-based alternative [16]. In the United States, top competitors in the dairy alternatives market are HP Hood, Oatly, Damone, Ripple, Silk Oat Yeah, Meyenberg, and Chobani [17].

Three Levels of a Product and Perceptual Map. Table 1 shows the three levels of a non-dairy product. Figure 1 is a perceptual map for major competitors in the dairy alternative market. Oatly is perceived as a sustainable company that only offers products from oat sources. Similarly, Ripple is another plant-based company that only provides products from pea sources. However, it has a nutrition-oriented focus, stressing its protein and DHA content for adults and children.

Table 1. Three levels of a non-dairy product.

Level	Description
Core	Safe to drink and storable
Expected	Nutritious, different size, various fat content, offered in multiple retail locations, and gluten-free
Augmented	Sustainability, offered in popular food-service brands, full range of products (cheese, yogurt, ice-cream), good with coffee, suitable for cooking & baking

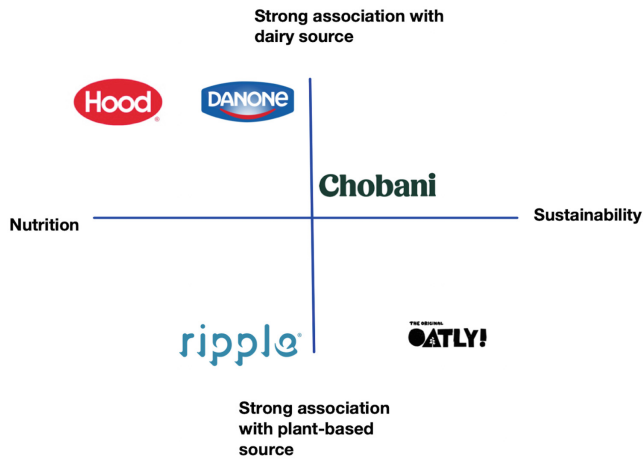


Fig. 1. Perceptual map for major competitors in the dairy alternatives market

4.2 Market Segmentation

Products Proposition. A positioning statement is a brief description of a product or service and a target market, and how the product or service meets a particular need of the target market. It is intended to be a tool to align marketing efforts with the brand and value proposition. To better illustrate its target consumers, Table 2 is constructed as the positioning statement of Oatly.

Table 2. Positioning statement of Oatly

Brand: Oatly	
Target consumers	<ul style="list-style-type: none"> • Urbanite • Middle class to lower class • Generation Z/Millennials • Love physical activities • Health-conscious • Environmental-conscious • Trendy • Receptive to new ideas
Competition target	<ul style="list-style-type: none"> • Consumers that have a strong preference for the familiar taste and texture of dairy products • Nutrition is a purchase factor • Sustainability is not one of their top purchase priorities
Right to win	<ul style="list-style-type: none"> • Expertise in oat milk that is suited for sustainability
Value proposition	<ul style="list-style-type: none"> • By consuming Oatly's product, you can have a positive impact on the environment

4.3 Products Proposition

Brand Purpose. According to Oatly, they have a bold vision for a better food system for the planet and the people. They firmly believe that reforming the food business is essential to confront humanity's concerns in climate change, environment, health, and lifestyle [2].

Product Proposition. Oatly provides solutions for individuals that have a plant-based and environmental-conscious lifestyle. The company has a wide range of products, including oat milk, ice cream, cold coffee, yogurt substitutes, cooking cream, spread, and custard. All products are plant-based and gluten-free. The brand has consistently emphasized that its oats are made for humans, from packaging to marketing campaigns—their production results in fewer carbon emissions, less land use, and less energy use. Oatly publishes annual sustainability reports on its environmental progress. Being the first to release carbon footprint data on its package labels, the company also challenged the food industry to do so for consumer transparency [2].

Premium Pricing Strategy. Oatly uses a premium pricing strategy for several reasons. The expensive price tag is a signal for product differentiation. After all, Oatly is providing alternative solutions for plant-based and lactose-intolerant consumers. Despite its recent popularity, the oat-milk market is still a niche market compared to the dairy market. Also, premium pricing is more likely to guarantee high quality, active engagement, and consistent sustainability efforts aligned with the needs of Oatly's target consumers.

4.4 Consumer Experience

Penetrating the Specialty Coffee Shops. Unlike debuting products in various retail locations, Oatly introduced their oat milk by targeting professional baristas at the specialty coffee shops in the United Kingdom, the United States, and China [2]. Such a novel approach has allowed them to go after where their target customers already are. Oatly's target consumers are urbanites who are trendy, receptive to new ideas, health-conscious, and cares about the planet. By comparison, specialty coffee drinkers are more likely to pay a premium to get what they want, be more educated about the food and beverages they consume, and care about fair trade and the environment. In other words, specialty coffee shops drinkers are ideal Oatly's consumers.

The brand's introduction strategy is to bring the first Oatly's experience through specialty coffee shop baristas as trusted and knowledgeable intermediaries. Intelligentsia, a boutique hipster coffee shop, was the first store to collaborate with Oatly's Barista Blend [18]. The blend has more fat content and is creamier than the original Oatly. Due to its consistency and taste, Oatly became an instant favorite as a dairy alternative for both local baristas and specialty coffee drinkers. The approach paid off, and Oatly's Barista Blend was seriously out of stock for a while because of its crushing demand. As of December 31, 2020, the company's products are available in about 60,000 retail doors and 32,200 coffee shops across the globe. Later, Oatly's reached a branded partnership with Starbucks as the exclusive oat milk provider in China and the United States [2].

From a marketing standpoint, Oatly's foodservice-led approach has generated an ideal first moment of truth for their potential customers by engagement with their trusted local baristas. Most importantly, this first brand experience will create brand recall in the retail channel and brand awareness in the long term. On the other hand, local baristas are one of the biggest influencers for coffee drinkers. Their preference and advocacy on Oatly will lead to consumer loyalty.

The LRF Mjölks Lawsuit. LRF Mjölks, the Swedish dairy lobby, was offended by Oatly for using marketing phrases and illustrations to degrade cow's milk as unhealthy. Oatly published the text of the lawsuit online, making the Swedish dairy lobby look like a bully and implying that oat milk, a sustainable alternative, has become a real threat to the traditional dairy industry. The David vs. Goliath lawsuit helps the company generate brand awareness for potential customers and creates value for existing environmental-conscious and vegetarian customers. Even though Oatly lost the case, the company's sales went up by 45% in Sweden after the incident [19].

The Wow No Cow Superbowl Advertisement. Oatly ran a 30-s commercial during the Super Bowl. It featured its CEO Toni Petersson singing an amateur jingle in an oat field. The commercial was strange and even painful for some viewers to watch. Whether one liked it or not, the low-budget commercial had stirred curiosity about the plant-based company and generated brand awareness in the mass market [20]. Its quirkiness approach on advertising the sustainability of oat milk had once again gained the heart of its loyal customer base.

Connecting with the Audience in a Meaningful Way. Conventional billboard advertisements are short, with catchy phrases and outstanding images. As a rebel in the industry, many of Oatly's billboard ads are consistent with its product packaging, featuring wordy messages. The unusual wordiness itself catches the attention of potential consumers, even though most individuals would not read them word by word. However, anyone who does take the time to read it, perhaps an existing Oatly's customer, would recognize and appreciate the brand for tackling sustainability with a voice. The length of the messages allows engagement in conversation with potential and existing consumers [21].

Talk Like the Way Your Consumer Talk. Another engagement strategy that the company utilized was communicating with its consumers with cultural relevance. In an advertisement on a New York City bus, the company talks like a local New Yorker humoring the heavy traffic in the city without stating any benefit of the product. Its wittiness creates brand awareness, and the local consumers will appreciate its relevant humor.

5 Conclusion

The upcoming Generation Z has gradually transformed the consumption landscape. Known as the sustainable generation, they view consumption as an expression of individual identity and as a matter of ethical concern [22]. In addition, the COVID-19

pandemic has changed the consumer mindset by making more health-conscious and environmental-conscious choices. This research aims to provide new perspectives for retail companies to rethink their value-creation models and consumer relationships by integrating sustainable marketing and customer-centric strategies.

Based on a literature review, marketing success often involves identifying and satisfying the right segments of the market. Sustainability marketing could be utilized as a competitive edge for brand differentiation. We conducted a marketing case study on the Swedish lifestyle brand Oatly. Its core business is to deliver sustainable oat-milk products that are good for the planet and the people. The Oatly case study incorporates an assessment of the dairy alternative landscape, market segmentation, products proposition, and consumer experience.

The results show that: (1) There is a growing demand for sustainable food alternatives. (2) Sustainability could be a feature of an augmented product. (3) Sustainability could be used as a competitive edge for brand differentiation. (4) Sustainable brand could offer a wide range of products that fit the lifestyles of target consumers. (5) Sustainable marketing strategies should also be consumer-driven, communicating in meaningful ways that resonate with the consumers' lifestyles and personalities.

To conclude, retail companies, especially food businesses, constantly face opportunities and challenges from the changing consumption landscape. Sustainable marketing and consumer-driven strategies could create competitive advantage, brand differentiation, and brand loyalty in the long run.

However, this study is based on a single case study of Oatly. Limitations might include lack of representatives, subjective methods, and researcher biases. Future research could investigate a broader range of companies in various geographic locations and explore whether consumers from different generations respond to sustainable marketing differently.

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A Summary of Platform Strategy in the Digital Age

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Abstract. New digital technologies are transforming how value is created and harnessed in modern businesses. They are empowering revolutionary business models that are upending the traditional anchors of competitive strategy. These momentous changes are also ushering in new opportunities. Nowhere are the new opportunities more evident than in the spectacular success of modern “digital natives” such as Alibaba, Amazon, Facebook and Airbnb, to name a few. These “natives” have pioneered new ways of unlocking unprecedented value from data through their digital platforms. They have also created and framed their business models around rich digital ecosystems. Similar successes are possible for traditional firms too. But it needs new strategic thinking. Traditional firms must understand the new potential of data and learn how to unlock it. They must move from their prevailing “industry” mind-sets to new “digital ecosystem” mind-sets. They should elevate their traditional product-value chain- industry centric focus onto a new data-digital platform-digital ecosystem centric mindset. That is what modern-day digital transformation entails. This paper summarizes some of the existing research on digital transformation, platform strategy and suggests some future research topics.

Keywords: Digital platforms · Digital strategy

1 Introduction

With the increasing popularity and prosperity of e-commerce economy and the continuous impact of new enterprises, traditional firms are now facing development problems as never before. Entering the Internet era, the cost of information has shrunk considerably, and consumers are relying less and less on traditional enterprises through lower prices and, for example, search engines to obtain better products and services. In order to adapt to the contemporary marketplace, traditional businesses must evolve. Based on industry characteristics and business models, they must develop a set of adaptable and successful strategic systems. The Internet has provided an unprecedented opportunity for the platform concept, and with the onslaught of digital transformation, the platform concept is deeply embedded in people’s lives, appearing in various industries, including social networks, search engines, e-commerce, the courier industry and many others. A successful platform business model lies in creating a well-developed, multilateral “platform ecosystem” that connects two or more user group, such as buyers and sellers [1].

In this article, we will briefly discuss how platform strategies can fulfil their potential in the digital age, in the context of digital transformation and its definition.

Digital transformation is a new prevailing notion that implies that digitalization can contribute to the transformation of established sectors as well as open new places for economic development and promote sustainable economic growth.

Businesses all around the world are attempting to increase market share by maximizing market opportunities and conducting internal research and development. Managers of firms can only achieve their objectives when they recognize that they live in a dynamic and changing world where various internal and external factors can impact their actions, which, in turn, affect the company and its very existence.

2 Literature Review

The Five Forces framework was first introduced by Harvard Business School professor Michael Porter in 1979 and published in the Harvard Business Review. Porter's five forces framework (threats of new entrants, threats of substitutes, consumer bargaining power, supplier bargaining power, competitive rivalry) is based on the perception of opportunities and threats that organisational strategy should encounter in an organisation's external environment. Porter argues that the aim of a strategist is to recognise and deal with a competitive environment by directly observing competitors, or by considering a broader perspective of competition with the organisation. According to Porter, recognizing and responding to the competing environment through observing competitors is what a strategist does [2].

A research from Caroline and Julie suggests that firms who operate in emerging markets are recommended to employ proper marketing techniques when facing rapid changes and address the issue they encounter [3]. Through varied levels of market-focused strategies, this study evaluates the impact of single vs dual strategies on the financial performance of domestic and international enterprises, with foreign companies outperforming local ones. Furthermore, it is less successful in low-concentration markets.

Bacanu's research aims to uncover a framework for achieving competitive advantage through cost and differentiation strategies [4]. According to the findings, there is a favorable association between the price levels of new entrants and producers. The focus strategy was adopted for some items because of the low cost benefit.

Shin's goal was to reevaluate distorted company tactics and build business strategies that maximize revenues in the most efficient way possible. The research identifies the company's business strategy for addressing the company's limited competitive capabilities and gaining a competitive advantage [5].

Rada discussed the negotiating strength of oil industry electromechanical suppliers, particularly when value is provided to consumers through suppliers by offering and selling items in a variety of methods. (i.e. the best offer, the modern offer, the just-in-time offer, and the cheapest offer) [6].

3 Digital Transformation

In its report “Digital Disruption: Delivering Multiplier-Effect Growth”, Accenture states that digital technology has become ubiquitous, bringing unprecedented change. Handy organisation, data-driven, proactive disruption and digital risk are the four cornerstones that hold up the digitalisation of enterprises and drive rapid growth.

Companies must reshape their strategy, organizational structure, and capabilities in order to survive in the changing digital environment [7]. Digital transformation can be defined as a process of innovation in the use of digital technologies by companies, encompassing not only technical but also strategic issues.

The emergence of new digital technologies has also led business leaders to identify new opportunities for growth, and business leaders have begun to develop strategies for digital transformation that are adapted to the information age.

One of the more “official” definitions in books on strategic business management is: “strategy is considered as the creation of a unique and valuable position, involving a different set of activities” [8].

Strategy, in simple terms, is positioning, direction and goals. Corporate strategy is the answer to the question of what a company should do in the long term, what it should rely on and how it should do it. Corporate strategy is further divided into operational and functional strategies from different levels. Business strategy generally includes marketing strategy, product strategy, brand strategy, etc. Functional strategy generally includes financial strategy, talent strategy, financing strategy, etc.

The digital transformation strategy is part of the corporate strategy, or the digital transformation strategy serves the corporate strategy, specifically through the “strategic” use of IT and data to support the achievement of corporate strategic goals. When a company reaches a certain point, its growth slows down or even stagnates, and it falls into a state of “involution”. At this point, companies need to find new growth areas in order to break through the “involution” and sustain growth. The advent of the digital age has made companies realise that “digitalisation” may be the opportunity to break through the bottleneck of growth and achieve sustainable growth, or even reinvent the business model to achieve fractured growth.

A digital transformation strategy or digital strategy therefore does not exist in isolation, but is itself a part of a corporate strategy, a combination of plans and actions to achieve a company’s strategic objectives.

4 Digital Platforms

In such a digital era, almost every process in every kind of business can be digitised. And the challenge for companies will be to use this technology to drive the creation of customer value. For this reason, it is of real importance to categorise the various industries according to their digital potential. Digital platform in this case is defined as a platform that “encompasses a particular range of layers (e.g. content and service layers) that can function as a new product, but simultaneously enable others to innovate upon using firm-controlled platform resources (e.g. SDKs and APIs)” [9].

The key strategic question for a range of ecosystems built around platforms in a “fully digital” industry is how to find the right niche for your business. Building your

own platform seems to be the most promising direction, and many experts claim that this is the only route worth pursuing. Still, simple logic leads us to realise that it is impractical for everyone to build their own platform and that the right way to think about it is to create an ecosystem of a few but aggregated platforms with a large number of users.

Digital platforms here are mainly digital solutions that serve different industries. Each industry develops its own digital platform, resulting in a completely new industrial ecology. This includes platforms and vertical industry applications for platformisation and cloudisation of data processing in different industries, dynamic optimisation of data systems, and real-time opening and sharing of data.

Major industries will generate massive amounts of big data around their industry chain links, such as production, marketing, and usage, as a result of the promotion of digital transformation strategies, which will be collected, stored, transmitted, calculated, processed, and exchanged on a data platform. This platform could be a cloud system created by the company or by a third party.

Second, a data system dynamic optimization platform. Data modeling, big data analysis, and cloud platform computing can be used by each topic in the industry chain to optimize production, distribution, and consumption decisions, as well as production, R&D, logistics, human resources, business models, and financing. A platform for real-time data opening and sharing is also available. Organizations may use in-depth, often real-time data analysis to make more informed decisions thanks to the capacity to access and share this data [10].

Platformization is a technique for operating multilateral platforms for consumers and suppliers of products and services that are not controlled or owned, such as eBay, Airbnb, and other similar platforms. Infrastructure, on the other hand, can be thought of as a plan for buying and reselling items and services, similar to a supermarket supply chain. In recent years, multilateral platforms have gained a lot of traction since they are more cost-effective than supply chains. Because they often take a cut of each transaction straight up to the baseline, these platforms have low operating costs and huge margins. Supply chains, on the other hand, have larger revenues but also higher infrastructure costs (such as data and product storage), higher operating costs, and lower margins.

There is always a misconception that the traditional industry is irrelevant to the platform model. In reality, however, most traditional companies today are forced to transform, and the platform business model provides an opportunity to do just that. It is worth mentioning that with the popularity of the platform business model, the traditional mindset of a one-way vertical flow of the industry chain is no longer applicable to all industries. In the case of Baidu, for example, the platform perspective sees both internet users and advertisers as “users” of Baidu [11], and their contribution to the development of the platform is equal, so platform companies must attract both of these very different users (information demanders and providers) in order to sustain their businesses. However, when the profitability model for keyword search was created, Baidu and Google transformed themselves from traditional technology providers to platform service providers. This shift from a traditional vertical value chain vision to a platform vision has allowed both companies to open up their own ecosystem and become highly profitable.

More and more companies are now changing their business models and trying to find new places to start making profits. The most obvious example is Apple. Its profitability has shifted from selling hardware products in the early days to earning commissions by building platform ecosystems (e.g. iTunes, App Store) [11]. Considering scale, Apple has adopted a typical pricing strategy that employs both platforming and infrastructure in its iTunes-iPod portfolio. However Apple does not participate in the infrastructure for the Apple Application Store since tracking thousands of developers, their pricing strategies, end-user licensing, and customer support would increase Apple's costs. Instead, the corporation followed a platform strategy of its own design [12].

Traditional methods, such as the five forces model, still apply to platforms [13], but it necessitates fresh strategic thinking. Some strategy frameworks have altered as a result of the importance of platform interactions [14] and the industry's impact on their supply and demand.

With the growing number of platforms and those adopting platform thinking, it's critical that we have a deeper understanding of platform competition dynamics. The majority of current research is based on platform owners' competitive strategies [15].

The digital age has provided an unprecedented opportunity for the concept of platforms, allowing the "ecosystem" built by platform companies to expand at an unprecedented rate. The right application platform strategy is a very important part of the digital transformation, and even today there are countless newly transformed enterprises adopting this concept.

5 Applying the Five Forces

5.1 Rivalry Among Competitors

As the competition among existing firms gets more intense, measures such as price discounting, advertising campaigns (Porter 1985) [16] are carried out and is expected to be carried on to attract potential customers. The design and structure of the platform also can be optimized in order to create better experiences for users who are accessing the platform.

5.2 Threat of New Entrants

Enterprises no longer face competition within their own industries, but also cross-industry competition (Downes 1997; Neubert 2018) [17, 18]. The more digital an industry becomes, the more competitive it is expected to become. Firms can compete globally with little to no physical presence, and the digitally-based business models are much less capital intensive and more easily scalable, the nature of platforms unintentionally lowers the barrier to entry.

5.3 Bargaining Power of Buyers

Due to the easy access of information and large amount of platform companies who offers same or similar products and services, many options are available to consumers, they can find an option that satisfies them the most.

5.4 Threats of Substitution

There is strong network effect and high switching costs, platform mostly face threats when another platform Provide services and features that are different from or more revolutionary than those already available in the current platform market.

6 Conclusion

With the deepening of digital transformation practice and the continuous development of platform strategy, this paper believes that platform strategy can be studied from three aspects: competition mode, profit mode and mechanism design.

The business model brought by the platform model is quite different from the traditional business model. The platform business model changes the original single competition pattern in the vertical value chain, and each platform enterprise can develop its own ecosystem and connect to the multilateral market. Therefore, platform enterprises should emphasize their core positioning in competition, clearly define bilateral (or multilateral) user groups, build their platform ecosystem, and explore how platform strategies can create more value and sustain development on this basis.

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Risk Evaluation of Construction Phase of EPC Residential Projects Based on Fuzzy Analytic Hierarchy Process

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Abstract. EPC residential projects in China are currently experiencing rapid development and are associated with uncertainties during the construction phase due to the large scale of the projects and the strict engineering standards. Therefore, it is significant to assess and method the risks that will likely arise during the construction phase. The study identifies 16 common risk indicators during the construction phase based on a literature review and expert interviews, then creates a risk assessment model based on fuzzy analytic hierarchy process (FAHP) and uses an EPC residential project as a case study to analyze the degree of risk involved. The results show that the general contractor's management capability and safety awareness on-site during the construction phase are essential, so they should be focused. The research can provide a model and theoretical guidance for other EPC residential projects on risk assessment during the construction phase.

Keywords: EPC · Residential project · FAHP · Project management · Risk assessment

1 Introduction

1.1 A Subsection Sample

In 2019, residential projects in China accounted for the largest share of construction completions in China, with over 67% of the floor area belonging to residential projects, and the total residential construction area in China has been consistently rising [1]. Residential construction projects in China tend to be large-scale in floor area and complex in construction processes, which can involve multiple contractors managing the construction of the project. The main drawback of the traditional construction model DBB is the lack of collaboration between the various departments during the design and construction phases of a project, which can lead to delays, financial losses, and unclear responsibilities, and in severe cases, high-risk incidents [2].

The EPC model, which is an integrated model of engineering design, procurement, and construction, has been chosen by an increasing number of construction projects in response to the principle of avoiding these problems. This model is used when the

investor plans the project and then decides, through a tender process, on an engineering contractor company that is to contract the design, procurement and construction processes and manage the relevant subcontractors through a contract [3]. In contrast to the traditional construction model, the general contractor can take full ownership and initiative over the construction management. The EPC model is also more suitable for residential construction projects in China as it avoids the problems of confusing management in large-scale construction.

However, the limited investment in large residential projects and the need to reflect the investor's philosophy in the planning of the area, resulting in investors not giving priority to the EPC model [4]. In addition, due to the limited number of general contractors involved in the construction of EPC residential projects, there is a high risk of inadequate site supervision and control, which can lead to significant accidents [5]. In 2017, 74 people were killed in the Jiangxi Fengcheng Power Plant EPC project in China due to the general contractor's lack of management of the construction unit and weak safety awareness [6]. The presence of these risks affects the potential for the EPC model to grow in China.

The large scale of residential projects in China and the extended construction process under the EPC model means that there are many risks and accidents within the construction phase [7]. At the same time, the general contractor will take on riskier during the construction phase. Therefore, it is significant to analyze and assess the risks of EPC residential projects during the construction phase. In this paper, a Fuzzy Analytic Hierarchy Process model will be constructed to evaluate the risks associated with the construction phase of an EPC residential project.

2 Literature Review

2.1 Identification of EPC Risk Factors

The principal task of risk identification is to identify project risks, define the main factors that give rise to the risks, and estimate the consequences of the project risks [8]. Therefore, risks are described based on the construction process and judged with the associated impacts. Risk identification for EPC projects is frequently based on the whole project process, with the risks associated with the construction phase included. Based on a review of the relevant literature, the following is summarized.

These 14 risk indicators cover all aspects of the construction phase of an EPC residential project and are all prevalent risk factors. These indicators are contained within four risk groups, namely economic risk, natural environmental risk, management risk and technical risk.

Based on the above literature review, a table containing 14 common risks can be compiled.

The risks in the table are relevant risks identified based on the results of the literature review, which are from oil, gas, transport, and construction projects. However, there is also a need to define and filter the critical risks that exist in the construction phase of EPC residential projects.

Table 1. Classification and definition of risk factors.

Group of risk	Risk factor	Definition of risk factor	Source
Economic risks (B1)	Difficulties in the availability of funds from the investor (B11)	Inadequate supply of funds from the investor can affect the construction of the project and can lead to significant stoppages	[9]
	Increases in the market price of materials (B12)	Increases in material prices can lead to increased project inputs, and failure to deliver funds promptly can lead to slow progress or even stoppage	[10]
	Cost overruns (B13)	It can be caused by changes to the project and can result in an increased financial burden	[11]
	Failure to complete construction as planned (B14)	Failure to deliver a residential project on time can affect the financial development of the property company	[12]
Natural environmental risks (B2)	Adverse weather (B21)	Generally, refers to wind, rain and snowstorms that can cause flooding, mudslides, and collapses, resulting in construction disruption, property damage and even casualties	[10]
	Changes in the construction environment (B22)	Generally, refers to the discovery of new hard rock formations, which can delay work and increase investment	[5]
	Force majeure events (B23)	Although the likelihood of an unpredictable natural disaster such as an earthquake is minimal, the damage is enormous	[13]
Management risks (B3)	Insufficient management organizational capacity (B31)	Inadequate management capacity of the main contractor can seriously affect the progress and quality of the project	[11]
	Strength and reputation of subcontractors (B32)	The quality of the project can be affected by the competence of the subcontractors and the quality of the materials supplied by the suppliers	[14]
	Changes in works (B33)	Changes arising from elements during the construction process can affect schedules and increase costs	[4]
	Safety incidents (B34)	Risky accidents due to unsafe practices generally result in property damage and injuries	[15]

(continued)

Table 1. (continued)

Group of risk	Risk factor	Definition of risk factor	Source
Technical risks (B4)	Design changes or mistakes (B41)	Design changes or errors can result in changes to the work, causing longer durations and higher costs	[11]
	Unclear construction techniques leading to duplication of work (B42)	Lack of clarity from subcontractors regarding construction requirements can lead to substandard construction, resulting in duplication of work and impacting schedules and costs	[12]
	Equipment failure (B43)	Equipment failure can lead to slow progress or even interruption of the project	[15]

2.2 EPC Risk Analysis Methods

Risk analysis is an essential part of the process of evaluating risk. In the field of research, many experts have developed risk evaluation models and analyzed risks for EPC model projects. Research constructs a risk decomposition structure model and refines it to provide a more rational assessment of EPC project risks through practical situations [16].

The author used the Analytical Network Process (ANP) approach to analyze a gas refinery EPC project in Iran, a model that allowed the identification of risk sources and countermeasures. In the literature review, Analysis Hierarchy Process (AHP) was found to be the most common method used in risk evaluation research [17]. Research conducted a risk analysis of an EPC project contract using the AHP method from the contractor perspective [18]. Another research also evaluated the risk of contractual claims in EPC model projects using the AHP method [19].

However, the AHP approach is influenced by the evaluator's subjectivity and preferences, resulting in certain inaccuracies in the evaluation results. In addition, these studies have been conducted for EPC contracts. For the construction phase risk evaluation, it is challenging to assess a specific aspect. Therefore, this paper addresses these concerns and selects the FAHP approach to assessing risks throughout the construction phase to acquire more accurate risk evaluation results.

3 Research Methodology

The research methodology first required a literature review to identify an initial table of risk indicators for evaluation, which was then filtered and supplemented by interviews with experienced experts involved in EPC residential projects. After the interviews, the results were analyzed based on fuzzy hierarchy analysis to obtain the level of risk and the influence factors for the project.

3.1 Experts Interview

To filter out ineffective risks, the risks identified in the literature need to be assessed by experts. These experts are those who can have extensive experience in the industry and advanced degrees in relevant fields. Through interviews with the experts, their input supported the development of the risk evaluation system.

3.2 Building of Evaluation Model

Construction of an Evaluation Set of Risk Factors for EPC Mode Residential Projects. The evaluation factor ensemble can be established according to the relevant risk evaluation indexes.

A is the first level factor set, representing the risk evaluation index system of EPC mode residential projects.

B is a secondary factor set, representing the risk group.

C is a third level factor set, representing the risk factors.

Using the "1–5 scale" to build the evaluation set, $V = \{\text{low risk, ordinary risk, medium risk, high risk, extremely high risk}\} = \{1, 2, 3, 4, 5\}$.

Construction of a Fuzzy Evaluation Matrix. Experts are interviewed and invited to rate the risks according to the relevant rating sets. The ratings of all experts were weighted and averaged before being standardized to obtain a fuzzy evaluation matrix R.

R is a $M \times N$ matrix. R is an $M \times N$ matrix, where M is the number of evaluation indicators in the evaluation set, and N is the number of indicators in the risk factor set. And R_{ij} represents the weight of the evaluator's relevant evaluation i of risk factor j in the total evaluation results.

Comprehensive Fuzzy Evaluation. There are numerous risk variables, all of which are fuzzy, and the elements at the upper level are influenced by the factors at the lower level, necessitating the use of two fuzzy assessments.

For the first level of the fuzzy comprehensive evaluation, the fuzzy evaluation matrix R of each layer is multiplied with the corresponding weight vector W, to obtain the fuzzy evaluation results.

For the second level fuzzy comprehensive evaluation, the first level fuzzy evaluation set is arranged to form the second level evaluation matrix and multiplied with the corresponding weight vector W to obtain the fuzzy evaluation results.

4 Case Study

An EPC residential project in Tengzhou City in Shandong Province in China was selected for the study, with five high-rise buildings. The building scale is divided into above and below ground, with 56,141 m² above ground and 2,450 m² below ground. The total budget for the cost is RMB 327 million. The project is invested by the Beikou Company and is for sale at the urban-rural border of Tengzhou City. This residential project is significant for the area as it provides an improved residential environment for the citizens

of the suburbs. The project has a large floor area and a total of 17 people in the project management department. It meant that the workload for everyone was a challenge for these managers. The project was in the middle of construction at the time of the interview with the relevant managers.

4.1 Experts Interview

A total of five managers of an EPC model residential project in Tengzhou, Shandong Province, China, were selected for interviews. They all have extensive construction and management experience, as shown in the table below (Table 2).

Table 2. Overview of experts.

Expert title	Degree	Experience (based on current position)	EPC residential project experience
General contractor manager	Bachelor	Three construction projects	Once
Construction supervisor	Master	Six construction projects	Twice
Safety department manager	Bachelor	Four construction projects	Once
Construction department manage	Bachelor	Three construction projects	Once
Subcontractor representative	Bachelor	Eight construction projects	Three times

The interviews showed that all the risks mentioned in the Table 1 arise during the construction process, only with different probabilities. Based on their experience during the construction process, they suggested that the following two additional risks need to be added, namely dust (B24) and inadequate safety monitoring (B44). Dust is the suspension of construction by the regulator for rectification because of the environmental impact of dust and noise in the construction environment. Inadequate safety monitoring refers to the construction of safety hazards that affect the construction schedule due to inadequate safety maintenance and testing techniques.

4.2 Building a Set of Risk Evaluation Factors

The following set of risk evaluation factors can be obtained from the literature review and interviews. The secondary matrix (B) and the tertiary matrix (C1, C2, C3, C4) are sets of four elements. The elements of the secondary matrix represent the four risk groups

in Table 1. The indicators of the tertiary matrix represent the risks associated with the results of the literature review and interviews, and each risk group contains four risk factors within it.

$$B = \{B_1, B_2, B_3, B_4\}$$

$$C_1 = \{B_{11}, B_{12}, B_{13}, B_{14}\}$$

$$C_2 = \{B_{21}, B_{22}, B_{23}, B_{24}\}$$

$$C_3 = \{B_{31}, B_{32}, B_{33}, B_{34}\}$$

$$C_4 = \{B_{41}, B_{42}, B_{43}, B_{44}\}$$

4.3 Building a Fuzzy Evaluation Matrix

The five experts interviewed scored each risk indicator in the project and standardized the results to produce an individual factor evaluation matrix.

The results of the evaluation were collated to obtain the following table (Tables 3, 4, 5 and 6).

Table 3. Results of expert evaluation of risk factors within economic risk group.

Expert evaluation results (persons)	Low risk	Ordinary risk	Medium risk	High risk	Extremely high risk
B11	0	2	3	0	0
B12	3	2	0	0	0
B13	0	0	4	1	0
B14	0	0	0	4	1

Table 4. Results of expert evaluation of risk factors within natural environmental risk group.

Expert evaluation results (persons)	Low risk	Ordinary risk	Medium risk	High risk	Extremely high risk
B21	0	0	0	0	5
B22	0	2	3	0	0
B23	3	2	0	0	0
B24	0	0	4	1	0

Table 5. Results of expert evaluation of risk factors within management risk group.

Expert evaluation results (persons)	Low risk	Ordinary risk	Medium risk	High risk	Extremely high risk
B31	0	0	0	3	2
B32	0	0	0	3	2
B33	0	0	4	1	0
B34	0	0	3	2	0

Table 6. Results of expert evaluation of risk factors within technical risk group.

Expert evaluation results (persons)	Low risk	Ordinary risk	Medium risk	High risk	Extremely high risk
B41	0	2	3	0	0
B42	1	1	3	0	0
B43	0	0	0	3	2
B44	0	0	0	3	2

Assume that R is the set of affiliation degrees and r is the degree of membership function of each criterion in the evaluation set corresponding to the indicators in the evaluation factors. For example, the first row of the R_1 matrix represents the expert evaluation affiliation of risk factor B11, where two experts consider the indicator to be an average risk, three experts rate the indicator to be a medium risk, and no experts rate it to be low, high, or very high risk. Therefore, 0, 0.4, 0.6, 0 and 0 are the degree of membership function of this evaluation among the five experts.

$$R_1 = \begin{bmatrix} 0 & 0.4 & 0.6 & 0 & 0 \\ 0.6 & 0.4 & 0 & 0 & 0 \\ 0 & 0 & 0.8 & 0.2 & 0 \\ 0 & 0 & 0 & 0.8 & 0.2 \end{bmatrix}$$

$$R_2 = \begin{bmatrix} 0 & 0 & 0 & 0 & 1 \\ 0 & 0.4 & 0.6 & 0 & 0 \\ 0.6 & 0.4 & 0 & 0 & 0 \\ 0 & 0 & 0.8 & 0.2 & 0 \end{bmatrix}$$

$$R_3 = \begin{bmatrix} 0 & 0 & 0 & 0.6 & 0.4 \\ 0 & 0 & 0 & 0.6 & 0.4 \\ 0 & 0 & 0.8 & 0.2 & 0 \\ 0 & 0 & 0.6 & 0.4 & 0 \end{bmatrix}$$

$$R_4 = \begin{bmatrix} 0 & 0.4 & 0.6 & 0 & 0 \\ 0.2 & 0.2 & 0.6 & 0 & 0 \\ 0 & 0 & 0 & 0.6 & 0.4 \\ 0 & 0 & 0 & 0.6 & 0.4 \end{bmatrix}$$

4.4 Building the Weight Vector Matrix

An expert interview method was used to interview the general contractor manager of the project. Based on their project management experience, evaluate the risk factors against likelihood and importance in a two-by-two comparison. Finally, the risk factor weights were obtained based on the yaahp software. The software's calculation of the fuzzy weights is based on a geometric average calculation method.

The Yaahp (Yet Another AHP) software combines hierarchical analysis and mathematical calculations with a visual hierarchical model. The software can analyze judgement matrix values, auto-completion of judgement matrices, sensitivity analysis, and generation of Excel questionnaires. The software functions are intuitive and easy to operate, and the automated calculations improve data handling and efficiency of use. The software has now been widely used for project risk assessment, engineering program decision making, energy development evaluation and service quality evaluation. For more information about yaahp software refer to the website {<http://www.metadecsn.com>}.

The study uses this software to calculate the weights of risk factors and improve the accuracy of the weighting results, thus providing a scientific basis for project risk analysis and FAHP models.

The set of weights corresponding to each risk indicator is shown below.

$$W = \{0.099, 0.1247, 0.4536, 0.3228\}$$

$$W_1 = \{0.012, 0.0098, 0.0256, 0.0516\}$$

$$W_2 = \{0.063, 0.0178, 0.008, 0.0359\}$$

$$W_3 = \{0.2189, 0.064, 0.0456, 0.125\}$$

$$W_4 = \{0.0403, 0.0403, 0.1210, 0.1210\}$$

4.5 Comprehensive Fuzzy Evaluation

From the above risk factor pairs weights as well as the evaluation matrix results in a first level fuzzy comprehensive evaluation.

$$R = \begin{bmatrix} 0.00588 & 0.00872 & 0.02768 & 0.0464 & 0.01032 \\ 0.0048 & 0.01032 & 0.0394 & 0.00718 & 0.063 \\ 0 & 0 & 0.11148 & 0.22886 & 0.11316 \\ 0.00806 & 0.02418 & 0.04836 & 0.1452 & 0.0968 \end{bmatrix}$$

The results of the second level fuzzy integrated evaluation based on the results of the first level evaluation are as follows.

$$C = [0.00378 \ 0.00996 \ 0.07383 \ 0.15617 \ 0.09145]$$

4.6 Overall Score

The final risk assessment scores for the EPC model residential projects are shown below.

$$S = 1.327$$

5 Discussion

Based on the FAHP model and applying the analysis of the model with a case study of an EPC residential project under construction, the following conclusions were obtained.

1. According to the analysis of the weighting results, the management risk group (B3) and the technical risk group (B4) have a significant influence on the project risk, at respectively 0.4536 and 0.3228. Management capability and construction technology play significant roles in the quality of the project. The natural environment risk group (B2) and the economic risk group (B1) have a relatively small influence on project risk, at 0.1247 and 0.099. These risk factors are less likely to be present during construction, although they can significantly impact.
2. For the 16 third-level indicators, the highest weighting was given to insufficient management organizational capacity (B31) at 0.2189, followed by safety incidents (B34), equipment failure (B43), and inadequate safety monitoring (B44) at respectively 0.125, 0.121, and 0.121. Inadequate management capacity of the general contractor can lead to problems in coordination between the various project departments, thus affects the project schedule. Unsafe construction can lead to stagnation of the project schedule and, in critical cases, property damage and casualties. Therefore, it is a significant risk factor in the construction process. On the other hand, the lowest weighting is given to force majeure events (B23) at 0.008. The likelihood of these risks being present is minimal as natural disasters such as earthquakes and tsunamis will not occur in the project area.
3. According to the analysis of the evaluation results, two experts considered the project to be low risk, two experts assessed it to be an average risk, and one expert evaluated it to be medium risk. In the evaluation of severe weather (B21), all five experts considered it to be a very high risk, reflecting consistency. In the evaluations of cost overrun (B13), failure to complete as planned (B14), dust (B24), and engineering changes (B33), four experts had the same evaluation, also reflecting consistency. On the other hand, there were three different evaluations for unclear construction techniques (B42), which reflects the variability of the evaluations. Because it is the experts interviewed that have various responsibilities and roles during the construction phase, they will pay more attention to the responsible sector. Also, the experts' work experience and background of expertise can impact the evaluation of risks.

4. The total evaluation score for the project is 1.327, which falls within the range of 1 to 1.5, with a low-risk level. It indicates an acceptable level of risk for the project. Although the overall score shows that the project is at low risk, some risk factors can significantly impact the construction phase. The presence of managerial capabilities, construction safety hazards, and environmental and technical issues affecting the project timeline can all have a substantial impact on construction's correct functioning. Therefore, to maintain the smooth operation of the project works, the risk assessment procedure for the building phase of EPC residential projects should focus on preventing certain risk factors.

6 Conclusion

The principal outcome of the study is the analysis of risk factors in the construction phase of EPC residential projects. And the development of a FAHP-based risk evaluation model to provide a reference for the construction management of this model.

1. Through literature review and expert interviews, the risk factors in the construction process of EPC residential projects are identified, and the relevant risks that exist are summarised on a theoretical basis. The study established a relatively complete set of risk evaluation index systems for the construction process of EPC residential projects. The system is divided into four risk groups and 16 risk indicators. The study verified the existence of relevant risk factors in the construction process of the project.
2. By constructing a judgement matrix to determine the weight of each factor, and at the same time using fuzzy hierarchy analysis to evaluate the risk factors, the evaluation results of each indicator and the overall evaluation results of the project are obtained. Ultimately, project risks are evaluated and controlled. A new model has been created to identify and assess construction risks in EPC residential projects. This model is more operational and has simple calculation steps, while the fuzzy evaluation method brings convenience to the expert pairs evaluation.
3. The study uses an EPC residential project under construction as a case study and applies the model constructed in the study to a specific project to validate its usefulness. It also demonstrates how the new FAHP model can be applied to assess the risk of an EPC housing project in China. The results showed that a lack of management capacity was an extremely high-risk factor. During the expert interview phase of the evaluation process, variability was found in the assessment of risk by experts with different responsibilities. Therefore, the degree of fit needs to be considered when selecting experts for interviews.

The model created in the study has real practical value for the analysis of the construction phase of EPC residential projects. The easy-to-operate analysis process and convenient judgement methods can help managers in the industry to complete risk assessments accurately and efficiently.

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Venture Capital's Performance in China Under the Influence of Various Government Policies

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Abstract. The national strategy of China decides the future of all industries for the guidance of economic development. With the maturation of venture capital industry, the incubation and boost of start-up companies have become the core for the drive of economy. Steered by the national policy, venture capital has become the new engine of economy. In search of variations on venture capital industry under the guidance of different policies in China, this article predicts the tendency of venture capital industry in future, with a particular focus on the tendency of investment fund raising under the influence of regulatory policies in China, the transformation and preference of investment style for investment institutions under the strategic policy and the support and boost for the venture capital industry by the preferential policies released by the Chinese government in recent years.

Keywords: China · Venture capital · Private equity · Policy

1 Introduction

1.1 China's Economic in Present

China's economic growth, characterized as “the fastest sustained expansion by a major economy in history” by the World Bank [1], has been astonishing in the last several decades. Growing at an annual rate of closing to 10% since 1979 (reforming of economic), China has become a major global economic power by lifting 800 million people out of poverty. While a downward growing trend is noticeable in recent years in parallel with the world economy, China ultimately became one of the few nations that achieved positive gross domestic product (GDP) growth during the global pandemic of 2020. Ranking as number one in GDP based on purchasing power parity at \$27 trillion USD in 2019, China is working towards the great rejuvenation of the Chinese nation. However, China's economics' long-term growth would experience heavy resistance in the near future if the United States and China are continuing to imposing punitive sanctions, including trade disputes and technology blockage, against each other. Increasing tariffs between the two nations would lead to a reduction of 1.1% in China's GDP in 2021–2022, projected by The Organization for Economic and Cooperation and Development. Other than global adversities, China also encounters long-term internal challenges to its economy. A major restructure in its economic model is unavoidable as policies employed

in the past which proofed successfulness incurred costs (such as income inequality, inadequate financial system, rising debts, heavy pollution) [2]. The transition to the new economic model, which promotes sustainable development and focuses on private consumption and innovation, allows China to evade potential problems like “middle income-trap”.

1.2 State-Led Development

Behind China’s continuous expansion, state-led development acts as an imperative role. Since the start of the “reforming and opening” era in 1978, China governs its economy through adopting state-led development, which is a macroeconomic planning process that enables states to lead the economy through various incentives and investments [3]. Likewise, the financial sector in China is operated by state capitalism. The state and policy makers use capitalism for serving the interests of the people and to avoid market manipulation by wealthy individuals. However, China’s policy change for the benefit of the country would directly influence the growth and development of a certain industry. China’s capital market has often sparked doubts by global investors. The skeptical voices, condemning the policies are inappropriately interfering in the free market and state capitalism in China, are highly sustained. Policy implementations, including the “double reduction” policy released on the 24th of July in 2021, are aimed at reducing educational burden on both children and parents. After school tutoring programs are forced to become not-for-profit organizations, leading the for-profit companies in the education sector to alarm the investors. As the shareholders of the Chinese education stocks are fleeing due to lack of profitability and political instability, highly valued education companies are experiencing plummeting share prices. The stock price of New Oriental Education & Technology Group (NYSE: EDU) dropped by over 90% from \$18 to \$1.8. TAL Education Group (NYSE: TAL) shares fell 65% in one day and over 90% within the past months.

1.3 Chinese Government Strategic Development Policy

The rise of China in every perspective requires well-defined goals and cohesive efforts. The development goals of the 19th Party Congress of the Communist Party established China’s vision to achieve the objective of becoming a “moderately prosperous society in all respects” by 2050. President Xi, reporting to the 19th Party Congress, stated that China’s socialism had entered a new era in November 2017. The ultimate objective comprehends many major goals including improving overall people’s living standards, endorsing innovation, promoting private consumption as the primary drive in the economy, reducing pollution, addressing income disparities. President Xi also reinforced that “We will work to see that state assets maintain and increase their value; we will support state capital in becoming stronger, doing better, and growing bigger”, strengthening the importance of the government’s role in terms of leading the economic growth. The newly established 14th five years plan also specifies China’s direction in the aftermath of the pandemic, in the years of 2021–2025. The plan involves the energy transition and future role of renewables, Geographical rebalancing and new urbanization, investment in technology infrastructure, local public finances, strengthening the Chinese governance model and encouraging positive behavioral changes after COVID-19 pandemic.

These key actions aim to achieve eco-civilization, high-quality development, and strong sustainable growth [4].

Made in China 2025 is another crucial strategic industrial policy developed by China with unprecedented efforts. The largest non-market economy in the world is devoted to promote advanced technology in the future. Initiating such a plan was motivated by (1) China has no longer the comparative advantage in producing labor-intensive goods due to increasing labor costs; (2) and China has shortages competing with countries like Japan and U.S in producing valued-added goods. The overall task of the plan is to improve national manufacturing innovation capability – by building 40 industrial technology research bases by 2025; internationalizing Chinese smart manufacturing; cultivating businesses that have global competitiveness in intellectual property (IP) rights; and building patent pools that are industrialization-oriented. The plan also adopts specific policy tools, including finance, IP law, fiscal and tax policy, labor policy, small businesses incentives, trade and investment policies [5]. Overall, the policies emphasized that the behavior of Chinese economic market and future developments have significant reliance on governmental intervention.

1.4 Private Equity and Venture Capital in China

The private equity (PE) and venture capital (VC) industries are flourishing while China's financial industry is progressing. Over the past decade, VC and PE have supported China's growth, particularly in gaining larger exposure to sectors such as consumer discretionary, technology, and healthcare [6]. As one of the largest PE and VC markets in the world, the tremendous growth allowed China to develop as a global technology innovator. Fostering giants like Alibaba and Tencent, VCs and PEs are becoming an important force to support and raise firms that fulfill the developments needs of the country and promote social progress. VCs in China can be divided into two types – government fund and non-government fund. Total investment in the venture capital sector has reached 211.8 billion RMB in 2018, widely driven by domestic VCs. However, the PE and VC market were initially largely dominated by foreign investors in the 1990s and early 2000s [7]. China as an emerging economy with unique social and legal system, the PE and VC investment decisions have been significantly influenced by the implementations of the country's policies. VC and PE gradually become sharp tools for the nation's strategic development.

2 Policies Affecting the Fundraising

The pattern of Chinese PE and VC fundraising structure has shifted dramatically in the past years. In the rise of PE and VC industry, three primary fundraising targets (institutional investors, corporate investors and high net worth individual) in the market supported the inflows of the total AUM in China [8]. After the influence of the implementation of the related capital control measures, the primary investing currency USD has gradually been replaced by RMB. As the industry grows into a mature stage, the corporate investors and high net worth individual (HNWI) have transformed their role

from acting as a limited partner (LP) to general partner (GP). Even though the characters in the industry have altered their roles, the diversifications on the background of the investors and annual increasing AUM have promoted the growth of more domestic firms, with IPO taking place in the Chinese security exchanges including A shares, ChiNext, STAR market and etc.

2.1 Capital Control Act

In 2016 and 2017, the State Administration of Foreign Exchange implemented a series of regulations in tightening capital outflow and restricting currency exchanges. Investments from assets, including stocks, bonds, properties, cannot be transferred abroad and eventually be reinvested in China. Specific measures in capital controlling includes: enhancing the supervision on transferring capital abroad, controlling off-shore RMB supply and increasing the expenses on shorting RMB, limiting corporations to purchase foreign currencies, restricting foreign investments, striking underground banks. Imposing such measure would avoid panic and chaos in the economic if the increasing capital outflows exceed the savings foreign exchange reserves of the central bank, and would also prevent further depreciations in RMB. However, the downsides of these regulations are clear. The difficulty to allow the capital to move out from China becomes extremely high due to bureaucratic scrutinization and investigation procedure. The restrictions would affect future capital inflows from foreign investors as the foreign capital are trapped in Mainland China and thus reluctant to further invest.

2.2 USD Fund to RMB Fund

As Chinese PE and VC industry are initiated by international investors like Blackstone and KKR in the early 2000s, most of the funds are based in USD, invested directly abroad. However, the process of switching from USD fund to RMB fund has been completed in the past years. The transformation on the primary fundraising currency is caused by the complexity of foreign investment in China. Since the actual investment will be made in RMB, the investment process involves currency conversion (buy and sell), with lengthy government approval period. As the capital control acts negatively influenced USD investments supply, foreign investors gradually existed the Chinese markets due to restrictions. Recently, start-up and growing firms would even turn down the investment interests from USD funds and prefer RMB-denominated funds to be disclosed in its corporate structure. Investors with foreign background or USD funds become less attractive as it impacts the IPO of the invested company, especially the high-tech based companies, in domestic China.

2.3 LP to GP

With the report published by Asset Management Association of China, the total PE funds AUM has reached 16 trillion RMB, including 7.06 trillion RMB (43.2%) invested by corporate investors [9]. As the largest primary funding source, corporate investors make significant contributions to the PE industry over the past years. However, the ratio of

fundraising of PE and VC institutions from corporate investors has been declining. The explanation is that corporations are becoming more and more sophisticated on investments, hence they make direct investments and developed to be general partners (GP). As public and private information tend to approach symmetric and become accessible to public investors, the advantages of PE and VC institutions have been weakened. Corporate investors choose to control capital more carefully and make their own investment decisions [10]. Wahaha Group, the fifth largest food and beverage production enterprise in the world earning its fund qualification certificate in August 2020, is a classic example of corporate investor transforming to GPs.

Similarly, another primary fundraising target, the HNWI, takes the same approach as the corporate investors. The LPs, especially the HNWI, that are making direct investments becomes a global trend, mainly reflected from co-investing with PE and VC. Mckinsey's report on world PE market and LP investigations in 2018 exhibited that the total co-investments from LP have doubled from 2012 to 2017. The indication of the global trend also reflects the phenomenon in China. Before, the LPs allow the GPs to manage their capital with high risks and high commissions. As fundraising peak past, PE and VCs, especially small and medium GPs, raise capital difficultly. LPs like HNWI with abundant capital resources turned out to be more powerful with cards on hand. Overall, LPs in China have become professional investors, evident by the frequent disclosure of LP's names and institutions on the shareholders' list in many IPO companies in domestic China.

3 Development Policies Affecting VC's Investment Styles

Along with the support and promotion of national policies, future valued industries are slowly transforming. This leads to a modification of concentrations in the VCs' perspective. According to the guidance of the implemented policies, highly valued industries shifted from internet, e-commerce and etc. to industries like advanced manufacturing and renewable energy. The Internet 50 ETF price plummeted from peak 2.5 Yuan to 1.3 Yuan in 2021. The New Energy ETF price increased from 0.8 Yuan to 1.4 Yuan within four months. Chips ETF price surged from 1.0 Yuan to over 1.6 Yuan in 1 year. Apart from the visionary change on the secondary market, the primary market also exemplifies a clear investment style change based on the national policy.

3.1 Government Fund

A demonstrative government backed fund is Shenzhen Capital Group Co (SCGC), founded by the Shenzhen Municipal Government in 1999. As an independently managed VC, SCGC has invested over 1200 projects with close to 350 billion RMB of assets under management (AUM). Even the company established with a vision of helping the growth of small and medium businesses with innovative high technology, the investment strategy is closely related to national development goals. In recent five years, the percentage of total number of investments in advanced manufacturing (AM) industry has been boosting. Especially in 2021 (before August), out of the 64 companies that SCGC invested, 25 of which are companies in the AM industry (Fig. 1).

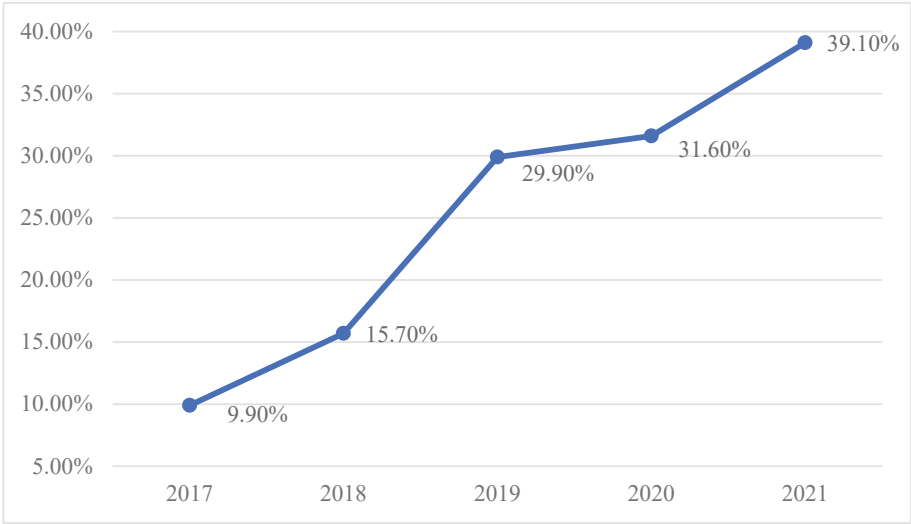


Fig. 1. Percentage of SCGC’s total number of investments in advanced manufacturing

In the 166 disclosed companies in the AM industry invested by SCGC in the past five years, 58 of which focus on the integrated circuit sector. Since the Trump’s administration banned global chip manufacturer, including Qualcomm and Taiwan Semiconductor Manufacturing Company, from supplying to Huawei, China is determined to develop its own technology in semiconductor and chip fields. SCGC lays particular emphasis on investing in integrated circuit, which is the fundamental technology in manufacturing chips, is aiming to both alleviate the pains caused by technology blockage and respond to the Made in China 2025 plan - technology breakthrough in important areas including integrated circuit.

3.2 Non-government Fund

As China’s financial industry grows, foreign venture capitals dominated the early-stage development in China’s economy. Traditional western international VC firms including Sequoia Capital and IDG Capital that entered China in the 2000s have all benefited from the expansion of the economy. These firms now became the most professional VC and PE investors with sophisticated investment skills and manage both USD and RMB Fund in China with access to the top resources.

Sequoia Capital China (SCC). As one of the most well-known VC in the China, SCC invested over 100 companies that publicly listed globally, and over 60 companies became non-listed unicorn company. With AUM of over 260 billion RMB, SCC has extremely diversified investment portfolio. However, investigating into its total number of investments in past years, there is a decent increase in the number of investments in the AM industry. As the company invested 17 different industries in 2021 (before august), 9.1% of the invested companies are in the AM industry (Fig. 2).

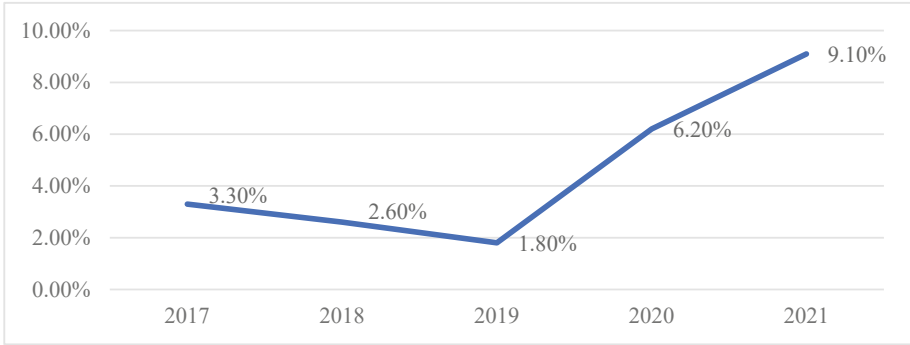


Fig. 2. Percentage of SCC's total number of investments in advanced manufacturing

The diagram depicts that the motivation of investing in companies in the advanced manufacturing industry becomes stronger after 2019.

IDG Capital. IDG Capital is a leading global VC and PE company, which is one of the earliest foreign funds that entered the Chinese market in 1993. With AUM over 150 billion RMB, IDG Capital empowered over 300 companies to IPO (Initial Public Offering) in the financial markets in the Great China (including Hongkong), U.S and Europe. Fascinatingly, the number of investments in AM has increased over the past years as well (Fig. 3).

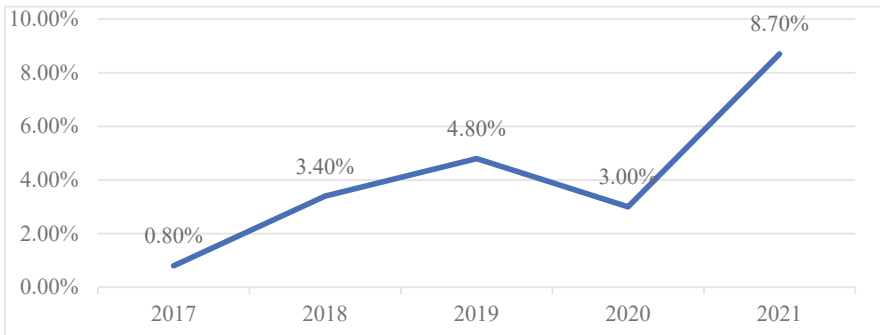


Fig. 3. Percentage of IDG capital's total number of investments in advanced manufacturing

The sharp contrasting between the investment ratio of 0.8% in 2017 and 8.7% in 2021 illustrates that the investment strategy of IDG Capital heavily corresponds to national development strategy.

Others. Despite the fact that the top VCs like SCC and IDG Capital are valuing the AM industry as a crucial investment target in the future, the whole VC and PE industry is prioritizing to make investments in the industry and embracing its potential value in the future (Figs. 4 and 5).

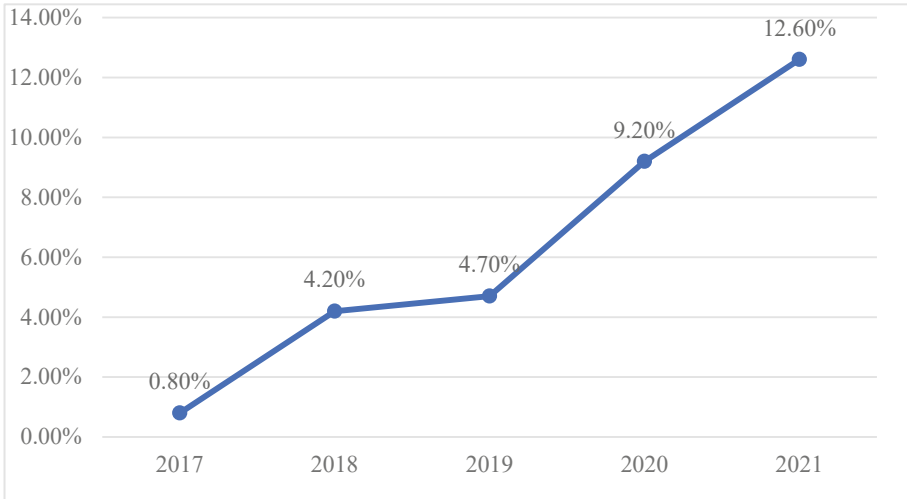


Fig. 4. Percentage of matrix partner’s total number of investments in advanced manufacturing

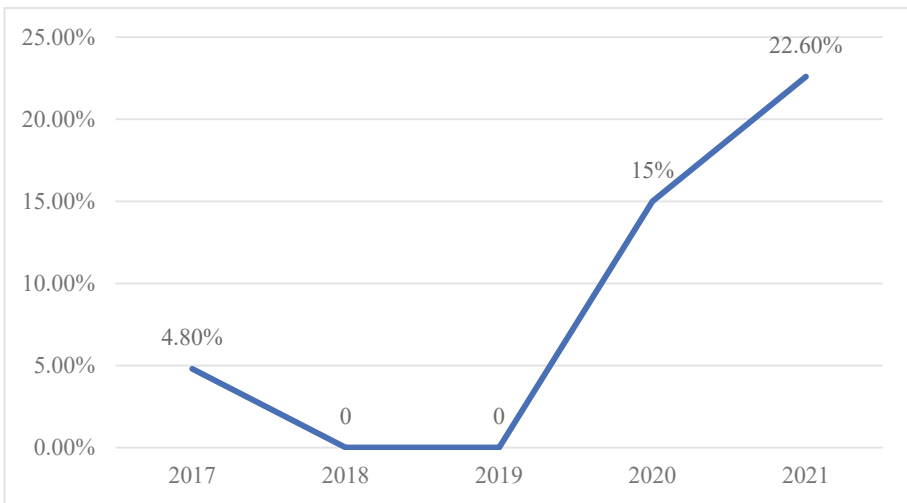


Fig. 5. Percentage of YF capital’s total number of investments in advanced manufacturing

All types of funds are reallocating resources and injecting capitals into AM industries. Matrix Partner, a domestic VC controlling mostly RMB funds, is tripling the percentage of companies invested in AM industry with the last 2 years. YF Capital, privately established by Jack Ma along with other great business leaders and entrepreneurs, has increasingly investing into the AM industry in the recent two years. Overall, it has become a collective awareness for the VC and PE industry to value the AM industry. The dedication of Chinese government promoting the AM industry through different

policies, especially the Made in China 2025 plan, withdrew the VC companies' attention and made changes to their initial investment styles.

4 Preferential Policies that Motivated the VC and PE Industry

4.1 Subsidizing the Investment Failures

According to the regulations of Beijing Municipality, if investment institutions and entrusted subsidy management companies meet certain conditions while investing in Zhongguancun Demonstration Zone or in the biomedical field, they will be given risk subsidies of no more than 15% and no more than 450,000 Yuan for a single investment. Guangdong province issued the *Rules for Trial Implementation of Venture Capital Investment and Credit Risk Compensation Funds of Science and Technology Business Incubators*, which stipulates that venture capital enterprises investing in small, medium and micro science and technology enterprises in the initial stage of science and technology business incubators shall be given 50% risk compensation in total and the maximum risk compensation for a single project shall not exceed 2 million Yuan if failed. According to the Measures issued by Shanghai Municipality, the proportion of compensation for investment losses incurred by science and technology enterprises in the seed stage is at maximum 60% of the actual investment losses [11]. The amount of compensation for investment losses of each investment project shall not exceed 3 million yuan, and the amount of compensation for investment losses of a single investment institution shall not exceed 6 million yuan per year. At the same time, the six - month lock-up limit on the recipients of large deals will also be removed. The subsidizing policies encouraged VC and PE firms to make more investments to empower growing firms, which then contributed to the overall economy [12].

4.2 Loosened Restriction for Existing

According to the *Special Provisions on Shareholding Reduction of Venture Capital Fund Shareholders of Listed Companies (Revised in 2020)* and the detailed rules for the implementation of the Exchange, qualified VC fund shareholders of listed companies can enjoy the "reverse link policy", namely, the longer the investment period before listing, the shorter the interval period after listing will be. When the investment period before listing reaches more than 60 months, the reduction ratio will be no longer limited, indicating the investors can sell out as many shares as possible. At the same time, the six months lock-up limit on the recipients of large deals will also be removed. As existing has been a difficult problem for most VCs, loosening the tight restrictions for investors have motivated their confidence to make re-investments.

4.3 Income Tax Discounts

Reduction on Tax Income. Based on the Ministry of Finance and State Administration of Taxation (No.55 [2018]) [13] and *Q&A on Supervision of Private Equity Funds --*

Standards and Application Procedures for Venture Capital Funds enjoying Tax Policies [14], issued by China Securities Regulatory Commission, VC funds that have made direct equity investment in start-up technology enterprises (excluding the stock equity of other shareholders) for 2 years can deduct 70% of the investment amount from the corresponding taxable income of partners in the corporate system or limited partnership system according to their different organizational forms.

Tax Rate Selection. Venture capital funds can choose one of the two accounting ways by single investment fund or overall annual income, and calculate the individual income tax payable for their individual partners' income from venture capital funds. If a venture capital fund chooses to be calculated as a single investment fund, the individual partner's equity transfer income and dividend income shall be calculated and paid individual income tax according to the 20% tax rate [15].

5 Conclusion

In summary, the performance of VC and PE industry is intensively close-related to the government policies. The Chinese strategic development policies significantly influence the investment styles of both the government-based fund and private funds. The institutions tend to invest in the industries that are strongly supported for future development by the government. Policies like regulation acts also pilot the market movements in the fundraising term while the traditional methods, including directly raising capital from LPs, become no longer viable and adoptable. As the VC and PE industry is positively boosting Chinese economy in the macro direction given by the central government, related subsidies are implemented to further promote the aggressiveness of investment institutions. These policies have stimulated investors to scale up investments by taking up a great proportion of losses, and to a large extent loosened the strict rules for existing on secondary markets. Investors would also enjoy an enormous amount of tax reduction, which again provokes the initiatives in the industry. The VC and PE industry is stepping to a higher level of prosperity, as the Chinese government is valuing the importance of financial industry to economic progression. The direct correlation between the VC industry and the government would actively improve along with the developments and improvements of the financial regulators and the regulations respectively.

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The Formation and Dissolution of Nation-States After Second World War: Specific Investigation of the Case of Yugoslavia

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Abstract. This research investigates the reason of why Yugoslavia dissolved, why Tito's ethnic integration policy failed, how the former theories in ethnic formation and rise of nation-states help explain the dissolution. In this research, theories of Pierre Bourdieu, Comaroff and Comaroff, Karl Weber, and Barth are used for this topic. First, the basic demographic situations of the six republics, which belongs to former Yugoslavia, are investigated, including major religious belief, major ethnic groups and ethnic composition, and official languages. Next, the historical context of each republic is investigated. These data are used for investigation the fundamental condition for the rise of nation concept. Third, Tito's economic and ethnic policies, like introduction of "Yugoslav" and market economic system, are studied. Finally, the explanation for the dissolution is derived based on all the data collected and the ethnic theories. The future investigation about this topic can be focused on electoral system of Yugoslavia and the new broadcast of six republic members.

Keywords: Post second world war · Nation state · Reasons behind the raise of nation states · Support toward the raise to nation states · The distinction · Border and disruption in the formed nation states

1 Introduction

This paper focuses on the reason of nation-state building and their dissolution, under a specific time period of post second world war, of a specific country—Yugoslavia. In order to study this topic, several about ethnic formations need considering: Why the territorial boundaries can be defined in accordance with the ethnic features? What justifies the significance and importance of the ethnic commonality? Can we take ethnic distinction as the absence of inter-ethnic interaction? Are the ethnic & national identity interrelated? How the fluidity of ethnicity contributes to the distinction? Will they change and become somehow contrary to one another? Next, how does the rise of nationalism in the six republics of former Yugoslavia contribute to the dissolution.

When the concept of nation appears in the main ethnicity of a geographical habitat, and overlap the territory, or polity, the nation-state is formed. In dictionary, a nation-state is a political unit, according to Britannica dictionary, where the boundaries of nation

and state become congruent. The notion of nation refers to the entity with a coverage of political claim over certain occupied area and the relevant population; whereas, the notion of state points to the polity under a certain system of governance with monopolized means of coercive force. The territory of a nation-states and a nation is highly overlapped. The formation of nation-state must be based on the formation of ethnic concept. By the inter-group communication, people will create their own ethnical identity. When this thought combines with the concept of nation, a nation-state is formed. Besides, the political tools or the state-apparatus may also contribute to this formation. The state-apparatus will deliberately describe a concept of ethnicity, by uniting the language, reinforcing the ethnical differences, special ways in illustrating the history and so on. The notion of nation-states flourished during the middle of the nineteenth century. Instances of the earliest nation-states, like France and Germany, were established following the republican¹ revolutions (the earlier ones were mostly feudal). One of the particularities of the then newly arising nation-states is that they proclaimed the intactness of their territories, and the unity of the culture inside them, which differentiate the then nation-states from the monarchies. The intactness of territory was not emphasized, and it is common acts for the ruling monarchs to cede the land to otherwise sovereigns. The smooth acceptance of the change in their territory. When it comes to the republican era, the government strongly emphasized the intactness of territory. The nations make a clearly line about their boundaries, and to cede the territory became shameful.

Bourdieu's habitus theory is a further development of Carl Marx's which claims that the economic basis determines the superstructure. Bourdieu claims that appearance to social classes is because people want to show their difference to other people. By proving the differences, people can gain direct benefit: people proclaim their possessions clearly. Before people have a concept of "you and me", they cannot proclaim their personal assets. In this case, even the largest nation will not include all the human in their group. Then Bourdieu extends Marx's theory that people use for capitals to show their difference: economic capital, social capital, culture capital, and symbolism capital. The Comaroff' idea specify Bourdieu's habitus theory on the formation of ethnical concept. The ethnic group has three main features: first, it identifies itself and gets recognized by others, it is made up of members that share cultural value contained in the cultural forms, and they form a platform for social interactions and material and symbolic exchanges. The ethnic group has its origin in the inter-group interactions. The interactions help the member of a certain group arise the subjective classification, by noticing the cultural difference. Ethnicity should not be seen that could be overcome by the advance of capitalism and the establishment of class distinction, but it extends from the "we-them" relations, which signifies and symbolizes the differences. The collection of the distinct differences are the social representations, which is a system of values, ideas, metaphors, beliefs, and practices that serve to establish social order, orient participants and enable communication among the members of groups and communities. The social representations are performative acts that people use to constitute the very reality. It is to make people see and believe, to get them to know and recognize, and to impose the legitimate definition of division of the social world. Ethnic difference is constructed again and again in a relational and situational frame, and understood as context and agent

¹ A series of republican nationalism revolution, represented as French revolution.

specific. People are not seek to reveal the truth or the foundational origin. Rather, they point to a discussion of ways, in order to gain and consolidate symbolic power.

We are going to focus on the factors that contribute to the formation of national and ethnic disintegration with the case of Yugoslavia. Especially, the rise of ethnical consciousness after the second world war is going to be discussed. Yugoslavia is an important example. It was founded after the first world war in 1918, combined by the union of State of Slovenes, Croats and Serbs and the Kingdom of Serbia. Later, the union was named Yugoslavia. During the second world war, Yugoslavia was split up into Independent State of Croatia, and the Government of National Salvation. Immediately after the second world war, the communist power established Federal People's Republic of Yugoslavia, and the constitution was modelled after the one of the Soviet Union. It included six republics: Socialist Republic of Bosnia and Herzegovina, Socialist Republic of Croatia, Socialist Republic of Macedonia, Socialist Republic of Montenegro, Socialist Republic of Serbia, and Socialist Republic of Slovenia. In 1992, Yugoslavia was dissolved, into those original countries. We find that the ethnicities are very similar here, but the country still dissolved. We could study the reasons of dissolution through Bourdieusian stance—the habitus theory, which explains how people form the ethnic distinctions from four capitals: economic, culture, social and symbolic.

We will consider the problem from three levels, personal, group, and nation, and the explanation will be based on the study of Benedict Anderson, Ernest Geller, Jean Comaroff and John Comaroff. They are discussing about the border of nation and ethnicity. The two concepts are highly overlapped even though they are different concepts. In this way, there must by some imagines or tangibles shared by people connecting the concepts of nation and ethnicity.

Max Weber is another socialist who claims that within an ethnical group, people will form a sense collective ethos. They decorate the facts in the world with the collective ethos and pass them down through social media and communication. And when people are talking about the issues happened in the society, they will use the ideal type to describe it, which would be difference with the reality. In this way, people in the society are viewing the world by an imaged collective ethos rather than the facts. Besides, the collective ethos will motivate the people within a group to behave similarly, think similarly, and pursue the same goal. For example, when people are singing the national rhythm, people feel the consciousness of ethnicity. Even though the lyrics might be crude, or the melody might be simple, it makes strangers to sing the same song. Singing the national rhythm together creates a situation of harmony and similarity. Then the ethnic consciousness is formed, or strengthened from them.

However, Weber doesn't mention how this collective ethos form. In the twentieth century, Barth gives his explanation, which is by inter-group communication. Barth proposed to shift the focus of inspection from internal constitution and history of separate group to ethnic boundries and boundary maintenance. Culturally significant feature can change over time with intergroup interactions. Intra-group can only clarify the behaviors valued within the society, but the socially significant cultural features of an ethnic group can be refined over time by inter group communication. The ethnicity and nationality are forms of social distinction in physiological identifying indicators—that of race, place of

origin. Sharing of the same distinctions or values are pervasive in the society, and they become the collective ethos of this group of people.

In summary about the theories, we use Bourdieu's habitus theory as foundation. Then Comaroff and Comaroff specify Bourdieu's theory in to the domain of formation of nation-states and rise of nationalism. Weber's theory tells us how the rise of nationalism particularly affects the people within the group, and Barth completes Weber's theory to make it more convincing.

Some results about demographic investigation are showed below, and they will be used for deeper analyzing the reason of rise of nationalism in each republic. Besides, Tito's economic and ethnic policy will be mentioned and help explain the dissolution.

2 The Case of Yugoslavia in Terms of Its National Diversity Policy

2.1 The Self-identification by National Citizens

The terminology "Yugoslav" did not appear until the third decennial census by Yugoslavia in 1961. According to the annual statistics from 1961 to 1981, the proportion of the people who recognized themselves as a Yugoslav increased in general. In 1961, the number was 1.7%; in 1971, the number was 1.3; and in 1981, the number was 5.4%. The reason for the decline in 1971 was because many people in the major identifier of Yugoslavs, Bosnia and Herzegovina, refused to identify them as Yugoslavs. In the census of 1971, the government first allowed Muslim as a nationality. The concept of Yugoslav was created to connect all the people together, and it was used as a "defensive identification" By identifying as a Yugoslav, one could resist claims that other make on one's identity and thus avoid potential conflicts. This theoretical thought can be applied in many daily activities. The identification of Yugoslav had the effect of eliminating the ethnic distinctions. Also, they concept had benefit to the minority ethnic group in the country which other ethnic groups prevailed. People of a minority nationality could claim a Yugoslav identity to resist the pressure from majority to assimilate into the local dominate nationality. In the six republics, the minority never distributed evenly in the territory, but concentrated in the particular areas near the republics where their nationality dominated. For example, the Serbs minority in Croatia located concentratedly near the border between Croatia and Serbia where Serbs were the majority group. These Serbs hardly recognized themselves as a part of Croatia. Therefore, Serbian nationalists often interpreted Yugoslav identity by the Serb minority living in Croatia as a defensive response to unfavorable treatment by Croats majority. Croat nationalists make the same identification on behalf of Croats in Vojvodina. Meanwhile, the concept of Yugoslav also acted a role of protective federation which was attractive to smaller national groups, such as Macedonians. Macedonians suffered from the threats from Greece and Bulgaria. The concept was also called Strategic Nationalism. Gradually, the league of communists of Yugoslavia satisfied the national aspiration of majority of people in Yugoslavia and gained widespread support by people for whom the ideals of communists or socialists. Combined with the effect of worker self-management, Tito wanted to build a country centralized by the power of ideology and a collective ethnic concept.

2.2 Split of Power Among Its Member National Republics

In general perspective, due to the development of its economy, worker self-management and sectionalization were promoted within Yugoslavia. The difference in terms of industrial development among different republics in Yugoslavia created strong sense of differentiation and distinction among the various Yugoslav national republics. During 1950s, Yugoslavia experienced a rise in GNP with uneven regional development, setting the stage for economic nationalism between regions. At this time, worker self-management became a vehicle for the expression of local than class interest. The nationalism not only pervaded the apparatus, but, on many occasions, turned party—LCY—into the principal battlefield of ethnonational struggle. The LCY became an association of eight regional party machine rather than a centralized one, and worker self-management reduce the control of republic to local economy, which further fragmented Yugoslavia.

From a more specific perspective, each republic has their own historical context, and their ethnic constitution are very different. Historical fact and myth concerning particular places is a major element in the national imagination. While the importance of key individuals and events in nation-building is obvious, there are often seen as rooted in place. For an ethnic group, group members have “national soil” to fight for, and die for. Sometimes, people are not fighting for the soil, but some imaginations, like parties, ideologies, or something that are regarded as a symbol of purity. Therefore, to fight for the purities is seemed to be lofty. (If the working class is imagined as a organization which merely pursuing breaks, furniture, and power, none—including the members of working class—would have been willing to die for it) Landscapes or features within the national soil are symbolized into their ethnic concept. From the great literature works, the descriptions like “Its rivers full of memories” always exist, which give the landscapes symbolic meanings. Some exemplary situations of the republics of Yugoslavia are to be mentioned.

Macedonia has its own historical context, which is highly associated with Greece. The very idea of a separate Macedonian itself is largely controversial. Alexander the Great, the Greek hero, came from what is present-day Macedonia, as did the Serb hero Prince Marko. For some people, to suggest that Macedonia is not part of Serbia is tantamount to suggesting that Prince Marko was not Serbian. The issue further confusing is Bulgarians also claims Prince Marko as a national hero. There are many other confusing national issues in Macedonia. Because the historical context of Macedonia is not clear, at the time when the territory of Macedonia forms, the concept “Macedon-Slav” is created. This concept is used to counter the thinking that this territory was Bulgarian, but for a long time, this allowed for an acceptance of logic of incorporation into Serbia. However, the concept of “Macedon-Slav” facilitates Macedonia as a discrete entity within Yugoslavia federation.

The ethnic problems in Bosnia-Herzegovina emerge in the relationship between different ethnic groups within it. Combined with religious problems, that many people living here are Muslims while others believed in Orthodoxy Christianity. Besides, the people believed in different religion gathered concentratedly. Though Bosnia-Herzegovina is a country with the multicultural and multiethnic history, the conflicts were inevitable. People realize that the idea that people can always unambiguously fit into a preconceived notion of ‘Croat-ness’, ‘Serb-ness’, or so forth is manifestly absurd. Areas were mapped

and information-gathered on the various ethno-national grouping living in indifferent localities. In this way, territories were designed “Serb”, “Moslem”, “Croatian”, etc., with line dividing towns and cities in different zones. Later after the disintegration of Yugoslavia, a clear line was set to define the Muslim-Croat part and Bosnian-Serbs part in Dayton Agreement of 1995, after Yugoslavia dissolved.

Kosovo is seen as a core Serbian territory. In Serb mythology their defeat in a battle by the Turks at the Battle of Kosovo Polje in 1389 is seen as a formative national identity. It is seen by Serbs as integral to Serbia. However, the vast majority of Kosovo’s current population are Albanians rather than Serbs. For many Serbs, conceding control of the location of their heroic struggle is equal to sacrificing not just territory but also national identity, which means to betray their history. In the late 1990s, Serbia was accused of conducting ethnic killing to the Albanians in Kosovo. This issue caused Kosovo to become a protective area of the United Nations.

3 Tito Introduces the Concept of Yugoslav in Order to Combine the Republics Together, and the Conflicts Between the Republics

During the second world war, the Nazi force invaded Yugoslavia. In order to regulate the territory, Nazi divided this area stiffly, with some straight boundaries. People living in different districts from those areas is highly isolated, so each group has their own ethnic concept. A highly sectionalized territory and people are the initial problems of Yugoslavia after the second world war. Within a divided society, there is a tendency to be more intensive conflicts, weaker institutions, and lower economic growth. People choose a narrower ethnic identity which makes them hard to blend in each other or build up further cooperation. After leading the powerful antifascist struggle, communists and their leader Tito, seized power in 1945. The communists were firmly committed to rebuild Yugoslavia, reorganizing the country into a federation. In this case, the communists attempted to reduce political and ethnic divisions, and distance themselves from the unitary, interwar, Yugoslavia. They introduce a broader ethnic concept called Yugoslav, which included the major Slav ethnic groups. It was inspired by the ideals of national awakening of Romanticism and French Revolution. Yugo-Slavism was based on the common cultural and linguistic link of primarily the Croats, Serbs, and Slovenes. Due to the cultural similarities proponents of the Yugoslav idea believed the South Slavs belongs to a single Yugoslav nation. The believed that Croats, Serbs, and the Slovenes were three tribes of one nation. However, the reality is, no matter how they perceive them as a whole, the difference in economy, culture, and society. The population that declared themselves as Yugoslavs increased over time after the introduction of the concept Yugoslav. The first time the category Yugoslav appeared in population census was in 1961, and 1.7% of the population declared themselves as Yugoslavs. By the 1981 census, the percent of Yugoslavs increased to 5.4. Among all six republics, Croatian contained the largest number of Yugoslavs in its population, 8.2%. However, the republican leaderships are highly concerned about the increase of Yugoslav sentiment. They regard the concept Yugoslav as the attempt of the federal government, or other republics to steal their popular loyalties of their citizens, and erode the republics’ power. Serbian nationalists often interpreted Yugoslav identification as the deliberate attempt by the Croatian leadership

to decrease the Serb minority in their republic. Meanwhile, the Croatian nationalists make the same argument in Serbia. The Yugoslav identification increased further during the 1980s, but with the rise of nationalism in each republic, the population with Yugoslav identification declined to 2%.

The rise of nationalism in each republic contribute to the failure of Tito's integral policy. The federal policies also reinforce the ethnic diversity in Yugoslavia, causing the wide emergence of nationalism throughout different regions. The first example of this is that the local enterprises have too much power over the wages, prices of goods and service, and the social securities. The economic condition in Yugoslavia after the second world war was terrible, so Tito introduced the market system into a socialist society, combining them together. The introduction of market system makes Yugoslavia the first socialistic country which accepts the market system. In this case, companies are given much power to stimulate their productivity. For example, the worker self-management policy is a rule for strengthening the companies' power. For a long time, there is difference between the extent of development in different regions, which also contributed to the formation of nationalism in different regions.

Strong local companies indirectly give the local government much power, which makes them more and more independent to each other. The electoral system of Yugoslavia also contributes to this problem, that six republics hold the election separately. Spain is also a country with many relatively independent districts inside, but they do not break apart. One reason is that they hold the election together in a national level. Besides, the regulation toward the news is weak and they are highly independent in each republic. The TV programs are focusing on local events rather than the events in the whole country, which increase the nationalism the republics. Finally, the dissolution of Yugoslavia happened after numerous political upheavals and conflicts during the early 1990s.

4 Conclusion

This research focuses on the reasons of how nation-states form and how they break apart. The object of this research is Yugoslavia. Therefore, how the nationalism forms in the six republics of Yugoslavia and how that nationalism led Yugoslavia to be break apart. The research begins with the theoretical study. The Habitus theory of Pierre Bourdieu is the fundamental theory of this paper, which claims that people use economic capitals, social capitals, culture capitals, and symbolic capitals to define the difference between different groups of people. Based on that, Comaroff and Comaroff's theory specifies Habitus theory into the area of the formation of nation-states, and finds the features of a nation-state about how it addresses inter-group issues, how the value of the ethnic identity makes sense to the people within an ethnic group, and how the similarity of the group members contributed to establishment of social order. Next, Weberian theory explained specifically how the values shared by group members help with the rise of nationalism. He introduces the concept of ideal type and collective ethos, which contribute to nationalism. In order to make his theory complete, Barth's criticism and claims are added. Barth criticized that Weber does not explain how collective ethos or ideal types form but only to show their influences. Barth completes that theory by showing that the collective ethos and ideal types are formed in inter-group communication. By comparing themselves to

others, people derive what is right and wrong, and then collective ethos is formed. Those theory are applied in explaining the dissolution of Yugoslavia. This paper focus on how the governmental policies, both economic and ethnic policies, contributed to the four capitals which help nationalism rise. The historical context and their culture conflicts are investigated to show the culture and symbolic factors, the demography are investigated to show social factors, and specifically, Tito's market policy and political structure construction shows the economic factors.

The argument provided in this study is a research of specificity on the reason of Yugoslavia's breakdown. With regards to this limitation, the study has only focused on theories about the reason behind the raise of nation-states, and how to use those theories to explain this breakdown. In future investigation, this topic should be further expanded and specified. Some questions need considering. How to further the theoretical framework through empirical data gathering? There are limitations of this theoretical review: giving that the literatures are adopted for the writing of this paper are written at earlier stages previous to current ages. Unfortunately, Yugoslavia has already gone; therefore, accurate data are hard to collect. Only ethnography of the present six republics is available, and the record of historians, anthropologist, residents' daily life, and politician of Yugoslavia time is also valued. For example, the contemporary TV programs and news broadcast, which also have huge contribution toward the formation of nationalism. Also, the records for electoral system are also important.

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The Effectiveness of Tennis Celebrity Endorsement on Tennis Enthusiasts' Purchase Intention in Endorsing Tennis Products

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Abstract. Over the years, the use of celebrities in brand and product endorsements have been a common approach in advertising. Previous studies have proven that celebrity endorsement plays a significant role in helping the business advertise and promote their brands or products, thereby attracting many consumers. However, most previous studies mainly focus on endorsements by actors and singers. Research in sports celebrities, especially for the tennis star, is still scarce and has little been paid its deserved attention. Based on the theory of source credibility (expertise, trustworthiness, and attractiveness) and Matchup, this study focusses on the analysis of whether the tennis celebrity endorsement has a positive impact on tennis enthusiasts' purchase intention in tennis endorsed products from the expertise, trustworthiness, attractiveness, and matchup dimensions. A questionnaire method was conducted with 82 tennis enthusiasts in Melbourne. This study demonstrates that tennis stars' endorsements based on four different dimensions all have a positive impact on amateur tennis enthusiasts' purchase intention in tennis products. The most significant one is the Matchup, followed by expertise, attractiveness, and trustworthiness. Further, this study also finds that people of different tennis ages have different consumer responses to the endorsements of tennis stars. These findings may help tennis companies and marketing practitioners understand the significance of celebrity endorsements on purchase intention.

Keywords: Tennis celebrity endorsements · Source credibility · Matchup · Purchase intention

1 Introduction

An increasing number of individuals are participating in sports to stay healthy and enjoy life. Tennis participation by adults 15+ was estimated to be 911,400 per year. Male involvement in adulthood was somewhat disproportionate, occupying 57% of participation, whereas females merely accounted for 43% [1]. With the increased number of people participating in tennis, the need for athletic wear, footwear, and equipment in tennis increases [1]. Most sports footwear and apparel companies such as Nike, Adidas, Wilson, Asics, Yonex, and Babolat had started to enter into endorsement contracts

with high-profile tennis players to advertise their respective brands to improve brand recognition and popularity to attract a significant number of consumers [2]. It is not uncommon that the phenomenon of celebrity endorsement is widely utilized in the marketing of sports products currently, since celebrity endorsement has played a significant role in enhancing the exposure of brands and attracting consumers' attention, especially when making a purchase decision [3]. Findings from a range of countries over time have illustrated that many marketers capitalize on celebrity endorsements to influence customer purchasing decisions in order to boost sales, expand market shares, and build brand image [4–7].

However, recruiting the right endorser is both a crucial and challenging decision. As such, the effectiveness of celebrity endorsement has become a controversial topic. Although many pieces of literature evaluating the effectiveness, one of the most often utilized is the source credibility model [8]. Based on this model, the endorser's perceived trustworthiness, attractiveness, and degree of expertise impact credibility. The credibility of the source, in turn, may influence one's desire to buy a particular product or brand [6, 9, 10]. Through a process termed internalization, information from a reputable source, like a celebrity, may affect recipients' beliefs, views, attitudes, and behaviour. This happens when receivers accept a source's influence regarding their attitude and value systems [9]. Source credibility is assessed on three dimensions such as celebrity expertise, trustworthiness, and attractiveness [8].

Expertise is defined as the extent to which an endorser possesses the necessary knowledge, experience, or skills to effectively advertise and promote products [11]. As Daneshvary and Schwer showed, expertise is the most critical component of endorsement success [12]. Further, expert source influences how an audience perceives the brand's quality. A source considered to have more knowledge is more convincing and creates more favourable intents to buy the product among the audience [13]. A study conducted by Ohanian indicates that respondents' willingness to follow the sources' suggestions varied significantly according to the source's perceived degree of competence and the quality of the advice [8].

Attractiveness is another critical factor in determining the source credibility [8, 14, 15]. Attractiveness is the stereotype of favourable connections with a person and encompasses physical attractiveness, personality, and athletic capability [9]. The experimental data on the influence of physically attractive communications on several dependent variables concluded that beautiful communicators are generally preferred, loved, and thought to have a favourable effect on goods compared to unattractive communicators [15]. Van der Waldt et al. state that endorsers seen as attractive and beautiful are likely to influence purchasing intention [11]. At the same time, attractive endorsers have a more significant influence on customers than less attractive ones [16]. However, an opposite opinion proposed by other scholars is that although attractiveness has a beneficial effect on assessments, it does not affect buying intentions [16, 17]. Source attractiveness is only successful if the product increases the user's attractiveness [15, 17].

Trustworthiness is described as the endorser's honesty, integrity, and credibility [11]. In communication, the trust paradigm is defined as the listener's confidence level in and acceptance of the speakers and message [18]. According to Ohanian, the trustworthy

communicator was convincing regardless of whether he or she was an expert [8]. Ohanian further proposes the level of trust a customer puts in a communicator's intention to communicate the most valid claims [8]. As such, a substantial body of research demonstrates that trustworthiness has a beneficial impact on effectiveness [19].

Additionally, matchup hypothesis theory has been proposed to determine the association between the endorsers' character and image and the nature of the product [20]. The matchup theory has been particularly successful in forecasting the success of celebrity endorsers [21]. Endorsers or spokespersons are effective when they are an excellent match for the advertising product [22, 23]. According to the matchup hypothesis, the degree of congruence between the sender and recipient of a message has a favourable impact on communication's efficacy [23–25]. To guarantee efficient communication and trustworthiness, an image of the celebrity featured in the endorsement should match a product or brand [26, 27]. The fit between the celebrity and the customer's ideal self is also essential since this improves the endorsement's efficacy [28]. In exploring the connection between celebrity endorsements and consumers' purchase intention, research has focused specifically on the source credibility model (expertise, trustworthiness, and attractiveness) and Match-up hypothesis theory to determine whether celebrity endorsers who are compatible with the nature of the product and the target audience have an impact on consumers' purchase intention [20, 29, 30].

Although there is enormous research on source credibility model and matchup hypothesis, most studies have been conducted in independent research settings without considering the interactive impact of these two constructs on advertising outcome measures, which means that the lack of research work has eroded academic comprehension. At the same time, it hinders the ideas' complete application and execution in reality. Thus, these academic gaps in the literature need further study in this area. Furthermore, other limitations exist regarding the generality and practical application of the matching effect owing to fictional endorsers in prior studies. For example, the influence of athlete endorser-product congruence on customers' perceptions and purchase intentions was examined by using fictional individuals as endorsers [31, 32]. The fictional figures were also used to be an endorser by other academics in sports [30]. The fictional athletes adopted in studies by most researchers predominately is because this method increases the internal validity by minimizing confounds. However, genuine celebrity can significantly reflect the external validity in real situations, which strengthens the accuracy of research results [30, 32]. These two different methods have different advantages and drawbacks when assessing the effect of celebrity endorsement, and it is meaningful in the celebrity-endorsement area to conduct research utilizing real-life celebrity athletes at this stage in order to figure out the actual effect of sports celebrity endorsement on consumers' purchase intention [33]. As stated previously, the source credibility model and matchup hypothesis have been widely adopted in many studies in various domains, including the sports industry, but applying these two models to study the effect of tennis celebrity endorsements on consumers' purchase intention is comparatively not common currently. To determine the authentic effects of celebrity endorsements, whether the tennis star endorsement affects tennis enthusiasts' purchase intention in their endorsed products should be explained. The purpose of this study, thus, is to examine the effectiveness of tennis celebrity endorsements on amateur tennis enthusiasts' purchase intention

from the expertise, attractiveness, trustworthiness, and matchup dimensions. The current study also further explores the response of purchase intention of tennis enthusiasts at different tennis ages to products endorsed by tennis stars.

2 Methodology

2.1 Sample

To examine the effectiveness of tennis celebrity endorsements on the purchase intentions of tennis fans in terms of expertise, trustworthiness, attractiveness and Matchup, a questionnaire consisting of 21 items was randomly distributed to 100 tennis enthusiasts through a web link. This questionnaire is filled out voluntarily. A total of 82 amateur tennis enthusiasts in Melbourne completed this questionnaire in the end, of which 56 (68%) were male, and 26 (32%) were female. Moreover, concerning age group, respondents under 19 years occupied 2.4%, respondents ageing from 19–35 years constituted 62.2%, respondents ageing from 26–50 years took up 30.5%, participants ageing over 50 years occupied 3.7%, respondents who prefer not to say were 1.2%.

2.2 Questionnaire Design

A questionnaire was made up of three sections. The first section mainly consists of three items associated with demographics (age, sex, and education level). Another five items related to respondents' tennis background were incorporated into the second part of this survey. The rest of the items are made up of the third section. It is noticed that the final section was based on 5-point Likert scales (Strongly disagree, Disagree, Neutral, Agree and Strongly agree) to measure tennis celebrity endorsement dimensions such as expertise, trustworthiness, attractiveness and fit. Measurement scales adapted from existing studies are summarized in Table 1. Based upon the fifteen items scale devised by Ohanian, ten items revised to fit this study was added into 5-point Likert scales to measure the tennis star's tennis endorsement dimensions of expertise, trustworthiness, and attractiveness. To justify tennis endorser/product fit, additional three items are comprised of 5-point Likert scales.

2.3 Pre-test

In the first place, the developed 13 items questionnaire was pre-test in a pilot study by two marketing academics and two marketing managers. Based upon these experts' comments and suggestions, the wording of the questions was rearranged and reorganized, and the logical sequence of questions was readjusted. Secondly, the revised questionnaire was pretested in a pilot study with ten amateur tennis enthusiasts. Several items in the questionnaire were modified to improve the clarity based on a pilot study with ten amateur enthusiasts. It is followed by starting the main study.

Table 1. Measurement scales.

Code	Scale items
	Expertise
Item 1	I will buy tennis products endorsed by tennis players who have higher ATP/WTA rankings, as opposed to their lesser ranked counterparts
Item 2	A tennis player's endorsements greatly influence my understanding of quality tennis products, which plays an integral role in my purchases
Item 3	I will buy an endorsed tennis product/brand solely for the purpose that high-level ATP/WTA pros are currently competing on the circuit with them
Item 4	I always insist on purchasing tennis products advertised by the elite players on both the ATP and WTA tours
	Trustworthiness
Item 5	I will stop buying a tennis brand if the tennis players who endorse the products become a source of controversy (e.g., illicit drug use, violence, match-fixing, etc.)
Item 6	When I am confused about a tennis product, I automatically trust the tennis players endorsements
Item 7	When I believe the tennis endorsements said by tennis players to be true, I will continue to become a loyal customer in the future
	Attractiveness
Item 8	I will buy tennis products/brands endorsed by players solely based on their attractiveness
Item 9	I will purchase tennis products/brands endorsed by the tennis player based on their public image
Item 10	The magnitude of the success won by the players who endorse a tennis product heavily affects my decision to purchase said object
	Match-up
Item 11	The chances of me buying a non-tennis related product increase if a tennis player endorses it. (e.g., watch, Perfume, Wine)
Item 12	Tennis products/brands endorsed by famous non-tennis players (e.g., singers or actors) have little impact on my purchasing decisions
Item 13	I am willing to pay a higher price for tennis products endorsed by tennis players, as opposed to those endorsed by actors and singers

2.4 Reliability and Validity

According to Beckstead, Cronbach's alpha is a widely used index of reliability [34]. An Opinion proposed by Cortina is that Cronbach's alpha >0.70 are accepted and adequate based upon recent literature in applied psychology [35]. Cronbach's alpha for each dimension ranged from 0.528 to 0.884, depicted in Table 2. Despite Matchups dimension less than 0.70, the overall Cronbach's alpha was 0.906, which symbolized high internal consistency. At the same time, alpha values were described as acceptable (0.45–0.98),

whereas the alpha values (0.4–0.55) were not satisfactory [36]. The overall reliability of this exceeded the recommended standard of 0.70 and thus archiving satisfactory reliability. Regarding validity, to ensure the sampling adequacy and appropriateness of the factor analysis, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of Sphericity are used to measure the dimensions' validity $KMO = 0.864$; $\chi^2 = 610.982$, $P < 0.01$, $df = 78$ respectively.

Table 2. Reliability assessment results.

Items	Cronbach's alpha
Expertise	0.884
Trustworthiness	0.711
Attractiveness	0.852
Matchup	0.528
Overall	0.906

2.5 Collection and Statistical Treatment of Data

Questionnaires were distributed to 100 samples of amateur tennis enthusiasts, and 82 usable samples were obtained after excluding the incomplete recompenses, generating an 82% response rate. This study utilized descriptive statistics to analyze the effects of tennis celebrity endorsements on amateur tennis enthusiasts' purchase intention. Specifically, from the perspective of expertise, trustworthiness, attractiveness, and matchup dimensions, the mean values and standard deviations obtained were used to analyze the extent to which tennis celebrities' endorsements impact the purchase intention of amateur tennis enthusiasts and further investigate which dimension is most influential.

3 Results

Descriptive statistics were computed. The means for expertise, trustworthiness, attractiveness, and match up dimensions were 3.13, 3.01, 3.04 and 3.21, respectively, on a five-point Likert scale (see Table 3). Given on the Likert scale, the numbers one to five represent a scale from weak to strong.

When it comes to the effect of tennis celebrities' tennis endorsements on the purchase decision of respondents, there are significant differences among these four dimensions, even though the mean of these dimensions is at a moderate level. Specifically, the respondents are influenced by tennis endorsers expertise, such as a higher world ranking and rich event experience, compared to trustworthiness and Attractiveness dimensions when making purchase decisions. Additionally, Matchup is the most influential factor in respondents' consumption decisions when there is a better fit between the celebrity tennis endorser and the endorsed products and brand. When the celebrity endorser and the advertised product and brand are congruent, tennis star endorsements become more

effective. Endorsers' endorsements are more persuasive when a matching relationship between the endorser and the endorsed product is based on the match-up hypothesis [37]. In other words, for convincing efficacy, the message disseminated the celebrity image, and the advertised product should be consistent.

Table 3. Descriptive statistics: the means and standard deviation for four dimensions.

	<u>N</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Mean</u>	<u>Std. deviation</u>
Expertise	82	1.00	5.00	3.13	0.86891
Trustworthiness	82	1.00	5.00	3.01	0.81219
Attractiveness	82	1.00	5.00	3.04	0.87295
Match up	82	1.67	5.00	3.21	0.76356
Valid N (listwise)	82				

Additionally, according to Table 4, it is revealed that the respondents who have played tennis for more than seven years are subtly influenced by the expertise, trustworthiness, and attractiveness of tennis stars when making a purchase decision. Nevertheless, the tennis endorser's expertise, trustworthiness, and attractiveness significantly impact purchasing the tennis product for subjects who have played tennis for less than seven years, especially for those with only four-six years of experience ($M = 3.15$, $M = 3.42$, $M = 3.31$). Most respondents are influenced in making purchase decisions when it comes to the match up a dimension.

The respondents with less than one year of experience are usually influenced by Matchup, with $M = 3.44$, indicating that the celebrity tennis endorsers might be viewed as a crucial reference indicator for tennis beginners' purchase decision when the relationship between the tennis endorser and the endorsed product keeps congruent.

Table 4. The results of mean comparison for tennis age.

Dimensions	Tennis age	Mean	SD
Expertise	Over 10 years	3.09	0.89655
	7–10 years	3.04	0.79654
	4–6 years	3.15	0.84410
	1–3 years	3.28	0.87500
	Under 1 year	3.06	1.05162

(continued)

Table 4. (continued)

Dimensions	Tennis age	Mean	SD
Trustworthiness	Over 10 years	2.71	0.72574
	7–10 years	3.00	1.01504
	4–6 years	3.42	0.72885
	1–3 years	3.21	0.73912
	Under 1 year	3.00	0.81650
Attractiveness	Over 10 years	2.87	0.85590
	7–10 years	2.97	1.00963
	4–6 years	3.31	0.83063
	1–3 years	3.19	0.75981
	Under 1 year	3.04	1.03339
Match up	Over 10 years	3.27	0.72925
	7–10 years	3.03	0.78442
	4–6 years	3.20	0.81455
	1–3 years	3.13	0.72903
	Under 1 year	3.44	0.91287

4 Discussion

Regarding the results of descriptive statistics, four different dimensions such as expertise, trustworthiness, attractiveness, and Matchup are calculated, with 3.13, 3.01, 3.04, and 3.21, respectively. While the means of four dimensions are all in the moderate level based upon the Five point-Likert scales, there are significant differences between them. Starting with source credibility, expertise ($M = 3.13$) indicates the most substantial effect on credibility, followed by attractiveness ($M = 3.04$) and trustworthiness ($M = 3.01$). From a statistically perspective, expertise can thus be identified as most important if credibility is to be positively influenced, showing that a tennis celebrity's expertise impacts amateur tennis players' purchase intention when planning to buy tennis products. This is in line with extant research [12, 13].

Furthermore, the result is consistent with the claims of Till & Buster that when it comes to pairing endorsers with brands, expertise may be more valuable than attractiveness in making purchase decisions [25]. Tennis endorsers' attractiveness positively influences consumers' purchase intention since attractive communicators are usually favored, adored, and believed to impact products positively. This finding is consistent with that of Kahle and Homer who attractive endorsers do have a stronger impact over the consumer than less attractive ones do [16]. On the other hand, the finding contradicts previous studies that have suggested that an endorser's physical attractiveness has no effects on consumers' purchase intention [16, 17]. Consistent with the research concluded by Chao et al., trustworthiness, to some degree, has positive effects on more consumers'

purchase intentions [19]. Therefore, the perceived trustworthiness of an endorser may be deemed relevant and beneficial when it comes to testimonies, including experts as endorsers.

Our results indicate that the matchup hypothesis is a viable model for predicting the effectiveness of various tennis endorsers for consumers' purchase intention. The endorser-product congruence plays an incredibly crucial role in affecting amateur tennis enthusiasts' purchase intention in all dimensions. This finding is in line with that of Kim and Na [37], who also found that endorsers are more successful in affecting consumers' purchase intention when they have a corresponding relationship between the endorser and the endorsed product under the matchup hypothesis. In other words, for persuasive effectiveness, the messages and signals communicated by the celebrity image and the sponsored product should be consistent. Additionally, the finding corroborates the ideas of Fink et al., who suggested that the most significant predictor of purchase intentions for the marked product was athlete-product fit, which is consistent with the matchup theory [21]. Concerning investigation in the relationship between tennis enthusiasts' purchase intention and tennis ages, the result demonstrates that tennis ageing over seven years is less likely to be influenced by tennis endorsers' expertise, attractiveness, and trustworthiness than counterpart. It is noticed that tennis endorser-product congruence has a significantly positive impact on all enthusiasts' purchase intention. However, contrary to the extant literature review, no evidence of the relationship between amateur tennis enthusiasts' purchase intention and enthusiasts' tennis age was detected.

From a practical implication perspective, these findings have important implications for tennis managers or marketers on choosing an effective tennis endorser to advertise their brands or products in general, thereby increasing the sales. Furthermore, although this research result indicated that expertise, attractiveness, trustworthiness, and matchup dimensions could generate a positive impact on consumer' purchase intention, tennis firms and marketing practitioners are well-advised to pay attention to the matchup dimension, known as endorser-product congruence, since this can be influenced to have a favourable impact on consumers' purchase intention. Importantly, to a certain extent, the results of this study can also be used as a reference for advertising endorsements in other industries, even though this article mainly explores the effectiveness of celebrity endorsements on purchase.

5 Conclusions

The study has shown that tennis star endorsements can positively impact tennis enthusiasts' purchase intention in products advertised from the expertise, attractiveness, trustworthiness, and matchup dimensions. The endorser-product congruence is the most effective dimension to influence tennis enthusiasts purchase intention in tennis products, followed by expertise, attractiveness, and trustworthiness, even though several dimensions have a positive impact on purchase intentions. There is value in this research, but nonetheless recognized limitations. In the first place, the small sample size, with 82 respondents, and the imbalance of respondents' gender might result in limited generalizability for tennis enthusiasts' purchase intention. Additionally, the Cronbach's Alpha of Matchup dimensions is relatively low, with 0.528, which means lower reliability. However, alpha values describe as acceptable (0.45–0.98) [36]. Future questionnaires are

better to reach at least 0.75, regardless of individual dimension or overall content [35]. By way of closure to this study, there are several recommendations for future research. First, increasing research sample size and ensuring gender appropriate are key aspects of making sure the generalizability. Second, one aspect that could be done in the future research is the recommendation of quantitative research and qualitative research, which could enhance the reliability and generalizability of the research. Specifically, qualitative research can be used in expert interview to explore marketing models while quantitative research can be used to measure the consumer attitude toward tennis star endorsements. Finally, future research should investigate the effects of tennis celebrity endorsements on tennis enthusiasts' purchase intention from source attractiveness and source trustworthiness models and then compare which model is most influential in affecting purchase intention.

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Analysis of Countermeasures After Being Listed as a Currency Manipulator, Taking Vietnam's Foreign Exchange Market as an Example

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Abstract. On December 16, 2020, the U.S. Treasury Department identified Vietnam as a currency manipulator. The purpose of this paper is to explain why Vietnam is accused of being a currency manipulator and why these accusations are inconclusive. This paper refers to the statement of the Ministry of Finance on Vietnamese currency, and then makes an analysis. It further explains the background based on the economic situation and bilateral relations.

Keywords: Vietnam · Currency manipulation · Foreign exchange market

1 Foreword

On December 16, 2020, the U.S. Treasury Department identified Vietnam and Switzerland as currency manipulators after conducting financial reviews of more than 20 trading countries. After the publication of the report, it is meaningful to make an in-depth analysis.

First of all, Vietnam and China share similar economic systems and development paths. Vietnam's current situation is more like China at the end of the last century, but the country is relatively close to China geographically and China was once listed as a currency manipulator in 2019 (and then removed) and other factors, which makes the analysis of Vietnam inspire or reflect on China.

Secondly, Vietnam's outstanding trade performance since the outbreak of pneumonia has made Vietnam the focus of many media discussions in 2020. Some people think that Vietnam is the next country that can be called the 'Asian miracle', and many articles analyze the great advantages of Vietnam's economic development from a historical perspective. In some mainstream social media and academic reports, there are many introductions to this incident, but very few follow-up actions. This move by the United States is bound to have an impact on Vietnam's economy, especially the foreign exchange market. However, it is difficult to get a detailed understanding of the countermeasures that Vietnam can consider and finally adopt, and the measures taken by Biden administration after the change of the US government.

Finally, American laws and policies are also very special. According to an American law in 1988, if some countries have sustained and objective overall trade surplus and

huge bilateral trade surplus with the United States, the U.S. Treasury Department should consider that these countries have ‘unfair exchange rate manipulation’. And among other variables, the Treasury Department also considered the increase of foreign exchange reserves. In 2015, the review procedure was strengthened, which stipulated that it should be conducted every six months, and the remedial measures included negotiations with the US Treasury or the IMF, which resolved the investigation results. If no solution can be found, tariffs may be imposed on goods imported into the United States [1].

Next, this paper will discuss and analyze the event that Vietnam is listed as a currency manipulator, the countermeasures that Vietnam can consider, and the actual impact on the foreign exchange market.

2 Vietnam Foreign Exchange

2.1 Foreign Exchange Market

Vietnam’s foreign exchange market has the following characteristics:

1. First, after the financial crisis broke out in 2008, the Vietnamese Dong depreciated sharply against the US dollar. Because of the small market capacity, the intervention ability of Vietnam’s central bank is limited. Once there are large transactions or important news in the market, the market fluctuation will increase or even be unable to digest.
2. Secondly, Vietnam’s foreign exchange policy is strictly managed, and the official price cannot reflect the actual demand and supply, so its foreign exchange free market is very developed.
3. Finally, Vietnam has strict foreign exchange control, and the government is vigorously promoting the ‘de-dollarization’ strategy. The government encourages enterprises and individuals to hold Vietnamese dong in order to improve its market position, but there is no restriction on the exchange of foreign exchange into Vietnamese dong.

2.2 Foreign Exchange Reserves

Vietnam’s foreign exchange reserves are already very impressive in the world, which shows that Vietnam’s external payment ability and strength in adjusting international balance of payments have increased. Within a few days of China’s announcement of the first case of COVID-19, Vietnam mobilized to organize the spread of coronavirus, and quickly controlled the epidemic situation, which enabled Vietnam to resume its business quickly, ranking first in the world in terms of economic growth. By the end of 2020, the scale of Vietnam’s foreign exchange reserves has reached 94.8 billion US dollars, and the total foreign exchange reserves have reached the highest level in history. It is estimated that the country’s foreign exchange reserves will exceed 100 billion US dollars in 2021 [2].

3 Manipulating State

There are three main criteria for listing Vietnam as a currency manipulator. Specifically, the bilateral trade surplus with the United States is over US\$ 20 billion. And the unilateral intervene in the exchange rate has been for at least 6 months and the net purchase amount accounts have been for more than 2% of GDP. Current account surplus accounts have been for more than 2% of GDP.

Now this paper will analyze three measurement standards in turn:

As for bilateral trade surplus and net foreign currency purchase, Vietnam's domestic special economic structure has caused such a result, instead of Vietnamese deliberately creating the devaluation of Vietnamese Dong to form an export advantage to the United States. With the rising labor cost and land cost in China, the low-end manufacturing industry has gradually moved to Vietnam and other countries. Since China's exports to the United States have changed into Vietnam's exports to the United States, Vietnam should always be alert to possible rebound and inevitable trade frictions while making profits.

As for the appreciation of the value of the Vietnamese Dong, Vietnam is a rapidly developing economy with high openness, and needs to use various monetary policies to maintain sustainable development and ensure economic security.

In fact, since 2016, the National Bank of Vietnam has implemented the exchange rate management mechanism according to the fluctuation of currency baskets of countries with important economic relations with Vietnam. Combined with prudent fiscal policy, the real value of Vietnamese Dong has only increased by about 2.6% in the past three years. In other words, Vietnam may even be negatively affected by the appreciation of the Vietnamese Dong against the US dollar, and may not have the export advantage claimed by the United States.

The actual exchange rate of Vietnamese Dong against US dollar is shown in Table 1.

Table 1. Calculation of Vietnam's real exchange rate, 2015–2020

	2015	2016	2017	2018	2019	2020
Nominal exchange rate ('000 VND/USD)	21.89	22.16	22.43	22.83	23.16	23.10
Vietnam/US inflation index	1	1	1.02	1.032	1.032	1.041
Real exchange rate	21.89	22.16	21.99	22.12	22.44	22.19

Note(s): End-of-year values are used for exchange rates; a GDP deflator of 2% is estimated for Vietnam in 2020. The real VND/USD exchange rate is the nominal rate divided by the Vietnam/US inflation index. Data from Asian Development Bank is licensed under CC BY 3.0 IGO

Source(s): Asian Development Bank (2020), U.S. Bureau of Economic Analysis (2021)

Generally speaking, it is more meaningful for the United States to consider accusing high-income or middle-income countries of currency manipulation, while Vietnam should not be accused of this.

In addition, apart from the impact of Vietnam's special economic structure, the United States also has certain responsibilities. First of all, as an international currency, the value of the US dollar is higher than that of other currencies, and it naturally has more imports of consumer goods, which leads to the trade deficit of the United States with many countries. In addition, a large number of American manufacturing industries moved to you, which also led to the United States having to import a large number of manufacturing products.

4 Countermeasures

According to different attitudes, Vietnam has some options to consider.

4.1 Tough

If Vietnam's attitude is tough enough, it is necessary to continue to maintain the status quo and maintain rapid development.

Based on the influx of foreign capital into Vietnam, Vietnam's economic development model is not very healthy, but Vietnam has to attract foreign investment, because Vietnam needs more capital to improve its competitiveness as soon as possible.

At the same time, the Vietnamese Dong should not be deliberately devalued, because trading partners can easily respond, which may cause unnecessary macro instability of Vietnam's economy. Therefore, Vietnam should strive to maintain the role of the national bank in regulating macroeconomic stability, and continue to purchase foreign exchange if necessary. The government should not restrain the national bank too much for fear of US sanctions.

On the other hand, not only Vietnam is a 'victim', but the United States also exerts pressure on many countries to impose trade sanctions, which are more or less dissatisfied with the three standards of currency manipulation set by the United States. Therefore, Vietnam can unite with these countries, and perhaps join forces to force the United States to reconsider its standards. The United States in Biden's era may not become a ubiquitous trade war power. America after Trump needs to strengthen its strategic relationship.

Therefore, it is necessary for Vietnam to show the United States. Only when Vietnam can develop itself, be strong and know how to stand with many other countries will it not be punished by the United States alone.

4.2 Compromise

First of all, Vietnam can maintain the currency value of Vietnamese Dong, and at this time Vietnam can further choose: a. Increase the quantity of imported goods from the United States. b. Accept higher tariffs imposed by the United States. In addition, Vietnam can also let the Vietnamese dong appreciate, and then Vietnam can choose. c. Reduce the trade surplus. d. Try to negotiate with the United States to avoid punitive tariffs.

The first case is difficult to implement. According to the data, Vietnam's overseas trip to the United States is \$80 billion, far exceeding the US export volume of \$10 billion to Vietnam. If Vietnam promises to increase imports from the United States, it may

promote negotiations between the United States and Vietnam, but in fact, the import and export gap of about US\$ 70 billion is difficult to completely make up [3].

The second measure will cause many problems for Vietnam. If the United States imposes punitive tariffs on Vietnam, Vietnam's exports will be greatly reduced, and a quarter of Vietnam's monthly exports are exported to the United States; In addition, Vietnam's attractiveness to foreign investment may also be weakened by U.S. sanctions, which may even further lead to an increase in the unemployment rate in Vietnam.

The third option has both advantages and disadvantages. In terms of advantages, if Vietnam wants to increase its imports, as imports become cheaper, the inflation of Vietnamese Dong will decrease and the real wages will rise, and Vietnam will greatly promote the growth of domestic economy in promoting consumption. However, in terms of shortcomings, the appreciation of Vietnamese Dong means that Vietnam's agricultural income will be affected, Vietnam's urban infrastructure will also receive greater pressure, and social instability may increase.

The fourth measure is actually a complete compromise to the United States. Vietnam has shown its sincerity to the United States thoroughly, not only to control the appreciation of Vietnamese currency, but also to promise to import more American goods. Vietnam needs to actively communicate information with the United States in a cooperative manner, and should communicate cautiously and actively in communication. In addition, the core concern of the United States is to reduce the deficit with its trading partners. Vietnam needs to increase imports of American goods and services, especially agricultural products, energy products, transportation, machinery and equipment, high-tech equipment and medical equipment.

5 Status Quo

5.1 Foreign Exchange Market

After receiving sanctions from the United States, Vietnam's foreign exchange market will undoubtedly be affected.

In the first quarter of 2021, Vietnam's exports increased by 22% and imports increased by 26%. If this trend continues, Vietnam's trade deficit may begin to shrink [4].

According to the data of the first half of 2021, Vietnam's total import and export volume reached 316.73 billion yuan, an increase of 32.2% year-on-year, of which exports were 157.63 billion dollars and imports were 159.1 billion dollars, with imports exceeding exports.

5.2 Reasons

The main reason is that the Vietnamese government does not want to give up the rapidly warming US-Vietnam relations in recent years.

First of all, in Vietnam, the exchange rate of Vietnamese Dong against the US dollar is generally at a low level, and various industries have begun to show weakness to the United States. For example, the timber industry in Southeast Asian countries has called for tightening supervision and buying more American timber to avoid punitive tariffs

from the United States. In terms of public opinion, most Vietnamese people expressed their support for the news that the relationship between the United States and Vietnam was warming up.

Secondly, on April 16, 2021, the U.S. Treasury Department announced that because there was not enough evidence to show that Vietnam manipulated the exchange rate for unfair advantage, the U.S. would not impose tariffs, but continued supervision and discussion would continue [5].

6 Summary

In recent years, the relationship between the United States and Vietnam has developed rapidly, but contradictions and differences still exist. Vietnam benefited from the escalating Sino-US trade tensions and China's rising labor costs, and its export volume and trade surplus increased rapidly. Vietnam wants to keep the real exchange rate of Vietnam against the US dollar stable, but it has attracted the attention of the United States. The United States is uneasy about the growing bilateral trade imbalance. The United States threatened to impose tariffs on Vietnam's exports because of what the US Treasury called unfair exchange rate manipulation.

Vietnam keeps courting the United States, hoping to get the support of western countries. However, in the face of the sanctions imposed by the United States for its own interests, the alliance between the United States and Vietnam is not strong. In the future, the United States and Vietnam are both partners and competitors, and the development of bilateral relations is expected to continue in cooperation and struggle.

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The Impact of B&B Refund Policy on Consumer Reviews—Based on the Risk Perception Theory

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Abstract. Affected by the epidemic, B&B refund policy has greatly affected consumers' purchase decision making and evaluation. However, the research on the impact of B&B refund policy on consumer evaluation has not been paid enough attention, the impact mechanism needs to be cleared urgently. Based on the risk perception theory, this paper establishes the influence mechanism of the refund policy on consumer evaluation used the data of Airbnb in Boston. This research found that the severity of the refund policy negatively influenced consumer evaluation. Meanwhile, “host response speed” and “instant booking policy” negatively regulating the impact of the refund policy on consumer evaluation, and the “super host badge” positively regulating the impact. This study provides a theoretical basis for the rational setting of the refund policy, broadens the boundary application boundary of risk perception theory, and enriches the situational applicability of the Airbnb platform mechanism, which provides enlightenment for the stakeholders of the B&B platform to maintain a balanced relationship and maximize their own interests.

Keywords: Online booking · Refund policy · Risk perception · Consumer evaluation

1 Preface

With the rise of the sharing economy supported by Internet technology and expanding B&B industry, online booking has become the main way for consumers to book B&Bs. It realized the efficient utilization of housing resources through third-party platform. This new sharing economy model not only brings novel experiences to consumers, creates revenue for landlords and platforms, but also injects new vitality into the tourism and accommodation market. Founded in 2008, Airbnb, a leader in the shared accommodation economy, has maintained high revenue growth since then, enabling the sharing of properties worldwide and creating a new pattern of travel. However, the platform's progress journey of massive expansion has also revealed many problems. First, the homogenization of listings is serious. The original intention of this form of accommodation was to allow tourists to have directly reaching hosts, and intuitively experience local customs, so that form a personalized perception of local culture. However, the majority of B&Bs is currently decorated in a single style, with similar service content, lacking cultural connotations, which making it difficult for tourists to differentiate their stay from

other experiences, hence unable to impress customers and form a good reputation. Secondly, due to the virtual and open nature of B&B booking websites, consumers need to overcome risk perception barriers [1]. From building trust to complete a purchase, consumers need to overcome the heavy barriers of risk perception, therefore the number of customers present the gradual step-down trend. The current B&B market is highly competitive, but still difficult to obtain such a huge market share as traditional hotels. How to win consumers and high praise in the competition? What factors influence consumers' choice and evaluation? There are urgent questions to be thoughtfully explored.

Most of the existing studies focusing research on the related stakeholders. For the B&B market, scholars have mainly studied the motivation and satisfaction of the demand side, operation methods and behavior of the supply side.

In the context of the virtuality of Internet, less research has been conducted from the perspective of the refund policy, which has a significant impact on consumers' willingness to pay, as well as the positive evaluation of product expectations [2], thus affecting the business situation of B&Bs. In addition, the impact of the epidemic has led to greater uncertainty in consumers' travel and a significant increase in the demand for refund. There are problems in the balance of interests between consumers and homeowners. Based on 2633 data from Airbnb Boston area, this paper examines the impact of B&B refund policy on consumer evaluation, constructs a model with refund policy as independent variable and customer evaluation as the outcome, and introduces "super host badge" "host response speed" "instant-booking" as moderator variable. This model not only make up for the shortage of the previous research on the relationship between refund policy and consumer evaluation, and broaden the scope of application of risk perception theory; but also practically provides insights for all stakeholders of B&B platforms to maximize their own interests.

2 Literature Review and Hypotheses

2.1 Risk Perception Theory

The initial research on risk perception began with Bauer argued that consumers' consumption behavior may have consequences that they cannot predict, there is uncertainty about the outcome in consumers' purchase decisions [3]. When consumers make online B&B reservations, they need to filter the information, and consider the uncertainty of their future journey, and perceive the possible losses may bring to them, at which point consumers generate risk perception. In the study of consumer behavior, it is believed that consumers' risk perception is one of the important factors that hinder consumers from making purchase decisions. Therefore, we need to study the factors that affect consumers' risk perception in depth so that make benign guidance for consumers' decision and evaluation. At present, many domestic and foreign scholars have studied the impact of consumers' personal characteristics such as consumers' age, gender, education level, and online shopping experience on risk perception; on the other hand, since consumers can only perceive the listings and services through pictures and online reviews without direct contact, the reputation of the landlord, and the brand of the listings become key factors affecting consumers' risk perception.

Risk perception is a multidimensional concept in terms of its constituent dimensions [4]. In the Internet environment, scholars mainly classify it into four aspects: product risk perception, financial risk perception, time risk perception and privacy risk perception. From the perspective of the impact of refund policy on consumer evaluation, the risk perceptions of products, financial and time are the dominant dimensions in this study.

2.2 B&B Related Studies

To study the research on B&B abroad in recent years, we searched the existing literature according to the theme of “bed and breakfast” using “Web of Science”, and retrieved a total of 212 related literature without any time limit. The keywords of the selected literature were imported into “VOSviewer” for Keyword Co-occurrence Analysis, and the results were organized as shown in the Fig. 1.

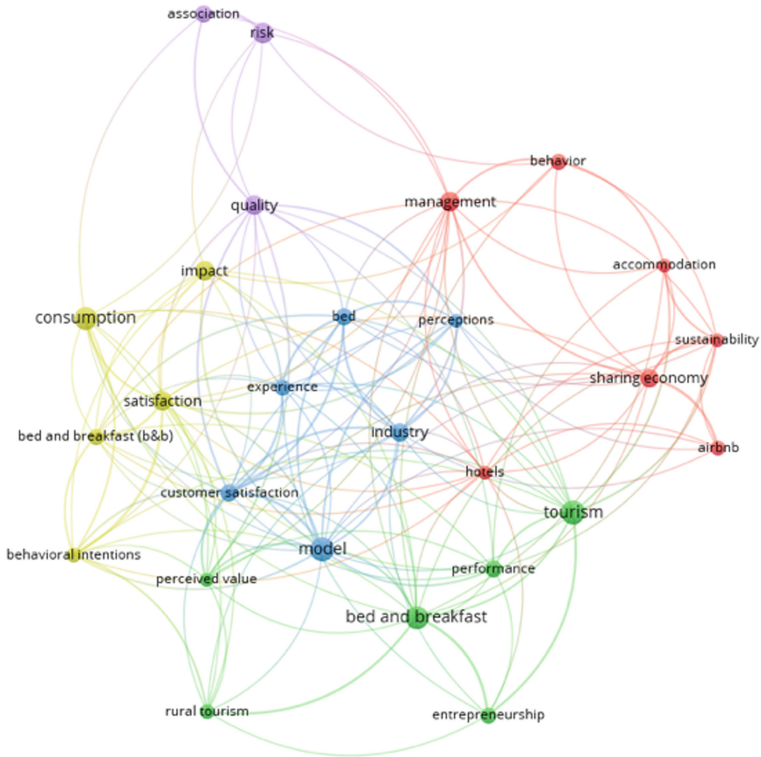


Fig. 1. Keywords co-occurrence spectrum

The publication time of the searched literature is distributed in 2013–2018, and the analysis reveals that 2013–2016 is in the budding period of B&B research, this period mainly focuses on theoretical research on the concept of B&B, business model and the influence on Tourism, etc. The number of relevant studies increases in 2017 and later, and topics are gradually enriched. Firstly, from the industry's perspective, the business model of B&B in the context of sharing economy and sustainable development is studied. Finally, from the consumer's perspective, study the motivation and consumption behavior of consumers to provide guidance for the development and marketing of B&B products; the others focus on the factors influencing consumers' perceptions of B&B experience, mainly including IWOM factors, perceived risk factors, trust factors, and familiarity factors. Secondly from the perspective of landlords, the impact of landlords' demographic characteristics, participation behaviors, and operational strategies on consumer perceptions and B&B transactions is studied. From the industry's perspective, the business model of B&B in the context of sharing economy and sustainable development is studied. Based on the literature search results, it can be seen that with the development of Internet economy, the research objects of scholars gradually tend to be micro. Combing the functional relationship between consumers, landlords and platforms has become a key link in the study of B&B.

3 Research Model and Research Hypothesis

With the popularity of Internet consumption model, online book brings many conveniences to consumers. However, because the online booking model cannot bring consumers complete information about the room experience, and there is uncertainty about consumers' trip plans, if they do not choose carefully it is very likely to bring losses in terms of time and money, meanwhile these expected losses will cause consumers to face greater perceived risks when making decisions [5]. Consumers who bear greater perceived risk will be more cautious in considering options [6], and are more likely to anticipate negative emotions such as regret from undesirable outcomes [7], and negative emotional expectations influence consumers' purchase behaviors and evaluations. An effective way to help consumers reduce regret is to have a refund policy for online B&B bookings.

Research on refund policy mainly focuses on two types. One is the general refund behavior caused by product quality factors and consumer preference factors in the retail context. The other is occurs when the consumer has not consumed the service but only booked the service [8], which is the scenario that B&B refund policy applies to.

A lenient refund policy provides a "buffer zone" for consumers' expected regret, reduces the perceived financial risk consumers face when making decision, not only effectively suppresses negative emotions but also increases willingness to book and improve the overall evaluation of B&B. Conversely, harsh refund policy forces consumers to take a greater perception of financial risk, which is likely to causes negative emotions at the decision phase, thus reducing willingness and evaluation. Otherwise, a refund policy is a business strategy of the owner and reflects the owner's service attitude to a certain extent. A lenient refund policy tends to give consumers a positive impression of the owner as "patient and considerate", which reducing the perception of risk caused

by the unknown and highly uncertainty, hence increasing the willingness to book and the overall evaluation. In addition, the reviews of other consumers form the word of mouth not only influences consumers' purchase behavior, but also their pre-purchase expectations, post-use attitudes and evaluation [9]. The reviews of the listings to a certain extent compensate for the lack of consumer experience perceptions in the online booking model and strengthen the overall perceptions of the listings, besides the content of the reviews about the refund policy can more directly reduce or enhance consumers' risk perceptions and have an apposite or negative impact on the reviews. Based on the above, Hypothesis 1 is proposed: The severity of the deposit refund policy has a negative impact on B&B reviews.

Due to the intervention of Internet transaction technology, online booking mechanism and other factors, consumers face more "prisoner's dilemmas" and adverse selection problems in the process of trading with landlords, when the reputation of the seller in the transaction process plays a more significant role in facilitating the transaction than in offline transactions [10]. The reputation and influence of the landlord has become a key factor affecting consumers' risk perception [11] for consumers facing greater risk perceptions. It is particularly important for platforms to establish online reputation mechanisms. The "super Host badge" given by Airbnb to quality hosts, which combines the number of bookings, response rate, refund rate and overall rating of hosts, and is a comprehensive reflection of the high quality and good reputation of hosts, thus distinguishing them from ordinary hosts on the platform. Objectively, the badge is the information from the platform's recommendation of the landlord and the listing, which is the platforms guarantee of the high quality and reputation. Through such a platform recommendation model can reduce consumers' product risk perception and improve the overall evaluation of the listing. In summary, Hypothesis 2 is proposed: the "super host badge" moderates the impact of the refund policy on consumers' evaluation. That is, the severity of the refund policy has a higher impact on consumer evaluation than that without the badge.

The online booking model reduces the cost of the search for consumers and enhances the accessibility of information to them. However, it also puts consumers amid mass information, making it difficult for them to decision in a short time, which leads to an increase in the perception of time risk. In this case, consumers will adjust the amount of information they process according to their situation and their cognitive ability, and thus develop a "satisfactory solution" rather than an "optimal solution" (Herbert Simon, Bounded Rationality, 1995). On the flip side, the online booking model hinders hosts from having direct contact with consumers, can only communicate limited external cues to consumers through the appearance of the B&B, such as function introduction, profiles and brand prices, while internal cues directly related to subjective perceptions, such as atmosphere, taste and touch, are difficult to convey [12], resulting in consumers can't forming a complete and deep perception about the B&B. Due to this asymmetry of buyer-seller information, it is more difficult for consumers to judge the quality of

B&B properties. Such situation makes the subjective factor of the landlord particularly important. To increase consumers' willingness to buy and improve positive evaluation, landlords do their best to enhance the effectiveness and timeliness of the information they deliver, of which the speed of landlord response is a concrete expression. The high response speed of the landlord not only reduces the time cost of consumers in screening information, but also lead consumers effectively select clues for screening and sorting out the actual situation and preferences, make a "satisfactory purchase" decision. Therefore, the high response speed of landlords reduces consumers' perception of time risk, while reducing their negative emotions when faced with a large amount of information, and thus tends to generate a positive evaluation of the property. In summary, Hypothesis 3 is proposed: The landlord's response speed moderates the impact of the refund policy on consumer evaluations. That is, the faster the response speed of the landlord, the weaker the effect of the refund policy on consumer evaluation.

As a typical bilateral platform, Airbnb has introduced the "instant booking" model to facilitate effective matching between the customer and host. This allows hosts to freely choose the matching method and have the right to accept or reject booking requests from consumers. With the "Instant Booking" option, hosts will not have the right to reject a consumer's booking request, but will get corresponding rewarded with a boost in search rankings. From the consumer's point of view, compared to the instant booking matching mechanism, the two-way choice mechanism significantly increases their search costs and the risk of being rejected by the landlord. But on the other hand, the instant booking mechanism also increases consumers' identification costs [13]. Low quality houses and hosts can improve their search rankings by enabling instant booking, which makes consumers more gullible by. At this moment, consumers' product risk perception increases. Therefore, for consumers, the "instant booking" policy not solely reduces their search cost and weakens the perception of time risk, but also enhances their identification cost and the perception of product risk. Considering the afore mentioned consumers' willingness to sacrifice decision accuracy to develop a "satisfactory solution" rather than an "optimal solution", this paper supposes that the impact of reduced time risk perception on decision making is greater than the impact of increased product risk perception on decision making. The "instant booking" policy generally reduces the time cost of consumers, thus reducing the perception of time risk and positively influencing consumers' evaluation. In summary, hypothesis 4 is proposed: the instant booking policy moderates the impact of the refund policy on consumers' evaluation. In other words, the effect of refund policy on consumers' evaluation is weaker for the listings with an "instant booking" policy than for the listings without.

4 Data Analysis

Data analysis revealed a strong negative relationship between refund policy and customer rating ($r = -0.160$, $p < 0.01$) (Tables 1 and 2).

Table 1. Correlation analysis

	M	SD	1	2	3	4	5	6	7	8	9
1. Review	9.106	1.093									
2. Latitude	42.339	0.025	-.055**								
3. Room type	1.43	0.532	.053**	-.260**							
4. Guests included	1.484	1.108	0.02	-0.015	-.270**						
5. Extra fee	12.174	19.776	0.035	-0.01	0.011	.399**					
6. Exact	0.87	0.34	-0.027	0.035	-.096**	0.015	-0.007				
7. Refund policy	2.281	0.843	-.160**	.131**	-.250**	.112**	.099**	.097**			
8. Response time	6.687	8.781	-.143**	-.039*	0	-0.027	-.041*	0.028	0.032		
9. Super host	0.142	0.350	.246**	-.096**	.068**	.078**	.078**	.047*	0.007	0.028	
10. Instant book	0.172	0.377	.067**	0.023	.049**	0.035	.037*	-0.002	0.02	-0.023	0.012

Table 2. Influencing factors of customer evaluation

	Model 1	Model 2	Model 3	Model 4	Model 5
Latitude	-1.884* (0.874)	-1.479 (0.865)	-1.444 (0.85)	-0.579 (0.842)	-1.611 (0.858)
Room type	0.11* (0.048)	0.056 (0.048)	0.059 (0.047)	-0.001 (0.047)	0.044 (0.048)
Guests included	0.019 (0.022)	0.017 (0.022)	0.018 (0.021)	0.002 (0.021)	0.012 (0.022)
Extra people	0.001 (0.001)	0.002* (0.001)	0.002 (0.001)	0.002 (0.001)	0.002 (0.001)
Location exact	-0.071 (0.061)	-0.036 (0.061)	-0.028 (0.06)	-0.077 (0.059)	-0.027 (0.06)
Refund policy		-0.211*** (0.026)	-0.201*** (0.025)	-0.231*** (0.026)	-0.286*** (0.028)
Response time			-0.016*** (0.002)		
Policy*Response			-0.02*** (0.003)		
Super host				-0.763*** (0.058)	
Policy*Super				0.153* (0.074)	

(continued)

Table 2. (continued)

	Model 1	Model 2	Model 3	Model 4	Model 5
Instant book					-0.195*** (0.054)
Policy*Instant					-0.424*** (0.065)
Content	88.691* (37.021)	72.053* (36.633)	70.628 (35.989)	34.05 (35.649)	77.766* (36.315)
F	3.160	12.530	22.906	30.348	16.327
R ²	0.07	0.031	0.070	0.090	0.051

The regressions were conducted with “customer evaluation” as the explained variable, dimension, room type, capacity, number of extra guests, and location accuracy as the control variables, refund policy as the explaining variable, and response rate, super host, and instant booking as the regulating variables. The results found that the refund policy had a significant negative effect on customer evaluation ($b = -0.211$, $p < 0.001$), the stricter the refund policy, the lower the customer evaluation, hence hypothesis 1 was verified. Models 3–5 analyzed the regulating effects of response speed, super host, and instant booking in turn. The results found that the interaction terms of refund policy response speed ($b = -0.02$, $p < 0.001$) and “refund policy-instant booking” ($b = -0.424$, $p < 0.001$) produced highly significant negative regulating effects, and the interaction term of “refund policy-super host” ($b = 0.103$, $p < 0.05$) produced a slightly positive regulating effect. That is the negative effect of the refund policy on customer ratings decreases when the host’s response rate increases or the property is available for instant booking, while the negative effect of the refund policy on customer ratings increases when the host has the super liked host label. Hypothesis 2 was not supported and hypotheses 3 and 4 were supported.

5 Conclusions and Discussion

5.1 Conclusion

According to the data of Airbnb in Boston, the severity of the deposit cancellation policy has a negative impact on the B&B evaluation. The more stringent the cancellation policy, the lower score.

The badge of super host, the responding speed and the policy of instant reservation can regulate the impact. Among them, the “super host badge” has a positive regulatory effect on the “refund policy-consumer evaluation” model, that is, the “super host badge” will strengthen the negative impact of the severity of refund policy on consumer evaluation.

Secondly, the study found that the responding speed of landlords has a negative regulatory effect on the model, that is, a faster responding speed of landlords can weaken the negative impact of severe refund policy on consumer evaluation.

Finally, the study found that the “instant booking” policy has a negative regulatory effect on the model, that is, the “instant booking” policy can weaken the negative impact of severe refund policy on consumer evaluation.

5.2 Theory Contribution

Affected by the epidemic, consumers are facing higher uncertainty in staying in B&Bs, thus bringing higher risk perceptions to their decisions, and the setting of refund policies has attracted widespread attention. Based on the study of the relationship between landlords’ behavior and consumers’ perceptions, this paper aims to investigate how the leniency of the refund policy affects consumers’ evaluation through their risk perceptions, and establishes the “refund policy-consumer evaluation model”. In this paper, we develop the model to provide a theoretical basis for the rational setting of refund policy on the premise of balancing the interests of both parties.

Second, previous studies on risk perception have mainly focused on how it affects consumers’ purchase decisions and evaluations as an independent variable, few studies have considered the impact of different degrees of refund policy on consumers’ risk perception. Therefore, this study fills in the gap about the mechanisms affecting between consumers risk perceptions and evaluations under different degrees of refund policy. It broadens the boundaries of the application of risk perception theory.

In addition, this study further extends the research depth of the consumer decision making process. Existing research has mainly focused on consumers’ final purchase intention or consumption evaluation, which is easily ignored consumers’ prior perceptions and leads to the loss of potential customers. Nowadays, with the increasing prevalence of online booking, the whole marketing environment, operation mechanism, and profit model have changed significantly compared with traditional offline transaction activities. This paper builds on previous research to gain better insight into consumer perceptions from the perspective of risk perception at the decision stage, enhancing the depth of application of risk perception theory.

Finally, this study further expands the situational applicability of Airbnb’s platform mechanisms. This paper selects three platform mechanisms that affect consumers risk perceptions into the model as regulating variables to investigate the regulating effects of other platform mechanisms on consumers risk perceptions under different levels of refund policy, which enriches the research on the influence of platform mechanisms on consumer evaluation.

5.3 Practical Implications

The rise of the sharing economy and related technological advances in recent years have pushed the rapid development of the online B&B booking market. Online booking of B&B has attracted consumers and landlords to the platform due to its convenience and lack of geographical restrictions and variety of categories. Affected by the epidemic, consumers’ travel is restricted and uncertainties in their itineraries increase, which leading to a greater perception of risk when making decisions and a higher demand for refunds. Therefore, the reasonable setting of the refund policy has drawn reasonable attention from consumers, landlords and the platform, and has become an important influencing

factor in consumers' decision making. A lenient refund policy is more acceptable to consumers, but may be detrimental to the interests of hosts. To balance the interests of both parties, Airbnb has also adjusted its refund policy and compensated hosts who offer a lenient refund policy in some way. In the current situation, how to balance the interests of multiple parties and develop a reasonable refund policy becomes a highly important issue to be addressed. The results of this study provide insights for stakeholders to maintain a balanced relationship and maximize their interests.

The findings of the study help landlords consider consumers' risk perception factors when formulating business strategies, provide some management insights into and landlords behavioral decisions, and help landlords better understand consumer preferences then adapt to the current market environment; in addition, this paper focuses on the impact of influencing factors on consumer evaluations at the decision stage, which can draw landlords' attention to consumers in the decision stage and attract more potential consumers through reasonable purchase mechanism, which is conducive to income. The second, for consumers who need to collect comprehensive information when making decisions, and this study provide direction for consumers to consider potential risks comprehensively, which facilitates their reasonable screening of receiving information. Finally, the operation of the platform strategy will have a positive or negative impact on consumers' purchase decisions and evaluations. Through this study, it can help the platform improve the rationality of the platform's operation mechanism, target the most effective operation strategy, and maximize the benefits of the platform while balancing the rights and interests of host and consumers.

5.4 Limitations and Future Research Directions

Firstly, other potential theories can also be developed in depth, such as the use of social exchange theory to study the impact of seller's strategy on buyer's evaluation in the perspective of sharing economy. Second, the overall consumer rating is used as the dependent variable in the study corresponding to the refund policy, and the individual ratings of each dimension can be selected as the dependent variable in subsequent studies to study the impact of operator strategies on consumer ratings of each dimension, which can explore the impact path between operator strategies and consumer ratings more precisely and help operators to formulate corresponding strategies in a targeted manner. Thirdly, Due to the limitation of secondary data, this study only conducted the impact mechanism based on available data, and subsequent methods such as scenario experiments and questionnaires can be used to analyze the specific impact paths in depth.

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Research on the Relationship Between Urban Construction and Tourism Development in China

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Abstract. In an environment where the constituent elements of the urban are becoming more and more diversified, the rapid development of the tourism industry provides a new way of thinking for the development of the city. China is facing more urban renewal issues, and tourism is considered as an opportunity to promote urban renewal and urban sustainability. This article explores the interactive influence mechanism between urban construction and tourism development through literature analysis and SWOT analysis. Through research, it is found that there is a two-way mutual promotion relationship between urban construction and tourism development in China. As the foundation and driving force for the development of tourism, urban construction supports the development of tourism to a certain extent. The tourism industry feeds back urban construction through its extensive influence and capital attracting ability, thus forming a sustainable urban development model in which urban construction and tourism development mutually promote and develop together.

Keywords: Urban construction · Tourism · Sustainable development · SWOT analysis

1 Introduction

In the 20th century, the establishment of China made urban construction a new theme of the times, and the urban development system adapted to industry promoted the progress and development of urban industry. In the 21st century, the primary and secondary industries continued to flow to the tertiary industry, and China's tertiary industry, especially the tourism industry, began to flourish. This made the urban system under the original industrialization system no longer applicable. The construction and renewal of the city needs to be injected with new blood.

In addition, since the beginning of the 21st century, driven by industrial transfer and globalization, the tourism industry and the cities on which its development depends have begun to have a closer two-way interactive development relationship. On the one hand, the high-quality development of the tourism industry can greatly enhance the visibility and reputation of the cities it relies on, and provide extremely favorable conditions for improving the urban investment environment, promoting urban investment, and

increasing the vitality of the urban. At the same time, the development of tourism can also help drive the development of related industries in the city, optimize the industrial structure, and provide new growth points for urban development. Moreover, the development of tourism promotes the upgrading of urban infrastructure and the renewal of some functional areas of the city, which contributes to the sustainable development of the city. On the other hand, some urban construction elements have become the core elements to promote the development of tourism such as the combination of traditional and modern urban style, complete infrastructure construction and development of leisure and entertainment facilities, active urban economic activities and diversified modern civilization.

In general, since the founding of the People's Republic of China, there is an inseparable relationship between urban construction and the development of tourism in our country. They promote each other and depend on each other. They are one of the important urban development styles after the founding of the People's Republic of China, and they have brought a strong endogenous driving force to the construction and renewal of cities and the vigorous development of tourism. It is worth mentioning that studying the relationship between tourism and urbanization is of great significance, which will provide a different development idea and construction model for the development and construction of future cities. This will also find possible development methods for many western and central cities in China, and provide directions and suggestions for urban renewal for some of the more developed cities. In addition, the ingenious integration of tourism and the city will also give new meaning to the tourist city.

2 Literature Review

2.1 Research on the Impact of Urban Construction on Tourism

Urban construction is the prerequisite and foundation for the development of regional tourism, and it plays an important role in promoting the construction of urban infrastructure and the renewal of functional areas. In 2020, the study of Wu et al. [1] indicated that urbanization is the reason for the development of tourism. The process of urbanization has brought about the renewal of a large number of urban infrastructures. At the same time, through consumption and investment effects, cities have shown unparalleled charm, which has greatly promoted the development of tourism. At the same time, the construction and renewal of cities has also led to changes in consumption preferences and improvements in consumption structure. This change provides a driving force for the development of tourism consumption patterns and greatly expands the scale of tourism consumption. In addition, Wang et al. (2021) [2] believed that the development of industrial clusters in cities has promoted the development of tourism and improved the status of urban tourism. From the perspective of tourism supply and demand, urban industry and infrastructure construction play an important role in the relationship between tourism supply and demand. In 2018, a study by Keesing et al. [3] pointed out that taking tourism as the main tone of urbanization development is generally regarded as a green and environmentally friendly urbanization method, which is to protect the environment, Make an important contribution to the promotion of sustainable urban development. In addition, Sheng et al. (2017) [4] pointed out that cities with weak urban facilities are

more likely to rely on tourism, which leads to a single economic structure. This structure is not conducive to the construction of the city to a certain extent.

2.2 Research on the Impact of Tourism on Urban Construction

Tourism is one of the fastest-growing emerging industries in the world in the 21st century, and its development will have a positive or negative impact on the development of all aspects of tourist destinations. In 2020, Yao et al. [5] proposed to take tourism as a driving force of urban innovation, and use this to develop the leisure space of urban residents to meet the needs of urban development. It can also ensure the tourism industry Sustainable development. This provides an alternative to the traditional urbanization method, which focuses on the promotion of urban construction by the tourism industry. At the same time, the plan also focuses on promoting the process of urban and suburban integration. From the perspective of developing countries, Musavengane et al. (2020) [6] believes that the development of national tourism, due to problems such as urban risks and regional differences, need to presents a comprehensive risk management approach. The core thinking about the urban management system, which promotes the improvement of the urban system and the renewal of the old functional areas. At the same time, they pointed out that tourism is not only a force to promote urban renewal in developed countries, but also promotes the renewal of developing cities to a certain extent, which serves as an important alternative method to promote sustainable tourism in a dysfunctional urban environment. An interesting phenomenon is that Kevin Markwell (2002) [7] also mentioned the role of tourism in his research on gender. He believes that the tourism industry should be critically studied as a social and cultural phenomenon. At the same time, the international flow, international payment and cultural cross-spreading brought about by the tourism industry are important for the construction of the city's international image and local development. Under the consumption and leisure-driven economy, the needs of niche groups have been taken into consideration by certain cities for tourism development, which will bring unexpected gains and development opportunities to destination cities. Tyrväinen et al. (2014) [8] pointed out that in the process of tourism development, due to the expansion of economic demand and supply demand, a large number of jobs have been brought to the city. And at the same time, the building density has gradually increased. The value of land has also risen accordingly. The rapid rise of tourism-related industries directly promotes rapid urbanization and the reconstruction and renewal of urban functional areas. Moreover, Dame et al. (2019) [9] found that more and more industrial cities and mountainous cities have begun to develop tourism. The expansion and development of tourism are the second driving force of urbanization and urban construction. In addition, Jingyong Zhang and Lingyun Wu (2015) [10] also believe that the tourism industry has a significant role in the construction of urban ecological environment to a certain extent, such as regulating the urban heat island effect.

2.3 Research on the Two-Way Influence Relationship Between Urban Construction and Tourism

It is worth noting that there is a significant two-way relationship between urban construction and tourism. The research of Rui et al. (2014) [11] shows that as the scale

and speed of urban construction tilt towards the two indicators of quality and benefit, urban tourism has become a key point for the construction and improvement of different regions. Urban construction has become a driving mechanism for the development of urban tourism quality. The development of the tourism industry also has a negative effect on the development and construction of cities. For example, the eastern regions and cities in China have shown a relatively high level of urban construction efficiency and tourism development. The construction of their urban infrastructure and tourism facilities is gradually accelerating, and the tourism industry The pull is significantly enhanced. An important issue facing China's cities and tourism industry is the urban-rural gap, which is the contradiction between the relatively backward development status of rural areas and the urgent need for regional renewal in developed cities. Liu et al. (2017) [12] pointed out that the development of tourism has an important positive effect on narrowing the gap between urban and rural areas, especially for narrowing the gap between urban and rural areas in China's central and western regions. At the same time, Nasrabadi et al. (2021) [13] showed in their study of religious tourism cities as an example that tourism cities will also face the problem of population surge-the huge economic benefits brought by the development of urban tourism have made people A large number of influx into the city, followed by the city facing the problem of residential and functional district renewal, the sustainability of urban housing is paid more attention to. In addition, Goh et al. (2021) [14] found that the creation of urban art districts by art entrepreneurs is widely regarded as a gentrification catalyst that can promote urban environment improvement and tourism development in deteriorating areas. This method promotes the mixed use of urban space, which perfectly demonstrates the two-way promotion of urban construction and tourism.

2.4 Literature Summary

Previous scholars have done some research on the impact of urban construction on tourism, the impact of tourism on urban construction, and the two-way relationship between urban construction and tourism. And they have put forward corresponding views. Among them, urban construction provides economic and material conditions for the development of tourism, and it is also the foundation for the gradual formation of tourism in the city. The tourism industry has played a role in promoting urban construction, especially in promoting urban renewal, upgrading of industrial and economic structures, and stimulating consumption. Urban construction and tourism development are two important indicators of a region. They interact and connect with each other and have an inseparable overall relationship.

Based on the previous research, this article focuses on the analysis of the interaction and influence mechanism of urban construction and tourism, and deeply analyzes the connections and functions of its internal elements. At the same time, this article innovatively constructs an industrial linkage method based on the integration process of urban construction and tourism system, and provides a brand-new way of thinking for urban development. This is of far-reaching significance for the study of future urban development directions and the formulation of planning systems.

3 Analysis of the Interactive Influence Mechanism Between Urban Construction and Tourism

3.1 Theoretical Basis

There is not only a close connection between urban construction and tourism, they also have a large amount of theoretical foundations, and urban construction and tourism are both valuable independent research directions. Some of these theories can provide important theoretical support for this article and advance the study of the relationship between the two in this article.

Jane Jacobs (1992) [15] put forward the ideological requirements in her book “The Death and Life of Great American Cities” in the urban diversification factor section, which are at least two functional areas, easy-to-turn streets, and diverse Modernized buildings and sufficient flow of people. These four factors can enable the city to produce the most effective economic resources and stimulate the city’s potential, thereby greatly increasing the diversity of the city and promoting the development and progress of the city. In 2020, Mulley Corinne and Nelson John D [16] pointed out in their book that the development of a city is composed of a complex arrangement of urban people and infrastructure, and they will interact in many ways. Moreover, shaping the results of various activities, including tourism, is determined by the basic physical structure of the city itself. As a key part of the direction of urban development, urban construction and renewal are necessary considerations, especially urban accessibility. Accessibility, as a product of the interaction of various factors in the city, plays a key role in the choice of urban form and its alternatives.

Mowforth Martin and Ian Munt (2009) [17] showed a high degree of concern for the formation of sustainable tourism models and the development of tourism in third world countries. They proposed that the center of sustainable tourism analysis is the understanding of imbalance and power. At the same time, they put forward the concept of “new tourism”. “New tourism” is produced by various economic conditions, social culture and environmental factors, and is a way of travel that is ethically and practically accepted. It usually conforms to the concept of sustainability and enables a way to travel far away from the masses and explore novel things. Linking the local tourism industry with the international tourism industry will also obtain greater development opportunities under the threat of risks.

In 2008, Junhao Wang [18] mentioned the theory of industrial linkage in his book “Industrial Economics”, which indicates that the strategic adjustment of industrial structure can help to form a reasonable industrial division of labor layout system. Good industrial linkage will realize the complementary advantages of the industries in the linkage region, thereby promoting the coordinated development of regional industries, optimizing the regional industrial structure, and enhancing the energy level of regional industries. According to this theory, the rational layout of urban industries, especially tourism, will greatly enhance the overall competitiveness of the region. At the same time, the theory also includes the concept of sustainability.

3.2 Analysis of the Impact Mechanism of Urban Construction on Tourism (SWOT)

Strength. Firstly, urban construction can bring better infrastructure construction to the city, which brings a material foundation and guarantee for the development of tourism. For example, the improvement of traffic accessibility brought about by the upgrading of streets will make travel more convenient. The construction of infrastructure guarantees the travel experience of tourists and enables the smooth and normal development of urban tourism¹. In addition, the increase in urban functional areas brought about by urban construction also provides space for development and extremely significant advantages for the development of tourism. More functional areas mean broader space and interesting experience, which benefits for attracting the settlement and development of the tourism industry. Moreover, the urban built-up area², that is, the urban area, has been increasing with the development of urban construction, and the phenomenon of urbanization has become significant. People usually get more income in the process of urbanization, which allows them to have surplus income for tourism and leisure. Moreover, the increase in urban area also gives advantages to the expansion of the tourism industry and the construction of the tourism industry chain. The space for the development of tourism has become larger, and some tourist parks have been planned as part of urban construction.

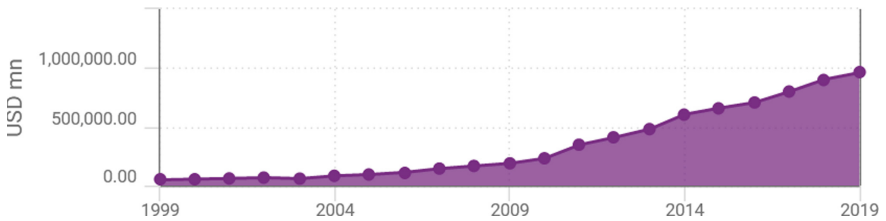


Fig. 1. Total revenue of China's tourism industry from 1999 to 2019

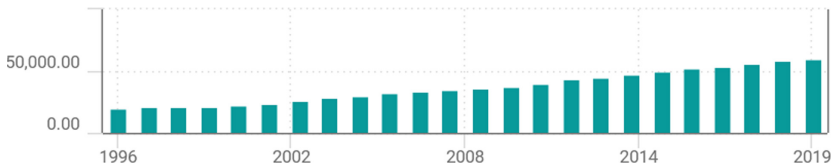


Fig. 2. 1996–2019 China's urban built-up area (unit: square kilometers)

Weakness. The weakness of urban construction to the development of tourism mainly focuses on the phenomenon of convergence. The development direction of urbanization is mostly modernization, technology and sustainability, which has led to a strong homogeneity between cities. The lack of unique and impressive landmark tourist locations

¹ Figure 1 Data source: <https://www.mct.gov.cn/>.
² Figure 2 Data source: <http://www.mohurd.gov.cn/>.

in some cities has reduced their attractiveness. For example, many second-tier cities in China have difficulty in promoting the development of tourism due to lack of features in the process of urban construction. Most of them still Rely on industrial industry as the main source of income. This phenomenon also exists in international metropolises. When people mention New York, the first reaction of many people is finance and shopping. Although shopping tourism is also a form of tourism, it can be replaced by other places easily. For example, London, Paris and Hong Kong can all become alternative tourist destinations.

Opportunity. Because urban construction is bound to be accompanied by the introduction of foreign capital. At the same time, the corresponding development policies will also bring subsidies from the government. Therefore, new investment is accompanied by the emergence of urban construction, which provides new opportunities for the development of tourism. With the support of funds, the tourism industry will have a broader living space. According to the statistical chart of the central government's subsidies for local fiscal expenditure³, built-up area and total tourism revenue, it can be found that with the increase of the central government's subsidies to local governments, urban construction continues to develop, and the total revenue and development trend of tourism are gradually improving.

At the same time, policy support is also a very important opportunity. After the construction and renewal of a city, government departments usually re-plan and set goals for the city. Tourism, as an emerging industry that has begun to flourish in the 21st century, has great potential. The government will generally reconsider the factor of tourism in the city's development goals and provide sufficient attention. With the inclination and attention of government policies, the tourism industry will be radiated with new vitality.

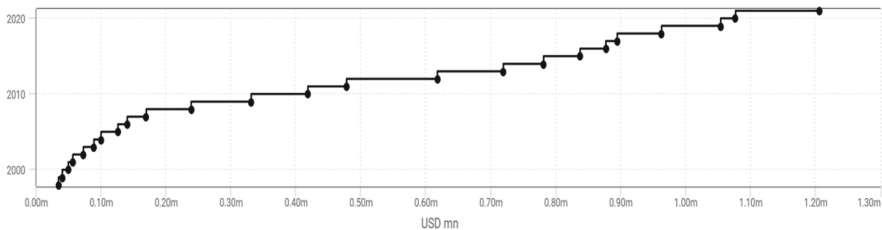


Fig. 3. 2000–2020 fiscal expenditure: central subsidies to local governments

Threat. Urban development brought about by urban construction has made cities more open and diversified. However, the multiculturalism that comes with the opening of the city may have an impact on the original local culture of the city, such as the forced demolition of the original historical residence. And the emergence of the phenomenon of “tragedy of the commons” caused the occupation of local historical and cultural

³ Figure 3 Data source: <http://www.mof.gov.cn/index.htm>.

facilities, and eventually led to the decline or even destruction of culture. These will cause huge losses to tourism resources.

In addition, the competition between cities also poses a huge threat to the development of urban tourism. There is bound to be a difference in the degree of construction between cities—cities with more complete infrastructure construction and more developed economy have stronger competitive advantages in all aspects than other cities. The same is true for tourism development. Considering travel comfort, safety, accessibility and fun, tourists usually prefer cities that are better built.

3.3 Analysis of the Mechanism of Tourism Industry on Urban Construction

The Population Impact of Tourism on Urban Construction. The vigorous development of tourism promotes the continuous upgrading of urban construction and the continuous expansion of urban area. At the same time, affected by economic benefits and urbanization, a large number of rural people have flowed into cities, providing more labor output for urban construction. According to the comparison of urban and rural population in 2000 and 2019, it can be found that compared with 2000, China’s urban population in 2019 is almost equal to the rural population. This change has provided a huge impetus for urban construction⁴. First of all, the emergence of more urban residents puts higher demands on residential areas. Secondly, the original urban functional area can no longer bear such a large number of residents, and its capacity is overloaded, so it needs to be updated in time. The tourism industry has played a very important role as the driving force among them.

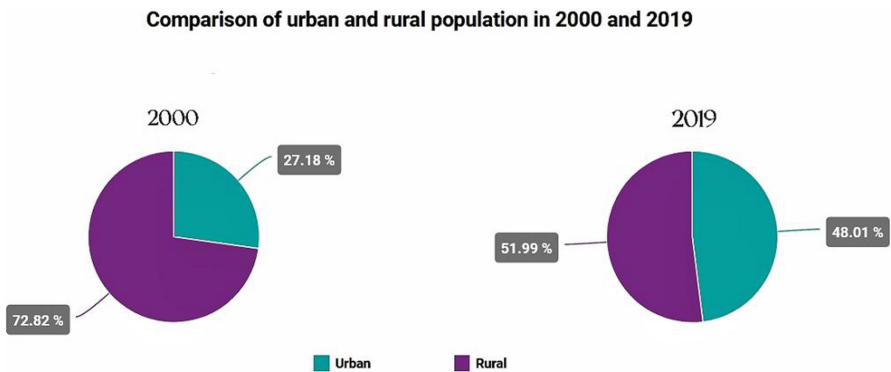


Fig. 4. Comparison of urban and rural population in 2000 and 2019

In addition, the development and construction of the tourism industry has also improved the quality of the population to a certain extent. As the tourism industry brings tourists from all over the world, this makes the city more international. Correspondingly, in order to give tourists a good impression and build the business card of

⁴ Figure 4 Data source: <http://www.stats.gov.cn/>.

a civilized tourist city, the improvement of the city's humanities and the construction of its style are valued. To a certain extent, this has attracted more high-quality talents to settle in, and at the same time, it has also enabled residents to continuously improve their civilization and accomplishments.

The Impact of Tourism on Urban Economy. Tourism can be a way to attract of attracting capital to enter. When companies feel that the tourism industry in the area is profitable, they will inject capital into the city. This allows the city to have more development funds to a certain extent. At the same time, according to the total income of the tourism industry and the labor market supply and demand ratio chart, it can be seen that with the development of tourism, the demand for market labor is also increasing, which makes more jobs appear. The increase in employment demand promotes the employment rate⁵, which gives strong support for the development of urban economy. This can enable the city to get a comprehensive upgrade, including the construction of all aspects of the city and the renewal of some backward functional areas.

The Impact of Tourism on the Urban Ecological Environment. Tourism is undoubtedly a double-edged sword for the urban ecological environment. On the one hand, the large-scale development of the region and the influx of tourists brought about by the tourism industry have caused great challenges to the carrying capacity of the urban environment. Tourists' domestic waste and tourism infrastructure have contributed to the deterioration of the urban ecological environment to a certain extent. At the same time, the different cultures and new living habits brought by a large number of foreign tourists have also had an impact on local culture and residents' lives to a certain extent.



Fig. 5. 2001–2021 China's labor market supply and demand ratio

However, for the long-term construction of the city, this destruction is temporary. Through the development of tourism, the government can quickly realize the ecological problems of the city and begin to consciously guide the tourism industry in the direction of sustainable development. Driven by the economic benefits brought by the tourism industry, ecological governance can achieve better results in long-term protection. For some cities with late tourism development, they can even directly learn from some ready-made sustainable tourism experience to avoid damage to the ecological environment as much as possible. Moreover, this also promotes the direction of urban development and construction to tilt towards sustainability, laying a solid foundation for future urban renewal and development.

⁵ Figure 5 Data source: <http://www.mohrss.gov.cn/>.

The Impact of Tourism on Urban Politics, Culture and Infrastructure. The rapid development of tourism on an international scale has become a new driver for promoting economic regions. In this case, tourism has become the focus of new regional policies. Various government documents and policies have been issued to focus on the development of the tourism industry. For example, the State Council (2014) [19] issued “Several Opinions on Promoting the Reform and Development of the Tourism Industry”, and emphasized the importance of promoting regional tourism integration and deepening tourism reform. Both in the long-term and short-term perspectives, it will greatly promote urban economic development. The economic income obtained from the development of tourism can provide the necessary economic foundation for the construction and renewal of the city. Tourism can also be used as a means of publicity for cities in terms of culture. As a marketing method, tourism can become one of the carriers that shape the city’s business card, promote the city’s culture and increase the city’s reputation.

In the development of the tourism industry, in order to enable tourists to have a better travel experience in the city and enhance the attractiveness of the city, the city’s infrastructure will be upgraded to a certain extent. Moreover, with a series of economic benefits and investments brought by the tourism industry, the scale of cities has begun to expand. At this time, in order to ensure the sustainable operation of the old functional areas and the construction of new functional areas, the urban infrastructure will be adjusted and added appropriately under certain conditions.

4 Discussion and Conclusion

This article starts with the relationship between urban construction and tourism development, and analyzes their respective and two-way effects, and built a city development model that combined urban construction and tourism, of which they can promote each other. At the same time, this article uses the SWOT analysis method to deeply analyze the impact of urban construction on the tourism industry, and determine the fundamental position of urban construction in the development of tourism. After consulting and analyzing the data from the Bureau of Statistics, this article draws the following conclusions.

- 1) Alfred Marshall (1890) [20] mentioned in his book “Principles of Economics” the issue of the balance between supply and demand, that is, the acceptability of demand prices and supply prices. This “balanced” idea is also applicable to the relationship between urban construction and tourism. They should form an ingenious dynamic equilibrium relationship with each other-tourism adapts to the development of the city where it is located, and the development of the city adapts to its corresponding tourism;
- 2) Urban construction is the fundamental condition for the development of tourism, and tourism is an accessory and optional condition of urban construction. Urban construction essentially serves the main development direction and functions of the city. Tourism, as one of the subsidiary products of urban construction, is easily

overlooked or even not considered. As a compromise factor, tourism actually has a great relationship with urban construction. It can easily become a beneficiary industry of urban construction, and it may also become a sacrifice industry of urban construction;

- 3) There is a close two-way interactive relationship between urban construction and tourism development. The progress or retreat of any one will have a certain impact on the development of the other. Generally speaking, urban construction will support the tourism industry in terms of its material conditions, while the tourism industry will feed back the city through humanistic propaganda and investment promotion. The interaction relationship and mode of action between urban construction and tourism can be briefly summarized in Fig. 6.

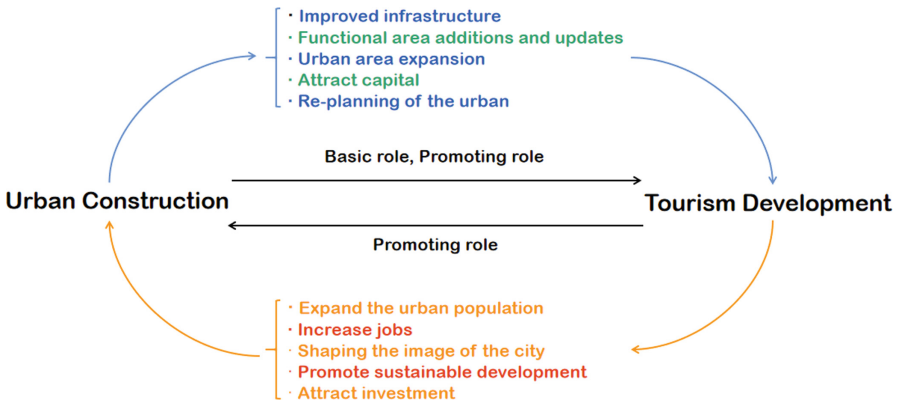


Fig. 6. The interactive influence mechanism between urban construction and tourism

This article analyzes the interactive influence mechanism of urban construction and tourism development from the theoretical level by consulting literature and statistics from the Bureau of Statistics. However, this article does not conduct empirical research after discussing theoretical mechanisms for specific cities, that is, this article lacks the process of actual investigation and social data collection. In future research, the specific reasons why urban construction plays a decisive role in the tourism industry, and how to build a theoretical model of urban development with data through the connection between the two are directions that can be studied in depth.

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The Existing Legal Risks and Future Trend of China's Real Estate Industry—Based on a Comparative Study of Real Estate Legislation Between China and the United States

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Abstract. China's current real estate market fluctuates excessively, which has affected the interests of all sectors of the society. It drives the development of surrounding industries and brings great impact to the process of urbanization. At present, the social disparity between the rich and the poor, the spread of negative interest rates caused by the devaluation of RMB, the linkage impact of second-hand housing, the development of internet trading media and the expansion of overseas markets have brought strong negative effects to China's housing market. Under this background, the prosperity of China's real estate is short, small, scattered and fast. It has aroused heated discussion, and the legislative defects have gradually become prominent. This paper takes the linkage between the development of real estate in China and the West as the breakthrough point, selects the United States as the research object, analyzes the historical experience of real estate in the United States through comparative research method, and on this basis, puts forward suggestions for the improvement of China's real estate legislation.

Keywords: Real estate · Comparison of legislation between China and the United States · Deficiencies in existing legislation · The U.S. real estate law system

1 Introduction

The real estate industry, the product of the development of market economy, occupies an important position in the national economic and social development. Since the birth of the real estate industry, the law has been objectively required to regulate, guide and adjust. Western developed capitalist countries have relatively complete and mature real estate legislation, with the United States as the typical representative. The real estate legislation in the United States started at the end of the 19th century. Since the Second World War, the development of real estate in the United States has become more and more mature. It insists on the market-oriented Land system and forms a complete real estate legislation system, including residential, retail, office and undeveloped land.

Behind the cyclical fluctuations in the U.S. real estate market, policies such as population, interest rates and credit, tax and other policies have played a very important role.

The housing market is relatively rational and mature. In contrast, China's real estate industry is being affected by these factors in many ways. The housing price fluctuates greatly, the government's macro-control intervention is strong, and the housing market is still in a passive and childish state. In the short term, China's real estate investment may have higher risks and benefits and stronger controllability. If we take a long-term view, we can more easily find that US real estate investment has the characteristics of low risks, stable returns and high returns. China's real estate industry is facing problems such as lack of laws and regulations, opaque transaction process, low coordination of laws and regulations in various fields, and unclear proportion of government and market. In addition, the large gap between urban and rural areas and the development situation of 'one place, one scene' caused by different responses to the urbanization process in various parts of the country have not played a role in alleviating the gap between the rich and the poor, and even exacerbated the imbalance in the allocation of resources, resulting in endless difficulties and the implementation of measures. Based on the development and historical experience of the real estate industry in the United States, China's real estate industry should be analyzed, perfected and implemented from the legal perspective.

2 The Existing Legal Risks in China's Real Estate Legislation

2.1 The Legislation Started Late and the Development Time Was Short

Since the reform and opening up, in order to adapt to the ever-changing social situation, China has changed from a planned economy to a market economy and has established a socialist market economy system on the basis of public ownership. Under this system, various new industries were born in China, and 1987–1991 was the initial exploration stage of China's real estate market. Due to the late start of the real estate market, China's real estate legislation has also been relatively delayed. In 1994, the 8th meeting of the Standing Committee of the 8th National People's Congress passed the Law of the People's Republic of China on Administration of Urban Real Estate. With the continuous deepening of the reform of the housing system and the improvement of residents' income level, the real estate market has become a hot topic of discussion, and housing has become a new consumption hotspot. The ensuing 'land grabbing', 'house purchase' and 'real estate speculation' crazes have led to a sharp rise in house prices, underutilization of land resources, serious deficiencies in the supply-side system, and the widening gap between the rich and the poor in society. All these phenomena are catalysts for the housing bubble, which has caused imbalances in the overall economic development of various regions. Since 1998, with the promulgation of administrative regulations and judicial interpretations, such as 'Regulations on the Administration of Urban Real Estate Development and Operation', 'Interpretation of the Supreme People's Court on Several Issues Concerning the Applicable Laws in the Trial of Disputes over Contracts for the Sale of Commercial Housing' and other administrative regulations, the cancellation of the system of physical distribution of housing and the implementation of the mortgage policy, the popularity of blind investment in real estate has decreased slightly. Also, it has gradually been brought back on the right track, with the house price gradually falling back and slowly entering the stage of steady development.

Now, China's real estate industry has passed 43 years. Although this industry has become one of the pillar industries of China's economic development, China is not good at real estate legislation and application of laws due to its late development in China. There are only a handful of documents related to real estate legislation. They only improve and revise the legal documents on the original basis, and do not regulate and control the compilation of specific and specific legal documents on various outstanding issues. Therefore, in terms of experience in dealing with real estate legislation-related issues, China needs to firmly base itself on the background of the change of the times, sort out and summarize social practical cases, flexibly apply limited laws, refer to other countries' legislative means, and sum up its own legislative experience, so as to make up for the lack of late legislative start and short development time.

The United States developed its economy under the system of capitalist private ownership. Capitalists possessed the means of production and exploited the surplus value of laborers through employment relationship in order to maximize private interests [1, 2]. The real estate industry in the United States rose at the end of the 19th century. The framework of its housing legislation originated from the Great Depression in 1930, when about half of the country's housing families were in the dilemma of not being able to pay their housing loans. The housing market was in chaos, and the National Housing Law of 1934 was born. With the outbreak of the Second World War, the business opportunities brought by the war greatly increased the total demand and production in the United States: in addition to the indispensable needs of weapon, arms and food, the housing demand of American residents and a large number of foreign asylum seekers increased day by day. The supply of land and housing was in short supply, until the land and housing prices peaked in 1973. Under the private ownership of the capitalist society, self-organization operation ability is very strong, coupled with the United States federal government to strengthen the economic intervention, in order to cope with the cold war and strengthen the militarization of the national economy. Through the wartime expansion of commodity exports and capital exports, it can make full use of foreign cheap resources, to obtain high profits and other means, such as oil, which have greatly stimulated the economic growth. The increasingly prosperous economy has gradually eased the chaotic situation in the United States, such as the influx of refugees during the war, the shortage of resources, the uncontrollable house prices, the stratification of classes, the breeding of contradictions, etc. Land transactions and the fluctuation of house prices operate normally on a periodic basis. Since the 1990s, in response to the different needs of different subjects and the different treatment of different positions, the United States has successively issued specific and clear legal and regulatory documents, such as the Veterans' Disability Compensation, Housing and Memorial Benefits Amendment Act, Rural Revitalization Act, Fair Housing Amendment Act, the Independent Agency Funding Act of the Ministry of Housing and Urban Development, the Housing and Property Disposal Reform Act for Multi-Population Families, and the Quality Housing and Work Responsibility Act, etc., which classify various types of building construction, family composition, and individual income levels in detail, and pay attention to the complementarity of moral, social, financial, and real estate development.

The U.S. real estate industry has been developing for more than a century. Its ability to solve problems is much more scientific and effective than that of China. A complete

legal system has been formed for real estate, which provides perfect and reliable legal protection for core issues such as real estate investment, sale and mortgage [3]. In addition, the United States attaches great importance to the coordination of all sectors of society and the flexibility of market regulation. Therefore, the United States applies different measures to different problems when formulating laws. At the same time, the United States uses the same example to draw inferences from other cases, thinks extensively and classifies concretely, and can better adapt to social development through detailed branch legislation.

2.2 Weak Legislative Convergence and Low Degree of Coordination

The rapid development of China's urbanization has promoted the accelerated operation of all walks of life, and the shortage of real estate legislation has been highlighted. That is, real estate legislation involves various aspects, with a wide range but not refined. For example, talent introduction system, household registration system and so on, all affect the real estate legislation. Since Wuhan sounded the clarion call for talent introduction in early 2017, talent introduction has become a prairie fire in China in the past three years. According to incomplete statistics, as of May, nearly 60 cities across the country have issued policies for talent introduction.

Taking Xi'an as an example, in 2020, Xi'an launched a talent introduction policy to classify talents into different levels. It aimed to give full play to the enthusiasm, initiative and creativity of talents, achieve the strategic goal of stimulating the growth of Xi'an's self-employment rate, improve the city's core competitiveness and achieve steady economic growth in Xi'an. Xi'an has introduced and trained a large number of high-level talents from employers in different fields. If the problems of living and employment environment become the worries of talents, their efforts to innovate will also be affected. Therefore, Xi'an has issued relevant supporting regulations, such as 'Implementation Rules for Identification of ABCD Talents in Xi'an' to provide preferential housing policies for talents. With talents, there will be a market. The influx of talents has greatly promoted the development of the city's commercial retail industry. The demand for housing and office buildings in Xi'an has greatly increased. At that time, a series of supporting buildings such as office buildings, residential buildings, large and small shopping malls and other cities in Xi'an have been built on the ground. Therefore, the development of the real estate industry is closely related to it. First, in order to retain talents, the Xi'an government has issued various preferential housing policies for the introduction of talents. Some large technology enterprises, such as Tencent, Alibaba and Xiaomi, have adopted different measures to help employees buy houses on preferential terms to attract talents. These preferential policies not only meet the demand for talents, but also have a great impact on the orderly development of the real estate market. The large consumption of land resources has caused the shortage of exploitable land in Xi'an City. A large number of shoddy construction projects and unqualified construction projects without obtaining a bid to build a real estate are idle and social resources are seriously wasted. In this case, the various preferential purchase policies provided by the government and enterprises for the introduction of talents have virtually brought tremendous pressure to the development of the real estate industry, which does not have much specific legal protection and has strong flexibility. Second, the implementation of

the talent introduction policy and the real estate industry are going hand in hand with difficulty. At the same time, it also challenges the original household registration system. The talent settlement system supported by the talent introduction policy reminds that the working hours of talents are directly proportional to the housing incentives, or the degree of simplicity in handling the household registration formalities is determined by the quality of talents, so as to achieve the goal of attracting a large number of high-quality talents to settle in Xi'an. The specific settlement situation is not classified into legislation, which breaks the advantages of orderly flow control under the original household registration system and makes Xi'an settlement more diversified, flexible and difficult to manage.

The interaction of introduction of talents, the regulation of household registration system, and the overlapping role of preferential housing policies provided by cities in order to retain talents, caused all kinds of housing contradictions. Different talents want to purchase the same building according to different preferential policies. There are also other questions, such as what standards real estate developers should refer to to issue standardized and reasonable housing announcements, and how they should protect their own interests while responding to the national urbanization development and urban talent introduction policies, etc. If there is an inflow of urban talents, there will be a corresponding outflow of urban talents. Taking Ningbo as an example, although the distribution of supporting buildings and facilities in the city is scientific and complete, the density of public service departments such as non-comprehensive hospitals and public security bureaus is relatively high, and the entertainment facilities such as shopping malls and squares are complete, the phenomenon of brain drain that Ningbo is facing cannot be concealed. In order to solve this problem, the Ningbo municipal government issued the 'city planning for the next five years' in 2021, pointing out that Ningbo will vigorously develop the property market, build six sections of high-quality goods, and conduct a household registration migration pilot in the next five years, with the aim of assisting the forthcoming talent recruitment. However, in the case of lagging economic development and imperfect policies and laws, the scientific nature of introducing talents only through the construction of office buildings and residential areas needs to be verified. More importantly, many cities are currently using the same or similar methods to ease the brain drain, ignoring the problems existing in economic development, abundant job opportunities and perfect legislation. They only focus on the construction of the real estate market. Such 'building monster' phenomenon will probably cause a vicious circle of urban development. The policy is flexible and changeable and the law is mandatory and protected. The norms related to real estate formulated by different subjects conflict in content, and the degree of cooperation between different norms is low. Therefore, the scientific nature of the current legislative activities needs to be improved [5].

Over the past 100 years or so, the real estate market in the United States has developed very maturely, which is inseparable from its perfect financial system and industrial characteristics with market regulation as the main part. In contrast, American society does not implement the household registration system, nor does it implement the talent introduction system as widely as China. So there is no such legislation. However, based on its perfect market economy system, the United States has established scientific and

complete 'Immigration Law', 'Federal Housing Law', 'Open Housing Law' and 'Housing and Community Development Law', etc. Under the protection of a standardized legal system, the United States has attracted a large number of talents through generous scholarship system, preferential loans, stock option incentive mechanism, etc., and retained talents through the means of share of earnings, share of profits, employee stock ownership, etc. in order to maintain a steady pace of revenue increase of the United States state-owned enterprises. These norms have been well coordinated in the operation process. They provide different and specific preferential policies for talents with different living standards, and the protection role of the law has been fully exerted. At the same time, they have not led too many unnecessary lines between American enterprises, real estate developers and the government, and have balanced development among various subjects and fields. They have not affected too much the interests of any party. They have ensured the scientific and periodic development of the American real estate industry and brought huge economic benefits to the country [6].

Under the sound financial system, the United States has scientific and practical legislative techniques, and clear and complete laws as support. Under such conditions, the United States has created a multi-level housing mortgage market. Under the premise of high degree of marketization, the U.S. government has guaranteed the housing needs of low-and middle-income people by means of interest rates and rent subsidies, which are clearly stipulated in the Housing Law. One of the reasons for the strong cohesion between the U.S. legislative documents is that the legislative documents in different fields involve less interests between different subjects and have weak correlation, so they can go hand in hand better.

2.3 Lack of Perfect and Systematic Legal System

Legislative activities are an important part of the country's rule of law. Without specific targeted legislative thinking, there would be no clear and efficient laws and regulations or other normative documents output, and it would be difficult for law enforcement agencies and judicial agencies to cooperate in the implementation of the rule of law. Legal documents relating to real estate in China, such as the Law of the People's Republic of China on Administration of Urban Real Estate and the Law of the People's Republic of China on Urban and Rural Planning, cover the general direction of the development of the real estate industry in China. They do not clearly specify how people should protect their rights and interests through preferential policies when facing different problems and different groups, or how to legally protect their rights and interests such as housing transactions. Although the 'Regulations on the Administration of Real Estate of the People's Liberation Army of China' is a good progress in China's real estate legislation, it provides targeted protection for this special group of soldiers in terms of housing registration management. It only stays at the level of regulations, and is still lack of mandatory and authoritative compared with laws. In addition, China's real estate legislation lacks legal documents regulating other groups.

On the contrary, the legislation of the United States involves various subjects and covers a comprehensive range of behaviors. Taking foreigners as an example, foreigners are engaged in housing investment, house purchase and other activities in China. China only has 'Opinions on Regulating Foreign Investment Access and Management in the

Real Estate Market'. There is no specific legislative document to distinguish and regulate these activities. As a result, foreigners are not legally guaranteed to purchase houses or conduct house transactions in China. The United States passed the 'Foreign Nationals Purchase Act' in 1980, which introduced detailed preferential policies for foreign residents to purchase houses in the United States that are different from those of their own nationals. It not only guarantees the advantages of their own nationals in purchasing houses, but also provides a complete legislative guarantee for foreign residents' housing transactions [7].

3 Historical Experience Advantages of American Real Estate Legislation

3.1 Through the Three Major Economic Turmoil, Legislative Activities Tend to Mature

After the First World War, Florida became a holiday resort in the United States and attracted a large number of investors, causing a sharp rise of the land price in Florida. Then the bubble burst rapidly, triggering the economic crisis in the United States, causing the collapse of the Wall Street stock market and indirectly causing a major global economic crisis. Roosevelt issued a new deal, focusing on rectifying the financial order and the banking system. He announced the devaluation of the U.S. dollar in order to bring down the heat of the market economy and cool down the 'stagflation' of the real estate industry. After the second world war, the demand for houses rose sharply because the baby boomers had grown into adults, which led the government to adjust the tax plan and provide tax incentives for real estate. This has greatly stimulated the demand of American citizens for apartments and houses, pushed the price of the real estate market to a peak for the first time since World War II, and led to the collapse of the real estate market in the United States. The U.S. government responded to the real estate market crash by cutting welfare spending, selling some state-owned enterprises and reducing state intervention, and accordingly issued the Comprehensive Budget Coordination Act, Emergency Housing Purchase Assistance Act and other legal documents to strictly control them. After the September 11 incident and the dot-com bubble burst, the Federal Reserve cut interest rates sharply. And the interest rate hit a 40-year low, the housing loan volume increased significantly, and the house price rose again. Many real estate credit institutions combined with the market situation, continuously relaxed the housing loan conditions, causing the rapid expansion of the US real estate market. The sub-prime crisis broke out. The United States closed the loopholes in the crisis by establishing a macro-prudential supervision mechanism, reshaping the financial supervision system, and reforming the housing loan granting procedures. At the same time, in combination with the actual national conditions, the United States issued the 'Housing and Economic Recovery Act', 'Tax Exemption Act for Mortgage Loan Debt Relief' and other legal documents, trying to promote and solve the problems encountered in various ways to stimulate the real estate development activity [6, 8] (Fig. 1).

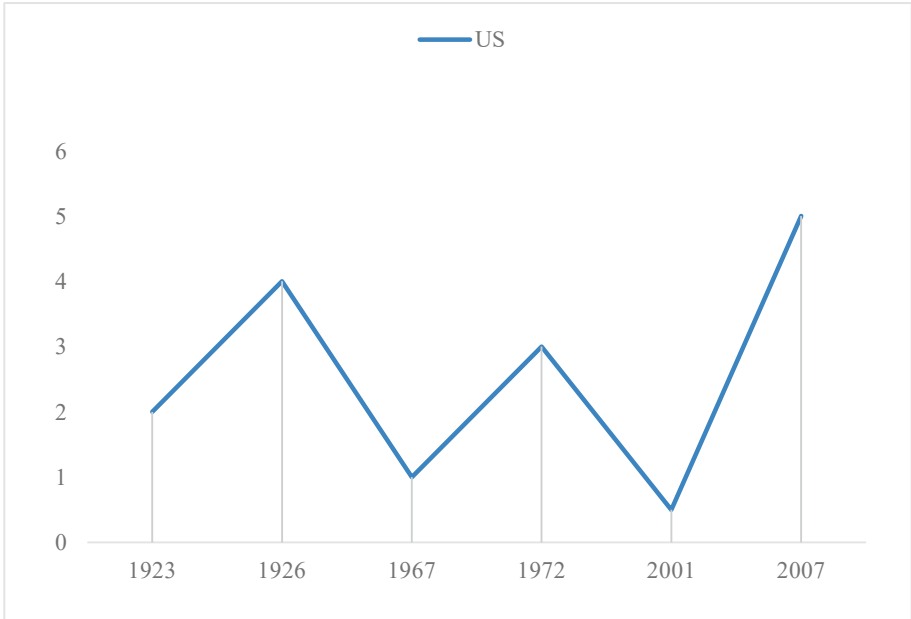


Fig. 1. Evolution of US real estate in the three major economic disturbances¹

3.2 Three Ways to Encourage Private Housing

In the private purchase transactions, the United States has proposed three major ways to encourage private purchase. First one is interest subsidies. In 1968, the U.S. enacted the Housing and Urban Development Act. The government paid or reissued interest allowances for low-and middle-income residents, loan institutions, non-profit supporters, etc. to provide housing security for individuals or groups at the bottom of the society. In the same year, the 'Open Housing Act' was personally signed by President Johnson. The Act provides for the provision of 6 million government-subsidized housing units for low-income families over a period of 10 years, and puts forward targeted solutions to the problem of helping the underprivileged become homeowners. The second is loan guarantees. In 1934 and 1944, the United States set up two famous guarantee agencies for low-and middle-income earners: the Federal Housing Administration and the Veterans Administration. They made full use of the cooperation between social organizations and government legislative documents to provide legal loan guarantees for different special groups. In 2004, President Bush signed the 'U.S. Down Payment Act' which reduced down payment to zero. It also assisted in the better implementation of previous legal documents on loan guarantees and fundamentally, which added a legal protection barrier to the basic housing problem of the public. The third one is to provide loans directly. In 1932, the United States established a federal housing loan banking system, which is a 'middle bridge' built by the state to solve specific issues such as people's livelihood purchase and housing transactions. The government acted as a guarantor, absorbs funds

¹ Data source: Baidu Library Five Crises and Measures in Modern America.

through private channels, and provided low-interest loans to low-and middle-income people [9, 10].

3.3 The Significant Regulatory Role of Real Estate Tax Policy

There are many kinds of peripheral policies to promote the development of the real estate industry in the United States, among which the tax policy plays an important regulatory role. US real estate tax is an important source of financial revenue for most local governments. The current tax rate is between 0.12% and 3%, which is mainly used to provide public services such as fire protection, public security, road traffic, education and environmental improvement. The tax status and legal definition of movable property related to real estate vary greatly from state to state in the United States. The laws of 43 states determine whether to levy taxes on movable houses according to their specific characteristics, and 35 states and the District of Columbia levy taxes on machinery and equipment attached to real estate [11] (Table 1).

Table 1. Latest US state property tax rates for 2021²

State	Real estate tax rate	Median
Washington D.C.	0.98%	593200
Hawaii	0.28%	718400
New Jersey	2.49%	310700
Wisconsin	1.85%	169400
Alabama	0.41%	125600
Colorado	0.51%	352500
Alaska	0.76%	295800

State property taxes in the United States vary based on annual fluctuations in house prices, land prices, and state markets. Insisting on the rule of law tax provides a strong legal guarantee for the different development of American real estate in different states. The market management policy of tightening up the outside and loosening up the inside has created a clean, transparent, highly liquid and competitive real estate investment and trading environment for the United States [10]. The strict and scientific division of labor and cooperation among the tax authorities and the efficient cooperation and management have provided practical guarantee for the standardized payment of property taxes in various U.S. states. A well-established real estate tax system controls the liquidity ratio in the real estate market, promotes good coordination between the government and the masses, and enables efficient recycling of social funds. It plays a good role in regulating and controlling related behaviors such as real estate transactions in the United States, and prevents the recurrence of the sub-prime crisis [12].

² Data Source: [Dealmoon.com](https://dealmoon.com).

4 Looking Forward to the Future Development of China's Real Estate Industry

4.1 Pay Close Attention to Emerging Social Issues and Promote Legislation to Keep Pace with the Times

China's current real estate emerging issues that deserve attention are as follows: the second-hand housing transaction qualification issue, the housing lease model issue. The typical performance is the 'Ke Holdings Inc.' run-off case. Here is a brief analysis of its social impact. Taking Shenzhen as an example, in the housing rental market, the profit of the intermediary depends more on the information price difference between the landlord and the tenant's transaction activities, and the information between the buyer and the seller is not equal, which makes the tenant rely too much on the trust intermediary and the landlord has more control over his own property. It provides convenience for many black intermediaries to skimp on the buyer's deposit and collect additional tenant's service fee. At the same time, it increases the hidden danger that the intermediary will lose money after earning the price difference or 'subleasing' at a high price, thus causing a large decline in the turnover in the secondary market in Shenzhen. In addition, the issues that urgently need to be regulated by law in China's real estate transactions include, but are not limited to, the housing purchase restriction system and the housing transactions in study areas.

Based on the new problems mentioned above, the Chinese government has pointed out the way for the development of real estate in China: accelerating the development of affordable rental housing. The specific legislative proposals are as follows: to standardize the qualification of the seller, to regulate the intermediary behavior, to reduce the authority of the intermediary, and to make different regulations on the transaction period and taxes of the second-hand housing.

4.2 Perfecting Relevant Laws and Regulations, then Constructing Real Estate Legislation System

In order to perfect China's commercial legislation, we should reshape our legal thinking, attach importance to the formation of the overall legislative concept, and adjust and standardize various social relations under the market economy conditions with a unified and coordinated legal system, so as to adapt to the complicated and changeable economic development and quickly adjust and recover from the heavy economic losses brought by novel coronavirus.

First, establish social groups or state-authorized organizations to provide legal services for real estate transactions. For the official introduction of relevant laws and regulations, it plays a role of offering valuable advice to alleviate the weakness that laws cannot be changed overnight. It provides targeted legal services and help for different groups in real estate transactions through such authoritative social organizations or institutions. Then it observes social repercussions, summarizes experience and improves methods to flexibly solve real estate problems. When the society slowly accepts, the law will be issued. The 'bottom-up' integration is easier to be accepted by the people than the 'top-down' implementation. Therefore, it can promote the law to play a better role in

strengthening the security, clearing the uncertain obstacles for the construction of the real estate legislation system and indicating the way forward. Second, the procedures for assessing house prices and housing transactions are simplified in line with local conditions. Make the real estate transactions with different degrees of simplicity open and transparent, clarify the transaction objects, clarify the transaction details, reduce the occurrence of ‘loophole’ and ‘playing dumb’, and form simple and precise legislative guidance for the construction of the real estate legal system. Third, we will open up various tax channels for property taxes and improve and add various welfare policies, such as offline site payment, online payment, government mail, equivalent tax offset, etc., which will help stabilize the source of local government real estate tax revenue. With the help of them, we can provide a variety of tax payment programs to deal with the rapidly changing social emerging issues, improve the enthusiasm of the people to pay taxes, stimulate the activity of housing transactions, promote the flow of funds in the real estate market, reduce the vacancy rate of residential housing and office buildings, and provide a stable and conscious environment for the construction of real estate legislation system to pay real estate taxes [12].

4.3 Strengthen Mutual Cooperation and Establish a Supporting Mechanism for Law Enforcement

Clarify China’s real estate-related law enforcement subjects and their responsibilities. For example, the registration subjects of housing transactions should accurately register the housing transactions and the information of buyers and sellers. While assisting and urging the purchase of housing registration, they should also protect the personal information security of residents. Market regulators should comprehensively supervise and manage the real estate market, organize and guide the integrated construction of market supervision comprehensive law enforcement team, guide the implementation of fair competition review system, and maintain the order of the real estate market. Tax subjects should do a good job in the connection between paying taxes and paying taxes, and play a pivotal role in strengthening communication between the government and the people. The third party plays an unquestionable important role in society, and plays a good role in balancing and coordinating the operation of the social real estate market.

To sum up, by strengthening the mutual cooperation of all sectors and making full use of the coordination and cooperation of various positions in all sectors of society, it will help to establish a law enforcement supporting system and provide a more scientific and complete guarantee function for the market operation of China’s real estate industry.

5 Conclusion

At present, China’s real estate legislation is facing the problems of high real estate prices, chaotic market transactions and low cooperation from all walks of life. Starting from the solution of the emerging social problems, paying attention to the comprehensive construction of the real estate legislation system and the perfection of the law enforcement supporting mechanism will become an effective method to deal with the current situation. Based on the current legislation of our country, and drawing on the successful

experience of the United States in the relevant areas of legislation, this paper puts forward suggestions from the aspects of promoting the legislative adaptability, supplementing and perfecting laws and regulations, constructing the real estate legislation system, and strengthening the mutual cooperation of all walks of life, etc. It aims at comprehensively improving the scientific nature and operability of China's real estate legislation, and finally forming a real estate legislation system with Chinese characteristics in the new era.

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The Influence of Subway Line Design on Human Happiness and Social Encounter

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Abstract. This article verifies the influence of subway line design on people's happiness, social encounter, and social disparity. Through observational studies, mapping exercises, estimation of route design, and industrial center, we can draw preliminary conclusions and analysis, which subway line design reduces the chance of social encounters, aggravates social differences, and exacerbates class differences. Pro-social behavior plays an essential role in society, and the government had better find a structural solution to solve existing social problems because human behavior is difficult to change. When people can use public transportation more and more effectively under the government's call, people's social interaction and cooperation will also increase quickly.

Keywords: Subway line design · Social encounter · Human happiness · Economic growth · Pro-social behavior

1 Introduction

In this day and age, people all over the world pay overwhelming attention to the development and the impact of the public transportation. Public transportation is closely related to people's lives, which provides mobility, can shape land use, create jobs and promote economic growth. At the same time, public transportation supports public policies on energy use, air quality, and carbon emissions. For example, Xuzhou's subway, it is a very effective means of facilitating transportation and a way to quickly promote economic development and enhance the city status in Jiangsu province. While researching texts written about subway design and its effect, Xuzhou government's plan has been accounted as an example, a published article, and research published on the Internet by a laboratory institution. However, while these authors discuss their research or plan, I intend to research the accuracy of their statements and whether the government have achieved the goal in the current situation. By looking at the current design of the subway system, there might be problems of social disparities and social encounter will be exacerbated because of the design, which most scientists do not see; this is important because the gap between the rich and the poor in the world's population is getting wider and wider, which most people's life will get harder and interfere with the sustainable development. To understand how the social disparities and encounters are affected by the metro design. This article examines the impact of subway design on social differences, social encounters, and the subway line planning.

To achieve this goal, I have organized the article into five main sections, two of which have subsections. In the first section, I summarized the academic literature that I have seen before and provide my personal opinion and current knowledge towards the academic literature and the main topic. In the second section, I introduced the method that I used in the research, which included three different studies: the observations, mapping exercise, and the labor force. In the third section, I talked about the analysis based on the second part. I end my paper with the forth section discusses the importance of expanding this particular project.

My hometown is Xuzhou, Jiangsu. To understand social disparities, you need to understand the economic conditions and wage levels in different areas of Xuzhou. Xuzhou is a second-tier city in China, dominated by heavy industries, with industrial parks concentrated in economic development zones. Xuzhou City has six districts, namely Yunlong District, Gulou District, Quanshan District, Tongshan District, Economic Development Zone and New City District. From the differentiation of housing prices and rent levels, it is possible to deduce the regional economic development status and the level of residents' wages. Among them, Yunlong District and Quanshan District have developed rapidly, housing prices remain high, and the new urban area is relatively affluent. These three districts gather people from the middle class and the upper class. However, the economic development of the remaining three districts is slower, the level of regional development is lower, and the people's wages are lower. These three districts gather most of the lower classes and are also the main source of labor. Due to the slow economic development of Xuzhou, the government decided to build a subway to achieve the effect of promoting economic growth and enhancing the status of the city.

2 Literature Review

The first paper is published by Huang Changfu and Xia Yuan. [1] This article is authoritative and they have identified that urban rail transit has huge social and economic benefits, and has become an important means for developing urban economy, improving industrial structure, and improving citizens' living standards. This article determines the status and role of the subway in the city, analyzes the social and economic attributes of urban rail transit from the perspective of urban sustainable development, and points out the direct and indirect effects of urban rail transit construction on economic development. At the same time, the subway construction plan of the Xuzhou government agency also responded to the country's expectations. However, in my research, I think that the government has only used the subway to promote the economic development of some areas but failed to achieve the common development of the urban economy.

Regarding research published on the Internet by a laboratory institution, it describes the relationship between the city and the development of the subway. Among them, it tells a point that the subway has stimulated decentralization, and I hold the opposite attitude to this point. Before I can begin the research examination, however, I need to provide the background information and the economic condition in Xuzhou, and it is to this that I now turn.

Zhao Rong published an academic paper on transportation economy. [2] This article uses the real estate for sale within 1 km along Xuzhou Rail Transit Line 1 as a sample

to study the impact of different stages of rail transit construction on the prices of real estate in different surrounding areas. Studies have shown that the trend of real estate prices around rail transit has spatial and temporal effects; the impact on suburban and new urban areas is greater than that in the old urban areas. The lower the accessibility of the real estate area, the greater the impact on housing prices. At landmark time nodes such as the period and before the opening, the housing prices around the subway have increased significantly. After the official opening, the housing prices will rise once, and then they will stabilize. This clearly shows that the opening of rail transit has played an important role in economic growth.

Lu Donglin wrote and published an article based on the impact of subway construction on the regional economic development of Xuzhou.[3] This paper puts forward the importance and role of scientific design and planning of subway network construction. Xuzhou is an important city in northern Jiangsu. With the continuous expansion of urban economic construction and urban construction scale, urban traffic problems have become more and more prominent, which seriously lags behind the rapid development of Xuzhou's regional economy. Therefore, planning and building a city subway network is the most powerful measure to solve traffic problems and promote urban economic development. At the same time, subway construction can also enhance the status of a city's comprehensive transportation hub, enhance the radiating power of regional central cities, and accelerate the pace of international city construction.

Jiang Wei and Qi Yishan published an academic paper on the impact of the Xuzhou Metro on the commercial industry along the line and its operation mode. [4] This article analyzes the impact of subway development on the commercial industry along the line based on the development status of the commercial industry surrounding the Line 1, Line 2 and Line 3 under construction in Xuzhou City and the changes in consumer psychology and behavior along the subway line. At the same time, learn from The experience of studying the impact of subways that have been built and [operating on the retail industry along the line, such as Guangzhou and Zhengzhou, discusses the impact of the Xuzhou subway on the development trend of the commercial business along the line and its operation mode. The development of the subway has rationalized and shaped the release of commercial business. The new spatial form of commercial formats has promoted the upgrading of commercial formats along the route.

The literature above always focuses on the economic development and says that subway construction and public transportation effectively lead the growth of economic. However, the impact of subway construction on society might not be as high as expected and people need to pay attention to the impact on human happiness and social disparity. Since social encounter is valuable and really benefits the society. At the same time, we need to identify whether the construction of the subway can effectively promote the development of the city all-rounded.

Delia Baldassarri* and Maria Abascal wrote a scientific paper based on the importance of pro-social behavior. [5] This article emphasizes the two characteristics of modern society: social differentiation and economic interdependence to estimate diversity and pro-sociality and the relationship between the two. Among them, this paper mentions that people encounter across different places is important. In detail, repeated interactions and closely connected networks within the group promoted the emergence of a shared

culture, mutually beneficial cooperation norms, and peer recognition, and produced positive results for the group. To be clear, pro-sociality is beyond the scope of the group by increasing the opportunities for contact between groups, encouraging superiors to identify and suppressing in-group-out-group thinking. Social differentiation refers to the growing number of identities and group affiliations that people have in their lives. The large-scale interdependence of life in modern society requires individuals to follow the universal norms of reciprocity and cooperation, rather than relying on mutual recognition or group identity. When people increase the chances of social encounters, more identities and affiliations bring different combinations to promote greater cooperation. At the same time, economic exchanges can gather people who may not belong to the same social circle and increase the frequency of interaction, which have the potential to reduce prejudice, especially under favorable conditions, including equal status, common goals, and lack of competition.

Not only this article mentions the benefits of social encounter, another article published by Richard]. Crisp* and Rose also makes a strong argument that encountering different people is active. [6].

Also, an academic paper written by Delia Baldassarri also agrees with the above view. [7] “Results show that cooperation is induced by patterns of reciprocity that emerge through repeated interaction rather than other-regarding preferences like altruism or group solidarity”. This result tells us that social encounter is precious and positive; Social encounter can not only solve common problems in society Problems like prejudice, social equality and other issues, repeated class interaction can also promote cooperation, which government should intend to promote.

3 Methodology Description

Observational studies. Out of curiosity about the design of the subway line, I asked my relatives about their feelings and opinions on subway construction. Some of their reactions were that the subway was convenient for life, but some people thought that the subway’s role was minimal or even counterproductive. With questions, I decided to conduct research on subway planning. On Saturday, July 24, when I decided to study the impact of subway construction on human well-being, I first obtained the Xuzhou subway line design and city map from the Railway Transportation Bureau and searched for housing prices in different areas on the Internet. In addition, I asked my friends and family around me about the lifestyles of different regions and the main means of transportation, because the family around me are from different social classes, such as working class, middle class, or upper class, so Everyone’s answer is different. After preparing for two days, I learned about the distribution of cities and the economic levels of different regions from questionnaire surveys, route design drawings and city maps. I chose three observation time periods, 6–10 in the morning, 11:30 to 2 noon, and 4:30 to 9:30 in the afternoon. These three time periods are the most representative and the time periods with the largest subway traffic in order to better observe people’s behavior and classification.

When I took Metro Line 1, during the peak hours of work, most of the people on the subway were young people and working middle- and high-class people, and only

a small percentage were students and the elderly. For example, you can see from the picture that the woman is wearing a formal, black high heels and shirt dress. Including the women behind, most of them are high heels and shirts. For men, they are all in suits and leather shoes, wearing watches and so on (see Fig. 1).



Fig. 1. An example about people's behavior and dressings on Metro Line 1.

When I took Metro Line 2, which is the same time as when I took Line 1, the classification of people is more complicated. (see Fig. 2) There are young workers, middle-aged people, teenagers, housewives with children and elderly people, but among them Most of them are middle-class or low-income earners. As can be seen from the picture, most young people wear casual suits, such as sneakers and short pants. Women and men are dressed casually, and it is rare to see people in formal attire. (see Fig. 3).

At the same time, I took Metro Line 3. On Metro Line 3, I observed that many of the passengers were teenagers and college students, as well as the elderly. There is a large age gap between people who take Line 3, and in addition to, except for students, more people are low-income or lower-middle-class people. For example, three of the four young people in this row are students, and they all wear school uniforms. (see Fig. 4).

Mapping exercises. Picking the map is very significant and it will affect latter results of the research. (see Fig. 5) To ensure the correctness of the research results, I asked the railway transportation bureau for the city subway line design and city map. The subway route map identifies the direction of the subway and the areas that it passes through. With the city map, I can observe the characteristics of each area, such as residential areas, commercial areas, and entertainment facilities. I studied the Xuzhou subway map and used Google Maps to observe the facilities next to the subway and in the community.



Fig. 2. An example about people's dressings on the station of Metro Line 2.



Fig. 3. An example about people's behavior and dressings on Metro Line 2.

Industrial center. Xuzhou's industrial parks are concentrated in economic development zones and include large private enterprises and state enterprises, which require a large amount of labor. Moreover, most of the people living in economic development zones are under-paid people. However, from the subway map and Xuzhou map, it can be

found that the Xuzhou subway does not have lines leading to those important enterprises, but instead leads to scenic spots and residential areas.



Fig. 4. An example about people's behavior and dressings on Metro Line 4.

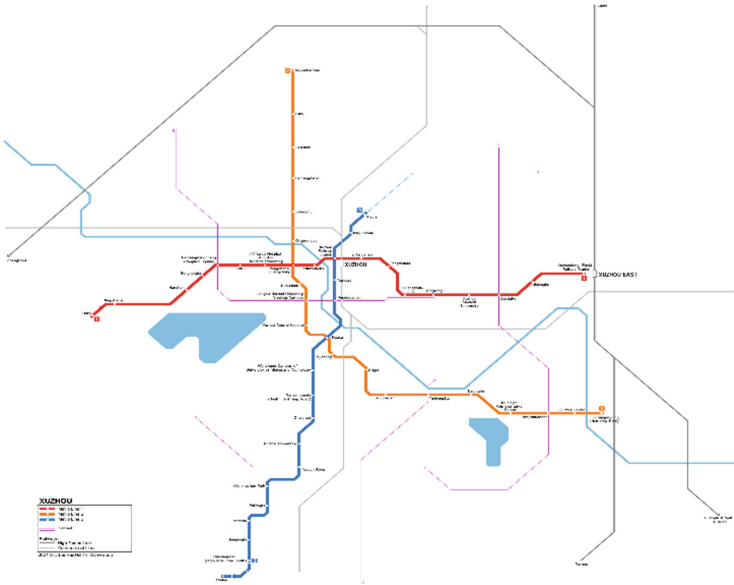


Fig. 5. Xuzhou subway route map.

4 Findings/Analysis

4.1 Analysis of Observation Studies

At 6 o'clock in the morning on Monday, July 26, I was going to wait at the entrance of the subway station, a direct determination of a person's social class based on socioeconomic variables - mainly income, wealth, education and occupation. In general, I use clothing counted to measure social class, I could observe the name on the uniform or the bands of their clothes. On the subway, I started to observe Men and women dress because of the clothing brand and style of dressing, you can see a person's taste and class, and this is also the most intuitive way to judge. I have observed that most women dress professionally, with long shirts. Skirts or long skirts, some men are sportswear, some suits and leather shoes, and some are informal casual wear (see Fig. 6). Although some people's clothes are formal, they will have a sign on their clothes, such as the logistics manager or insurance salesman. In detail, during the morning rush hour and evening rush hour, there is a lot of traffic on Metro Line 1 from People's Square Station to Xuzhou East Station. Men and women on the subway wear mostly formal attire, and some men carry computers on their shoulders. About Bag, some women will carry a small backpack. But most women carry or cross-body a bag, many of which are luxury brands. When taking Metro Line 2, I found that about two-thirds of the people are dressed in casual clothes, mostly elderly and young people. Similarly, most of the passengers on Metro Line 3 are college students and housewives. Some people also wear work uniforms, such as supermarket staff or restaurant waiters. In general, I use clothing counted to measure social class, I could observe the name on the uniform or the bands of their clothes. On the other hand, people of different classes have different prices and materials for the clothes they wear. And different clothes materials and degree of folds can also tell a person's economic status. For the upper-middle class, most of them will change their clothes and shoes every day or every other day. If you see a person wearing formal clothes, but the degree of folds in the clothes is very serious, the collar is not turned up properly, and the leather shoes are dirty or old, then it can indicate that the person is not concerned about appearance and is not economical. Also, if there are threads on a person's clothes or the line of the clothes is very unclear, then the workmanship of the clothes is very poor, and in terms of the gloss of the clothes, the gloss and fabric of expensive clothes and cheap clothes is completely different. Similarly, different groups of people and people doing different jobs have different qualities and temperaments. For example, we can not only judge a person's economy from the clothing and accessories of a person, but also judge a person's economy and work from the expression, appearance, makeup, and perfume of a person. If on Line 1, for example, a boss, if he frowns while taking the subway, keeps checking his mobile phone and sending messages, then he may have encountered difficulties in doing business or other reasons. Or he is dressed very formally and wears a tie while riding the subway, which may also indicate that his business is not smooth or to make his company develop better, because he may have to meet investors or important people. Some type of. From perfume, we can also judge a person's economy or work. Women spray more perfumes, but for working people, they can't spray too sweet perfume or too strong scent. Their best choice is light floral, fruity, or woody scent. However, the average men who wear perfume are a minority. Men who

are more concerned about their external image will spray perfume, most of which are woody, but in most cases, these men are young men or men who need to see important customers.

After a week of research and observation, my friends and I observed and summarized the working hours of the low, middle, and high classes. When I do surveys on the subway, I observed people's clothes at different times and in different compartments and judge their working class. After a week of research, I found that between 7 am and 7:30 in the morning, more people in the company who hold management positions or with higher wages take the subway. Moreover, these people work late at night until 9–10 pm and spend most of their time on the subway with their eyes closed. This result is very surprising to me because in the impression that people in management may have less work pressure. In fact, they want to reach high positions and many jobs require them to review. However, people like the middle class or the average salary level, according to my observations on the subway, most of them will go out between 7:30–8:30 in the morning, following the working time cycle of 9 am and 5 pm. For this group of people, most of them will look at their mobile phones on the subway and I consulted with the human resources director of my dad's company. They said that these people have low desire for promotion. The working people at the bottom work harder, and their working hours are the earliest and the latest to finish their work. According to my survey on the subway and the results of my consultation, people in the lower class have fixed working hours, such as cleaners. They need to clean and arrange the space before all employees arrive at the company and clean the company after all employees leave the company. Most of the work they do is not mental work but rather hard and tiring work. Previously, I expected that I would find that the characteristics of passengers on the three subway lines were similar, such as clothing, age group, and so on. However, after my careful observation, I found that things are very different from what I originally imagined. People on each subway line have unique characters and can be classified and summarized.



Fig. 6. There are always a lot of people on the subway station in the early morning.

4.2 Analysis of Mapping Studies

Through Mapping studies, we can find that the subway line design has great drawbacks, and I will analyze the disadvantages from the direction of the three lines. Xuzhou Metro Line 1 runs east west and it connects Xuzhou Old Town and the eastern of the city. At the same time, it has passed through five major commercial centers and fast contact two comprehensive passenger transport hubs. Most of the people living on Line 1 are upper-class people, and some are middle-class people. Most of these people have busy schedules. The Xuzhou Metro Line 2 mainly guides and promotes the development of the northern part of the city and the new urban area, and expands the city's space to the east, passing through mostly middle-class residential areas and a small number of commercial centers, while Line 2 The usage rate is the highest among the three lines. Instead, the utilization rate of Line 3 is lower in the whole line because the areas it passes through are poorer residential areas and university towns. We can find that the design of these three routes is unreasonable and will reduce social encounters and eventually lead to aggravation of social disparities. The reason that social disparities will increase is that subway lines restrict the trajectory of the middle and upper class people and the poor. When people's course of action is defined, zoning becomes more obvious, which leads to a gradual decline in the number of social encounters, the middle and upper classes become rich, and the poor cannot be driven to develop. Finally, the gap between the rich and the poor widens and aggravates social disparities. The following are the characteristics of each subway line I summarized. Metro Line 1 runs through the old and new wealthy areas of Xuzhou from east to west, connecting important commercial centers, office buildings and shopping centers. Basically, every place the subway passes through is a workplace, office building, commercial center and newly built expensive residential area. Therefore, Line 1 can be said to be from the rich zone to the rich zone. Metro Line 2 runs through Xuzhou from south to north, promoting the development of the northern part of the old city, the new city and the new city east. Most of the areas passed by Line 2 are areas under development and low-wage areas. The main passing areas are university towns, schools, old residential areas, small shopping malls, some office buildings and some villages. Metro Line 2 passes through two stations in the city center. This should be for the convenience of workers to transfer to Line 1 to get to their jobs. However, most people need a long subway journey to get to their workplaces. The main purpose of Metro Line 3 is to promote rail transit in the urban area and peripheral urban areas and strengthen connections. Therefore, most of the areas it passed were poor residential areas, undeveloped places, ancient cultural scenic spots, and mountains.

4.3 Analysis of Unreasonable Route Design

First, Xuzhou is a second-tier city dominated by heavy industry. The main industrial area is located in the northeast of Xuzhou and named as Economic Development Zone. Most of the labor force is concentrated there, including people with poor economic conditions or poor families (see Fig. 7). Because the housing prices there are lower and the demand for labor is higher. However, the subway line does not pass through the economic development zone. In fact, I think that what can really drive economic

development is to allow workers at the bottom to have more contact with the upper-middle class and to use the subway to facilitate their travel, which can contact the modern technological society more frequently, increase their knowledge, and promote the common development of the economy. If the subway drives the development of the industrial zone, Xuzhou can also quickly transform from a heavy industrial city to a city dominated by high-tech industries. Therefore, it can be seen that the line design of the subway did not realize the government's original purpose and plan, which did not promote the common development of the economy.

Secondly, I think that the construction of the Xuzhou subway is late, because the real rich already have established ways to travel. Most of them drive to work. Therefore, after the completion of the subway, the real improvement is the middle- and upper-class managers rather than the upper-middle class managers. The rich and the poor, which is a small part of the population. The real labor force and poor people are distributed in economic development zones. In general, people at the bottom have not progressed while people in the upper and middle classes are getting richer, class differences are getting worse, and social disparities are increasing.

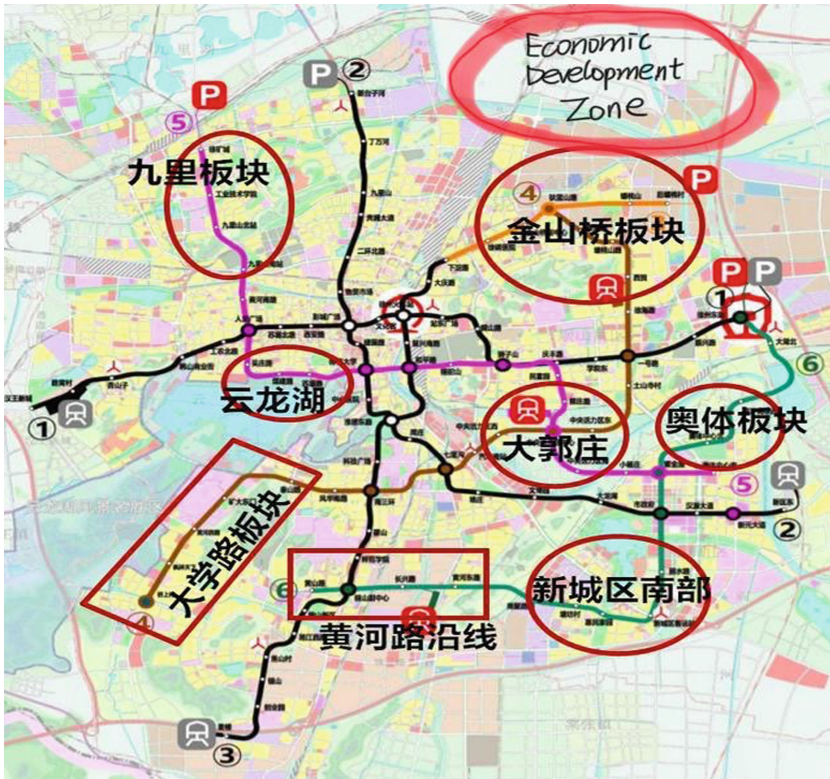


Fig. 7. The economic development zone.

5 Conclusion and Further Study

To gain a complete understanding of the effect of the subway, it is necessary to conduct a study that examines the effect and problem of subway's line design. Through observational studies, I found that the clothes of people on the three subway lines can be classified. People on Metro Line 1 generally dress more formal and expensive than those on Metro Line 2 and Line 3. People on Metro Line 2 wear more sporty and casual style. People on Metro Line 3 have a large age difference, so they wear very different clothes. Through mapping studies, I found that the chance of encountering the poor and the rich through the subway line is very small. In general, Line 1 is from the rich area to the rich area, and Line 2 is from the middle-class area to the poor area. 3. The line runs from the university town to the poor area. What is even more strange is that through estimation, I found that some poor areas do not have subways at all, and the social encounters are even less.

Connecting to literature review. Through verification and estimation, I found that my guess is basically the same as the academic paper in the Literature review. For example, the price of real estate in the areas where the subway crosses has increased, and the number of commercial centers has increased, which promotes the economic growth of the city and increases the wealth of the landlord. At the same time, we also understand and discover the importance of social encounter and pro-social behavior.

After the observations and mapping exercises, Xuzhou's subway line design does have problems, which reduces social encounters, exacerbates social differences, and is not an effective way to promote economic development. What's more, the most important thing we need to do now is to find a structural solution to solve the existing problems because it is related to people's quality of life and happiness. As we all know, people's behavior is difficult to change, so government agencies should think about the next solution or consider publishing some public policies to increase class interactions and social encounter.

Encountering and increasing pro-social behavior play significant roles in the society. Under the call of the government, people should use public transportation more and more effectively, which is a favorable way for people to increase social interaction and cooperation. In daily life, people in remote areas can take Metro Line 1 or Line 2 to the city center in their spare time and enjoy the lifestyle and rhythm of the city center. During working hours or business activities, people can choose to work in the city center or bustling commercial centers, which effectively enrich people's experience, refresh their minds, and rekindle their creativity.

6 Limitation of My Study and the Suggestions for the Future Scholars

The drawback of my study is quantification. You can use questionnaire to collect big data about human happiness and satisfaction with the subway and do regression equations to get more scientific conclusions. For observational studies and clothing counted, quantification can also help people convert subjective and perceptual analysis into rational data. In future studies, abstract and subjective concepts can be transformed into measurable

concepts. For example, the beauty of clothes and the high and low are converted into the time that people's eyes stay on it, because time is a measurable value.

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Research on Emotional Marketing Based on the Case Study of Coca-Cola

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Abstract. Indeed, due to the rapid advances of the times and the development of the Internet, the way in which marketing is addressed today has changed and consumers have the opportunity to “generate” their own information about products and brands, as well as to spread and share it through copying, browsing and etc. Consumers’ purchasing decisions are more susceptible, as the increase in ways of gaining and generating multitudinous information and some might be deceptive—because of the decreasing cost of sharing, the content and quality of consumer-generated marketing messages are becoming increasingly difficult to control as a result. Emotion acts as one of the factors contributing to changes in behaviors and actions, has been widely studied in the past few decades [9]. Realistically, the marketing messages that are spread by consumers seem to share a common characteristic of trying to achieve communication by evoking emotional resonance in consumers. We found that emotion will not only help to explore and reveal the relationship between the emotionality of the message content and the sharing behavior but also provides more valuable and relevant suggestions and insights for enterprises to carry out new media marketing, as it distinguishes marketing messages from ordinary messages [2].

Keywords: Emotional marketing · Business management · Coca-Cola

1 Introduction

Originating in psychology, the research and application of emotions were widely present in the study of consumer behavior. Emotion can be defined as an individual’s adaptive response to stimuli, which can influence an individual’s judgment and decision-making behavior to a certain extent, by affecting their attention, perception, and memory [8]. What information consumers are willing to share spontaneously, and the judgments they make when they receive new information, are also influenced by emotions. In fact, the key role in marketing message communication means that companies should continue to focus on rational persuasion in the process of marketing communication with consumers, but also pay attention to the emotional changes in the process of using the product or service experience, and target consumers to focus on the creation of value experiences, emotional evocation and cultural resonance [7]. From the marketing perspective, the likelihood of success and accomplishment for organizations depends on providing customers with sought-after emotional states, while disliked emotional states are limited

[1]. Therefore, when scholars talk about the influence of emotions on consumers' purchase decisions, they usually categorize them as emotional tone, which may be positive or negative at both ends of the spectrum, and degree of emotional activation, which may be interested and indifferent at both ends of the spectrum. Based on a systematic review and analysis of existing literature, such as an understanding of the classification of different emotions and why different emotions can elicit different responses, etc. In this paper, the Coca-Cola case study will be analyzed to illustrate specifically how emotions affect consumers' judgment and willingness to share information and the company's marketing model/strategy.

2 Literature Review

Emotions play an important role in the process of individual information-sharing behavior, but the relationship between different emotions and information is worth exploring in order to understand how emotions influence individual information-sharing behavior. In other words, it is essential to understand the interaction among information from organizations, emotion received from consumers, and the final sharing behavior. In fact, the whole process, from the company's marketing message to the consumer's processing of the message, and finally affect the consumer's behavioral strategy, can be categorized into two different methods, "direct and indirect methods/routes". In the first case, the emotional expression in the marketing message is explicit and integrated with the message, while in the indirect expression, the implicit emotion is the result of the marketing message stimulus leading to a mediating role in the process of message action and sharing.

2.1 Differences in the Classification of Emotions

As mentioned in the previous pages, "basic emotion theory" and "emotion dimension theory" are the two main existing theories of emotion [26]. In fact, emotions are inherently communicative, and information containing both implicit and explicit emotions is more communicative than information containing no emotions; on the other hand, information containing specific emotions such as anger or sympathy is more likely to stimulate consumers' information sharing behavior than information containing other types of emotions. Here, we need to question why external information stimuli lead to different emotional changes and why different emotions lead to different sharing behaviors [24].

2.2 Why External Information Stimuli Lead to Different Emotional Changes

To understand the first question, it is of importance to draw on analysis and understanding of "emotional infection theory". Emotional contagion theory suggests individuals are likely to change their original emotions during the receiving process, by imitating and synchronizing others expressions, movements, sounds, and postures, which ultimately keeps the emotions of the expresser and the receiver consistent [11]. They can be transmitted from person to person through certain mediums, either face-to-face or

through pictures, text, audio, or video via online media. As for “Emotion priming theory”, it suggests that individuals can be stimulated by being presented with pictures or words that contain emotions, producing an emotion priming effect [28]. In many prior academic studies on emotions, there is ample evidence that the acceptance of emotions is accompanied by a variety of perceptions [23]. These perceptions are composed of many elements and norms that relate to the emotional experience of each individual, and thus form a mental representation that has both affective and individual characteristics [15]. Like the operation of an information network, these knowing patterns link specific emotions to related memory, cognitive and action processes, acting as a “guidance function” that contributes to emotion-related behavior [28]. Similarly, research in the field of marketing has found that emotional stimulus is prevalent in the external environment in which consumers find themselves, such as the emotions of service personnel, the emotions of other consumers, and advertising messages, that the emotional changes caused by these emotional stimuli in turn influence individuals’ subsequent cognitive attitudes and behavioral decisions [12].

2.3 Why Different Emotions Lead to Different Sharing Behaviors

When people share information, different theories have different answers to the question of ‘which emotions create a stronger sharing-desire’. “Selective awareness theory” proclaims that individuals tend to share information that contains positive emotions as selective attention is the act of filtering and selecting information, meaning that audiences naturally tend to receive information that is consistent with their own views, attitudes, interests and needs, while ignoring or avoiding content that is irrelevant or opposed to their own views. Individuals are motivated to share marketing messages for impression management purposes and to create a positive personal image, so consumers pay special attention to and try to share marketing messages that contain positive emotions [18]. For example, based on the research designed by Peter et al. [18], participants were consistently the most willing to communicate, and most likely to actually communicate, social anecdotes that inspired relevant positive emotions (e.g. surprise & happiness). In contrast to selective attention theory, negative bias theory suggests that negative information has negative efficacy. Compared with positive information, negative information is prioritized for attention and processing, leaving individuals with more profound perceptions and memories, and causing stronger emotional reactions, thus having stronger transmissibility in time and space. According to the experiment implemented by Vaish, Grossmann, and Woodward, participants were significantly more willing to convey highly emotional versions of anecdotes rather than positive emotions (e.g., surprise, disgust, and fear) because some emotions had significant main effects [27]. However, this pattern shifted with audience identity, so that participants had a significantly lower preference for communicating highly emotional anecdotes with strangers compared to unspecified listeners. Nevertheless, not all negative emotions enhance consumers’ desire to share on some level; sadness, for example, weakens communication because only emotions that create activation and arousal are conducive to sharing [4]. Consequently, whether it is selective attention theory or negative bias theory, emotions play a role in message

identification and filtering. Moreover, emotional social messages are more easily communicated to certain audiences, and certain emotions are more easily communicated than others [18].

3 Methodology

3.1 Model of Direct and Indirect Routes

According to Berger, emotion is an ‘informational cue’ that can directly influence consumers’ decision-making judgments [3]. Therefore, companies can directly influence consumers’ sharing decisions through the intuitive and outward expression of emotions in their marketing messages. For consumers, their emotional feelings are intuitively derived from marketing messages, and they are able to make quick decisions and judgments based on the emotions outwardly expressed in the messages. In this process of information acquisition, emotions are external and independent, without integrating external information with their own internal memories and associations. An example is the experiment made by Berger, various renditions of the story were utilized to examine what various measures of positive or negative emotions may have an impact on the willingness of sharing and arousal [4]. The result indicated that fact when the information contains emotion, either is positive (e.g. happiness and pleasure) or negative (e.g. anxious and sadness), people are more likely to share the experience because the higher willingness to share is driven by awakening it triggers [4]. Consequently, it can be seen that the explicit expression of emotions in marketing messages is a direct influence on information-sharing behavior.

However, consumers process information in a way that is both simple and automatic through emotional words or emotional expressions, and through a series of complex reasoning processes to achieve understanding and empathy for the content of the information. Emotions also play a mediating role in the process of sharing marketing messages, i.e., marketing messages are emotional stimuli, in other words, when consumers process the marketing messages they receive, certain emotions are evoked, and these emotions then influence their sharing behavior [13]. In the process of information sharing, in addition to the fact that marketing information can stimulate emotions and lead to information sharing, the presentation of marketing information and the presentation environment can also affect the sharing behavior through the mediating effect of emotions. Factors such as the credibility, interactivity, and vividness of the information platform are important influencing factors for consumers to make emotional perceptions. Besides, consumers’ perception of the characteristics of the information itself (e.g., usefulness, functionality, and innovation) significantly affects consumers’ emotional arousal. The higher the level of individual emotional arousal, the more likely it is that informed choice and information dissemination behavior will occur. It is a common misconception that positive emotions enhance indirect emotional communication, while communication is not just about sharing positive things, some elicit highly arousing emotions (such as awe, anger, and anxiety) and their content is “more ‘viral’ after taking into account ‘valence’” [4].

Marketing Interest in Emotion Marketing states that “emotion can stimulate interest in buying, guide choice, evoke purchase intent, and influence future purchase decisions”

[17]. In other words, emotional marketing is not only a marketing concept but also a marketing practice to create consumer demand, meet consumer needs, should be throughout the entire process of product production, publicity, after-sales, etc., in order to provide consumers with the best products and the best service. For companies, effective emotional marketing can bring good public reputation and word-of-mouth so companies should learn how to tell their brand story well [3]. The impact of emotion is significant because it is inextricably linked to an individual's perceived rewards, and it is the organization's job to craft strong emotions and combine them with the product to achieve efficient marketing.

How to maximize the use of emotion in marketing? Initially, be simple. As complex language or scripts often leave consumers with misunderstandings or ambiguities, and without understanding, they can't influence their emotions and increase their desire to buy and share. Next, emotions in marketing should be centered on human values, because values drive emotions, which promote behavior. An effective emotional marketing, such as the advertisement of Apple, shows a beautiful and warm image of a family recorded on an iPhone, which makes the viewer feel happiness and easily understand the brand's values - that Apple's products are not just cold machines, but also tools for recording treasured memories. In addition, to clarify and ensure what emotions you want your customers to receive thus create consonance (e.g. surprise, curiosity, satisfaction, etc.). According to Kellerman, understanding emotional defense mechanisms is important when developing marketing strategies because individuals often attach emotional defense mechanisms to their emotions in order to maintain a predictable understanding of their environment [20, 25]. Therefore, the defense mechanism limits to some extent the expression of the customer's most emotional desires for the product [25]. If the principles of defense mechanisms can be accurately understood and applied to fill the void in the consumer's mind with emotions, the strength of a service or product and the communication information with the greatest inspirational effect can likewise be revealed [22]. Finally, companies need to be mindful of the techniques and tools they use for emotional marketing. In the case of advertising, it is possible to make a slice of life or simple customer feedback, but each method has specific practices and embodiments. To differentiate themselves from their competitors, successful emotional marketing is often out of the box, and companies should be unafraid to take risks and be creative [14]. At the same time, always be aware that the brand and the product itself are the heart of this story because all emotions are attached to the product.

3.2 Case Study of Emotional Marketing: Coca-Cola

From a marketing perspective, emotional branding is always successful in comparison to other brands in the same market because it leads to the reception of emotion from customers. That is, the impact of emotional branding becomes apparent when consumers are not always rational in their decisions, especially when they feel and experience some strong and lasting brand attachment. Coca-Cola, as a successful brand, which addresses efficient emotional branding, has established branding practices and marketing strategies that effectively appeal to consumers' emotional states and satisfy their needs and desires.

Like most companies, Coca-Cola used emotion in its advertising to attract customers. A prime example of this is the tagline, "Share Coca-Cola, share a feeling" [5].

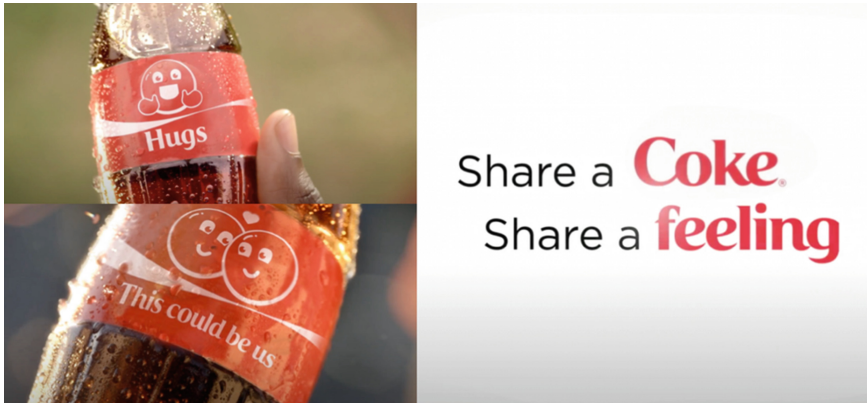


Fig. 1. Frame from the advertisement of Coca-Cola in 2016

In the case of this campaign, as shown in Fig. 1, the words used in the advertisement of Coca-Cola (e.g. hug, share) brought a sense of warmth and happiness to consumers and were able to target a broader audience including children, youth, and adults, thus increasing consumer brand loyalty and enhance the work-of-mouth of Coca-Cola. At the same time, Coca-Cola has worked to develop diverse marketing strategies and contagious communications by changing the outer packaging, as well as labeling different cans and bottles with different emojis [2, 14].

Compared to the one-way dialogue between consumers of some brands, Coca-Cola uses its “secret language bottles” to bridge the gap between consumers, putting internet buzzwords created by netizens on the bottles, turning the bottle ads from PGC to UGC, and allowing users to produce content, thus truly realizing the interpersonal communication of bottle advertisements. The launch of the Whisper bottle coincided with the summer season, when consumers often take the time to travel and chat, and spend more time communicating, just as the tagline “Coca-Cola Whisper Bottle makes summer more chatty. The words on the bottle always bring more topics for communication, as most of them are words expressing joy, and as happiness is one of the more evocative emotions, consumers are more likely to buy Coke with positive words to share their joy. At the same time, consumers can also take photos on social media platforms and use the bottle slogans to visually express their current mood [29]. Coca-Cola bottle advertising has successfully expanded the dialogue between product and consumer to a dialogue between consumers, bringing a new way of expression to interpersonal communication.

Leonardo O’Grady, director of IMC ASEAN for Coca-Cola, once claimed that: “Coca-Colas’ marketing-strategies aims to address the ‘doses of happiness’ through an innovative and surprising way, in order to benefit both those present and the wider consumer” [6]. Thus, sharing Coke’s emotional model proves that Coca-Cola’s “consumer-centric” marketing approach has brought Coca-Cola closer to consumers while also benefiting the company’s business and thus increasing sales. For Coca-Cola’s emotional branding strategy, the resonance generated by the emotions prompted consumers to experience attachment to the brand to a large extent. This innovative way for companies

to engage with consumers also drives personalization and promotes creative expression by enhancing their desire to share with others.

4 Conclusion and Further Areas of Research

Even though previous academia suggests “people are rational”, rational and emotional factors are equally weighted when consumers making their purchase decisions [10]. When searching for brand-loyalty and word-of-mouth, marketers often try to target “influencers” or opinion leaders, while the truth is that this approach is not more effective than focusing on creating compelling content is a more effective approach in terms of value and cost-effectiveness [4]. In the light of analyzing the highlights above, emotion may have a significant impact on marketing, especially in the aspect of sharing information and gaining word-of-mouth. First, the relationship between emotion, information, and sharing behavior is mainly realized through two paths: direct and mediated. In the former case, emotions are external to the message, and consumers can intuitively feel emotions through the marketing message and make quick judgments and decisions based on the emotions expressed in the message. In the intermediary path, emotion is the result of the stimulus of marketing information, and in addition to the marketing information itself, the presentation form and environment of the marketing information can be used as stimuli to influence consumers’ emotions and then influence their sharing behavior. Secondly, when exploring the difference in the effect of different emotions on information sharing behavior, it is found that information-containing emotions are more communicative than information not containing emotions, but there is no consistent conclusion on whether positive or negative emotions are more likely to lead to sharing. Third, based on the logic that “stimuli lead to emotions and emotions lead to behaviors,” this paper explains why information stimuli lead to different emotional changes and why different emotions lead to different sharing behaviors. The above research on emotions provides suggestions for companies to apply emotion marketing effectively and uses Coca-Cola as a case study to illustrate the key to real-life emotion marketing.

4.1 Further Areas of Research

In fact, other characteristics of information media (such as perceived usefulness and perceived ease of use), the presentation form of information content (such as different forms of text, pictures, audio, and video), and the quality, quantity, vividness, and interactivity of information content all affect information sharing behavior [16]. In other words, the mechanism of emotion on information-sharing behavior may be influenced by the media’s emotional preference, but in the mobile Internet era, new media are emerging, and different media may show different preferences for different types of emotions. In other words, does the “emotional preference” effect of the media have an important influence on the transmutability of emotions?

The majority of the existing academic literature is based on studies of single emotions, and the mechanisms of action of mixed emotions should be examined in the future, which is a new perspective to explore the function of emotions sit might have a great impact on consumers’ purchasing behavior [19]. In definition, mixed emotions are the

simultaneous presence of two or more emotions with multiple presentations, such as anger and happiness, disgust and satisfaction, and the complex emotional experiences faced when making major decisions in daily life [21]. Such phenomenon indicates that consumers will use the product with a mix of satisfaction with some features and disgust with others. Whether the generation of these mixed emotions affects consumers' willingness to share information and whether their mechanism of action is the same as that of a single emotion are questions worth considering. In addition, the relationship between the proportion of positive and negative mixed emotions and sharing behavior, or whether there is a range of single emotions or mixed emotions that trigger sharing behavior, are questions that deserve further exploration.

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Comparing the Influence of Historical and Religious Factors on the Status of Women in Bangladesh

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Abstract. Scholars have long been interested in the situation of women in South-east Asia since numerous factors influence its development. Religion brings a cultural context and moral constraints to people's actions, while historical events set the basis for the development in the present and in the future. This paper proposes the hypothesis that religion has a greater impact on the development of women's status in Bangladesh than historical institutions have had on it. By analyzing historical and religious factors structurally, institutionally, and culturally, we explain how both elements have influenced the current status of women's existence and infer which factor accounts for a greater proportion to support our previous hypothesis.

Keywords: Women status · Bangladesh · Rape · Islam

1 Introduction

Women's status has been increasing continuously with the improvement of the educational level, economic construction in countries all over the world, and the awakening of women's consciousness. However, there are still some countries that are restricted from developing women's rights by their relatively backward customs in South Asia. One of the most representative examples in Bangladesh is that there is no approach to protect the basic rights of women in society, women could even be traded as goods. However, according to the 1972 Constitution of Bangladesh, women's rights are protected under equality and participation [1]. But for some reason, the discrimination against women promotes the difficulties of female empowerment, and this research will discuss the potential factors.

Evidence suggests that historical background and religion are two pivotal factors in the low status of women. From the structural and institutional perspective, there is a mass of variables throughout the long history of the country that influenced the level of female oppression, such as the evolution of legislation, coup, etc. From the cultural aspect, the Islamic faith has laid the foundation of Bangladesh's culture, and its unchanging rules have protected women's rights to a certain extent, but have also posed severe obstacles to the development of gender equality.

In Bangladesh, more than 70% of married women and girls have been subjected to some type of intimate partner violence, with over half reporting physical attack by their spouses. Between January 2001 and December 2019, approximately 3,300 women were murdered over dowry disputes, according to Odhikar, a respected Bangladeshi human rights organization. In the first nine months of 2020, at least 235 women were slain by their spouses or family, according to Ain o Salish Kendra (ASK) [1].

More than 70% of married female in Bangladesh have experienced some form of intimate partner abuse, with about half reporting physical assault by their partners. At least 235 women were killed by their husbands or his relatives in the first nine months of 2020, according to a Bangladeshi human rights group.

Therefore, it is necessary to study the factors affecting the development of women's status in Bangladesh to consider ways to improve their situation. Nevertheless, this study is unable to encompass the entire elements, but will focus on comparing the proportion of influence of two factors, historical and religious aspects, on the subject.

2 Literature Review

There is a large amount of literature on the various kinds of factors that affect the extremely low status in the Southeastern country. Initially, empirical evidence highlights the facts and the influence of some specific elements. Mary Arends-Kuenning and Sajeda Amin present supporting evidence that it is difficult for women to have access to high levels of education [3]. In rural Bangladesh, parents often see education as a means of enhancing their value in the marriage market. For the conclusion in this study, the territorial limitation was not taken into account since. Until 1970, about 10 percent of the population still lived in cities, but the female education rate remained unchanged. Lisa M. Bates, Sidney Ruth Schuler, Farzana Islam, and Md. Khairul Islam found through qualitative research that Women's socioeconomic situations in rural regions, such as the form of registered marriage and the high dowry, can have a complicated and conflicting impact on their risk of being abused [4, 11].

Sarmila Bose focused on the sexual victims throughout the Bangladesh military campaign and analyzed the contingency and premeditated nature of the entire incident [5]. And Nayanika Mookherjee explored that during Bangladesh's 1971 liberation campaign, there was a link between female prostitution and power operations [6]. Both studies proved that Women were brutally used in the war, a part of their history that they were most ashamed of, which bring them into an inferior position from then on. Hos-sain, Kamrul proposed that social structure is the significant cause of gender inequality in Bangladesh.[7]. Besides, he also pointed out the importance of adopting the Uniform Family Law by comparing the different treatment met by Muslim and non-Muslim women. This indicates the impact of Islam on Bangladeshi behaviors and thoughts, which result in the struggle of women and the difficulty of advancing their status in society. The prominent problem is that the religious aspect is rarely considered as a crucial factor affect social status, for its inconsistency and complexity.

3 Impact of Bangladesh's War of Independence on Women's Status

Women are often a vulnerable group in disasters and wars. They do not have the power to participate in the battle, but need to survive and even raise their children in chaotic circumstances. As trophies and captives, women became a tool for soldiers to give vent to their desires, and the number of rapes in 1972 was so large that it became a documented historical event.

Jessica Lee Rehman said "The Pakistan Military is an Islamic agency. Its soldiers are God's warriors who rape in God's name. As a result, the rapping of females, forced physically indiscretions, and abuse and torture are seen as a victory for the good." During the war, the number of females who experienced violence and sexual assault reaches up to around 400,000, and some of them even got pregnant [7]. This is suspected to be genocidal rape. Genocide is defined as "contributing to a great physical and psychic injury to group members" and/or "consciously trying to inflict on the group living standards estimated to give rise to its complete annihilation of all of the part," based on the Convention on the Prevention and Punishment of the Crime of Genocide in 1948 (hereinafter "the Genocide Convention") [8]. However, it is difficult for scholars to conclude because of the widespread silence and shame of the victims. After suffering multiple assaults with no recourse, this group of women would exhibit a degree of numbness and trauma and lost their fighting spirit. Outside the battlefield, women also lived an extraordinarily difficult life that became destitute and homeless in almost a year. In that circumstance, sex trafficking opened up its market and thousands of women were traded for commercial sexual exploitation [7]. A large group of trafficking victims is attracted by unveracious employment opportunities offered by men from the overseas country, and then force them to labor and prostitute. Although the government has made significant efforts to address the sex trafficking issue, it has not increased penalties for offenders, resulting in an increase in the incidence of women violently raped [7].

After the Liberation War, sexual exploitation was remained rampant throughout the sex trafficking industry. Even if these female victims leave the industry, they will still be excluded by society and even by their families of origin, because the defilement of women is unforgivable in the belief of Islam. Moreover, low level the low level of education and discrimination against women in the current society prevent them from gaining an advantage in the professional market. Then, they have no choice but only could make a living by prostitution in a brothel [9, 11]. With the development of the sex trafficking industry chain, pimps and other characters have become the main beneficiaries who take the lion's share of the profits, while women still have no income of their own. Due to the legal loopholes and historical events that have condoned the evil of rape, a part of women has chosen a path of disrespect and lack of sovereignty because of the pressure to survive, and this path has doomed them to the fact that they cannot change their inferior status compared to men.

According to historical facts, it is difficult to say how much the suppression and rape during the war had an impact on the subsequent process of women's liberation, but it is undeniable that since the establishment of the Republic of Bangladesh, the lax laws and the government's inaction in the situation of women have caused women to still be unable to get rid of the pain of being oppressed and their disrespectful social status.

4 Impact of Islam on Women's Status

Textual analysis usually concludes that Moghadam: The Quran's disclosure is primarily ethical and egalitarian in faith, or the Quran is an unclosed word with precepts that are somewhat more patriarchal than in other major faiths. According to him, the Quran's perspective of women as wives and mothers differs from most of the other Abrahamic religions like Christianity and Judaism [10]. However, in the patriarchal society promoted by Islam, women themselves are not given the right to speak, decide, and own their property.

It seems that many regulations in the canon protect women's rights from being violated, such as not exposing the body other than the face, hands, and feet in front of the opposite sex, except for the husband and father [10]. However, it is precisely because of these special rules that women have become a disadvantaged group in society because people's subconscious has established the background that women need to depend on men for survival in society. Western scholars interpreted the veil and the burqa as a kind of visual protection, and they are also representatives of gender repression. If these women always follow the culture and customs of Islam, it will be difficult for them to have a free personality, which will hinder their path to empowerment.

5 Comparison Between the Two Factors

Perhaps historical factors are the root cause of the inability to develop women's status, but this research states that in the process of development, the traditional shackles carried by women are a more important factor. Even in South Asian countries where the educational level is relatively backward, some groups of women will try to resist and strive to pursue power and a freer future. However, the obstacles on this journey are often as turbulent as floods. There are too few people who can withstand the flood to achieve their goals since society's tolerance for them can't accommodate any differences that go against the common customs.

The most striking fact is that the sex industry generally exists today in Bangladesh and is even legalized. According to reporter's field investigation of Vice News in Doradia, the largest brothel in Bangladesh. There are women from all over the world working in sex work here, most of them are trafficked to the place and then arranged customers by brothel pimps to earn profits, but in fact little money is given to them personally to even make ends meet. Notably, when asked why they didn't leave the place where they were oppressed, they said it was difficult to return home after working as sex workers because it was seen as a shame and their original families would no longer accept them. After experiencing irreversible harm brought about by the state's tolerance of rape and transactional sex, they have completely lost their right to freedom. This shows how much the moral constraints of society have affected them. In short, the women's status has not been changed from the war time. Furthermore, the women's status in the war itself is the result of Islam regulations.

Whereas the former was caused by the historical events laid down and the stagnation of the country's development, the latter was due to the prejudice against women that religion has brought to the whole society deeply for a long time. Hence, the status of women was largely prevented from being elevated because of this prejudice.

6 Conclusion

This study emphasizes the importance of the religious factor from a cultural perspective. Compared with historical conflicts and institutional flaws, people's reverence for and internal bondage to moral traditions created by religion is indelible since the historical conflicts and institutional flaws are based on the moral tradition. On account of the deep-rooted nature of religion for people that it is hard to get an effective solution to the problem of women's low status. The moral traditions have to be changed to tear open the cage that restricts women from protecting their basic human rights and save them from the dire straits. [12].

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Whether COVID-19 Vaccination Rates Are Associated with Different Countries' Demographic Character?

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Abstract. The emergence of COVID-19 vaccines is a topic of a worldwide nature, and the vaccination rate of vaccines varies in different countries. This paper mainly concentrated on the influence of different countries' demographic features on coronavirus vaccination rate. 50 countries which were selected by ranking the GDP were applied to this research. Multiple linear regression was conducted to the different countries' demographic traits compared to the vaccination rate of COVID. Our analysis showed a strong correlation between GDP per capita, specialist surgical workforce per 100000 population, and GDP with respect to the rate of COVID vaccination. This study concludes that GDP per capita, specialist surgical workforce per 100000 population, and GDP increase the rate of coronavirus vaccination. In this work, we explore the different perspectives on the research of vaccination rate in the direction of demographic characteristics and make a certain pavement for subsequent articles on related research directions.

Keywords: Covid-19 · Covid-19 vaccination rate · Country demographic character · GDP · Vaccine

1 Background

The infection caused by COVID-19 (SARS-CoV-2) [1] has brought the world to a standstill. To curtail the spread of the virus, governments are trying valiantly to isolate the patients, asking citizens to stay at home, stopping all public gatherings, and imposing lockdowns. On the other hand, the scientists from various countries are trying their best to discover an effective vaccine and a medication to control this disease [2]. By the end of 2020, preliminary results have been achieved in the national research and development of COVID-19 vaccine, and various vaccines have been used for the prevention and control of novel COVID-19 in people around the world [3]. However, there have been significant differences in vaccination rates between countries since vaccination began. By comparing all kinds of publicly available data from countries around the world. We hope to find the factors that influence the actual rate of vaccination.

There have been several studies that have pointed out what the number of infections and deaths from COVID-19 might be related to, or they have made predictive models of the number of possible infections in the future. However, there is a lack of research on what impact the vaccination in each country. Thus, it is a valuable research direction to compare the factors that influence the rate of COVID-19 vaccination using the open data of different countries.

About half of the world's population lives in low - and middle-income countries [4]. In general, these countries have poor health care facilities, hygiene and sanitation, which are often cited as contributing factors to the high incidence of infectious diseases. Thus, pandemics of infectious diseases, such as COVID-19 is expected to have catastrophic consequences for low - and middle-income countries. The development of safe and effective COVID-19 vaccines is a critical step in ending the pandemic. Vaccination requires a certain amount of basic medical facilities, supplies, and personnel, and also depends on the availability of vaccines [5]. There is some correlation between GDP and these factors. Therefore, the medical level reflected by GDP will be potential factors affecting the vaccination of COVID-19 vaccine.

Demography is another factor that affects vaccination rates [6]. The urbanization rate usually using a demographic indicator, that is, the proportion of the urban population in the total population (both agricultural and non-agricultural). UN estimates that 55 percent of the world's population lived in cities in 2018. Based on numerous facts and studies, COVID-19 is a highly contagious disease. It can spread through the air and in cities, people are more densely populated, and the infection is also faster comparing to rural areas. This may be a factor in the willingness to vaccinate [7, 8]. Collecting urbanization rate data from countries and comparing vaccination rates to explore whether urbanization rate is a factor at the time of COVID-19 vaccination. Experience has shown that population density can greatly affect the spread of infectious diseases. Compared with rural areas, cities, especially megacities, are more likely to exacerbate the epidemic of infectious diseases [9]. The severity of the outbreak can make people more aware of the infection and willing to get vaccinated [10]. There is also a higher density of hospitals and clinics in cities, so the rate of urbanization has an impact on COVID-19 vaccination.

The Human Development Index (HDI) was created by the United Nations (UNDP) to measure the level of development of countries and regions. Since 1990, the HDI has been published annually, combining economic and social indicators with a greater emphasis on human development rather than just economic status. It uses some easily accessible data and scientific calculation methods to reflect the problems of different countries and regions comprehensively, stably, and objectively. It has three basic indicators: life expectancy, education level, quality of life. So, the human development index is also a factor worth to comparing.

2 Method

This study collected world COVID-19 vaccination progress [11] data from the Our World in Data GitHub repository from February 2nd to present. As a more reliable parameter to evaluate the current pandemic, we chose the rate of the total number of COVID-19 vaccinations administered per dose (per 100 people) rather than the daily vaccination

rate per million. Statistics on GDP per capita [12], expenditure on health (covered by the percentage of total GDP) [13], and enrollment in schools (per 100 people) [14], as well as the number of surgical professionals in each country (per 10,000 people) [15], were taken from the World Bank, while urbanization rate (covered by the ratio of urban population to total population) [16] is on Kaggle and HDI (Human Development Index) [17] is on UNPD Annual Report 2020. In addition, 50 countries were filtered based on the highest GDP [18] value. Furthermore, the time period in the research is restricted to Mar 1 to May 31 of 2021, as the rate started in some countries only in March of that year. Next, we removed Vietnam and Venezuela from our filtered data because both countries lacked data on the number of total COVID-19 vaccinations administered per dose and on the GDP per capita. In the case of countries that lack response values, we either arithmetically adjust the value (according to the progress of each country) or keep it constant for the next couple days (e.g., 0.1 on Mar 8th, then 0.1 until Mar 8th). And when there were no values available for health expenditures, school enrollments, or the number of surgical professionals in a country, we imputed these values using averages calculated by other countries. After filtration and imputation of missing values, there were 48 countries with values corresponding to 6 variables. In order to facilitate the analysis of the results of our model, we set the low, medium, and high divisions of the response variable according to the interquartile range on March 1 and May 31.

2.1 Statistical Analysis

Multiple linear regression models were employed to evaluate the associations of demographic characteristics and the rate of the total number of COVID-19 vaccinations administered per dose. First, we evaluated the interaction between GDP per capita and the rate of the total number of COVID-19 vaccinations administered per dose by adding a linear regression model. GDP per capita with a $P < 0.01$ for interaction with the rate of the total number of COVID-19 vaccinations administered per dose. The P value for this regression model is less than 0.01, while the t -statistic for GDP per capita is 5.374. In these circumstances, a conservative P value may not have a counterintuitive effect on the precautionary principle. Thus, a significance level of 0.01 can significantly reduce false claims of significance, and it is used for interaction analysis.

Second, we construct a multiple linear regression in the GDP per capita, expenditure on health, enrollment in schools, urbanization rate, HDI and the number of surgical professionals in each country with the rate of the total number of COVID-19 vaccinations administered per dose. GDP per capita with a significant level with 0.05 for interaction with the rate of the total number of COVID-19 vaccinations administered per dose, while the number of surgical professionals in each country presents a significant level with 0.01. The rest variables with a 0.1 significance level as well as the intercept of the model. The P value for the regression model is less than 0.01. The 95% confidence interval for these demographic characteristics were calculated. We used the VIF (Variance Inflation Factor) test to determine the correlation of these demographic indicators.

In this study, we used a significance level of 0.01 for all statistical inferences other than interactions. The study includes only two-sided P values. All analyses were performed using R (Version 1.3.1073© 2009–2020 RStudio).

3 Results

Analysis was carried out on total vaccination rate (by dose) from the beginning of the epidemic to 31 May 2021 in 48 countries as well as with other related indicators which are GDP per capita, Specialist surgical workforce per 100000 population, School enrollment in tertiary level (% gross), HDI (Human development index), Current expenditure on health (% of GDP), Urban population (%).

In order to find out whether these indicators have an impact on the vaccination rate, we use a multiple linear regression model to explain and check their correlation. The residues are the difference in actual values of the dependent variable and its predicted values predicted from predictor variables. After testing various combinations of these groups, we did not find a variable that was significantly related to the vaccination rate.

Then we do stepwise to find variables that can explain this model. As a result, we selected that Specialist surgical workforce per 100000 population and GDP per capita can explain the model mostly, compared to other variables (Table 1). The GDP per capita and Specialist surgical workforce per 100000 population are significant at the level of 0.001. And adjust r is 0.4751 (Table 1).

Table 1. Analysis of linear regression

	Estimate	Std. error	T value	Pr (> t)	Significance
Intercept	5.4638927	6.5568260	0.833	0.40907	
GDP (%)	0.0005856	0.0001665	3.517	0.00101	***
SUR (%)	0.3500122	0.1106510	3.163	0.00279	***
GDP (%) in I	0.0018916	0.0004423	4.277	0.000662	***

GDP (%): GDP per capita in 2019

SUR (%): Specialist surgical workforce per 100000 population

GDP (%) in I: Region I includes countries where vaccination rates and per capita GDP are below the average value

Signif. Codes: 0 '***', 0.001 '**', 0.1 '*'

Further, GDP per capita is a more common indicator than Specialist surgical workforce per 100000 population. And many previous studies have shown that GDP per capita has a significant correlation with mortality and health care, so we choose GDP per capita for further exploration. To explore the dichotomy of rich and poor countries in relation to Total vaccination rate (by dose), we consider dividing the scatter plot of vaccination rate and GDP per capita into 4 part, based on the average value of GDP per capita and the average value of total vaccinations per hundred (vaccination by dose), to analyse separately (Fig. 1).

Roughly, most points show a general trend of higher GDP with higher vaccination rate.

Reading into the I section. It includes countries which have low GDP and low Total vaccination rate. The scatter plot shows that there is a linear relation between these two variables. Through the result of linear regression analysis, it shows that GDP per capita

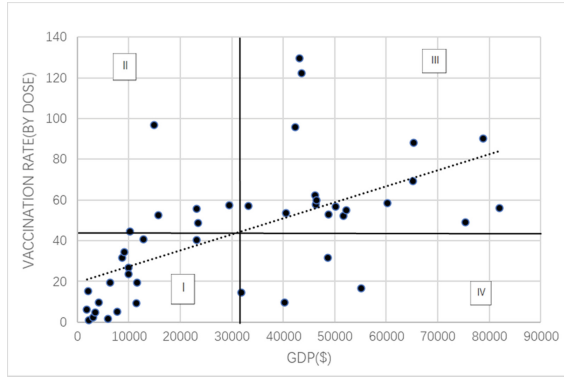


Fig. 1. This graph shows a scatter plot of GDP per capita and the rate of total vaccinations (vaccination rate by dose) in 48 major countries affected by the Covid-19 epidemic.

has significant influence on Total vaccinations per hundred in section I which T value is 2.477 (Table 1).

Reading into the II part. It includes countries which have low GDP but high Total vaccination rate. With the increase in GDP per capita of different countries, the vaccination rate of these countries fluctuates around 60% (except Chile).

Because of the mutant viruses, people from Chile pay more attention to vaccination. So that's why Chile has high vaccination rate.

Reading into the III part. It includes countries which have high GDP and high Total vaccination rate. As the GDP per capita gets higher, the vaccination rates in different countries are diverse. It can be roughly seen that there are more than 60% of countries, regardless of whether the GDP is high or not, the vaccination rate is always maintained at around 60%. The vaccination rate in the United States, the United Kingdom, and Ireland are around 90%. Two Middle Eastern countries, Israel and United Arab Emirates, the vaccination have exceeded 120%.

Reading into the IV part. It includes countries which have high GDP but low total vaccination rate. These 4 countries or region which urbanization rate are much higher than the world average urbanization rate (55%) is all island topography, and their cities are highly clustered near the port.

4 Discussion

We selected the top 50 countries [19] which most affected by the epidemic through the indicators of GDP (Total), and then analysed the correlation between vaccination rates and per capita GDP in different countries. At last, here are Some simple descriptive explanations and discussions for each Section.

For these countries whose GDP is less than US\$ 13,000. They are still the world's major economies. These countries participate in the global commercial activities and transportations. Compared to other poorer countries, they are still deeply affected by the epidemic. For these countries, the main factor affecting their vaccination is GDP per capita.

When GDP is greater than US\$ 13,000 which are richer countries. In this section, most countries have total vaccination rates between 50%–60%. The analysis of variance found that GDP has no significant impact on the vaccination rate.

Then we do LSD analysis, the grouping is the result after calculating their differences. This further observation revealed that these countries with similar Total vaccination rates have similar HDI indexes (Fig. 2).

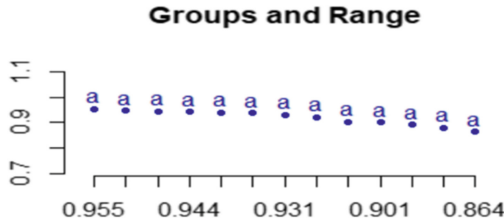


Fig. 2. Least Significant Difference (LSD). Each dot represents a country whose Total vaccination rate is around 60%. The ordinate is the value of HD and the abscissa is the different inoculation rate.

Why many wealthy Middle Eastern countries have high vaccination. Here are three main reasons. Firstly, in these Middle Eastern countries, the data on the vaccination rate with a relatively small population will increase more rapidly. And also, they do vaccination earlier. Secondly, these countries have a small land area. From December (last year) to March (this year), the weather in the Middle East is mild, so it is easier for people, especially the elderly, to reach vaccination sites. Thirdly. These countries are traditional countries, and the public opinion environment is very different from those western country, and national leaders are more appealing. On the other hand, the public opinion environment of these three countries, United States United Kingdom Ireland, is similar, and the time of starting vaccination is also close. So, they have close Total vaccination rate (by dose) which around 90%.

Why these island countries with large urban populations have high GDP, but low vaccination rates. Here are three main reasons. These island countries with relatively large urban populations have high GDPs but low vaccination rates. Firstly, the urban population is large, but the average urban human resources are low. For example, Japan [20] has gradually allowed dentists across the country to enter newly expanded vaccination sites for services. Secondly, it takes more than 20 min for one person to ask for a doctor’s consultation and vaccination on average, the urban population is densely populated, which will cause serious queuing problems, and the appointment procedure will be more complicated, which will further trigger people’s reluctance to vaccinate. Thirdly, as the urban people has more information resources, everyone’s ideas will be more diverse, and there will be more cautious and unwilling psychology.

5 Conclusion

As COVID-19 is raging around the world, vaccines have become the most effective means to combat the global epidemic. It is essential to understand how COVID-19 vaccination

rates are influenced by different countries' demographic character. By building the statistical model between the demographic feature and covid vaccination rate, this study established that different countries' demographic traits does indeed have a substantial impact on the rate of coronavirus vaccine. Specialist surgical workforce per 100000 population, GDP per capita, and total GDP can mostly explain our multiple linear regression model. However, considering the different institutional backgrounds and different public opinion environments, the vaccination rate in some countries does not correspond to the value predicted in our model and the above demographic characteristics will not affect the country's vaccination rate. This suggests that, while demographic traits do impact the vaccination rate of COVID, it is also crucial to consider the different consensus of countries as well as the distinct government system backgrounds. Feature studies into COVID vaccination rate and other virus vaccine related should focus on establishing a model that can observe the impact of different public opinion backgrounds and national systems on the virus vaccine situation, or to understand more clearly the combination of public opinion background, national demographic characteristics, and the virus vaccine situation under the national system.

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Factors Affecting the Change of the Exchange Rate of Vietnam Dong

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Abstract. The exchange rate is an important price for a country in its participation in the global market. It affects international trade and cross-border capital flows, which in turn has an impact on domestic investment and consumption, and plays an extremely important role in the country's economic development. This paper first analyzes the changes of the exchange rate of the Vietnamese dong from 2005 to 2020, and then analyzes various factors that affect the change of the exchange rate of the Vietnamese dong from a theoretical perspective, finally, it establishes a regression model from the empirical level to study the domestic and foreign factors that affect the exchange rate of the Vietnamese dong. It analyzes full samples and sub-samples in an empirical analysis. On that basis, it explores what way to maintain a stable exchange rate is conducive to promoting steady economic growth, and puts forward relevant policy recommendations.

Keywords: Vietnamese dong · Exchange rate · Money supply · Foreign exchange reserve · Influencing factors

1 Introduction

The exchange rate is an important price for a country in its participation in the global market. It affects international trade and cross-border capital flows, which in turn has an impact on domestic investment and consumption, and plays an extremely important role in the country's economic development. In the world, there are obvious differences in the exchange rate systems and formation mechanisms of exchange rate in countries with different levels of economic development. The foreign exchange market and capital market in developed countries are relatively complete, and their real-time monitoring and management of exchange rates are more effective. Faced with the negative impact of the exchange rate, they can buffer in time to avoid the collapse of the domestic economy caused by large fluctuations in the exchange rate. As a developing country, Vietnam's foreign exchange market and currency market are not well developed, exchange rate fluctuations are relatively frequent, financial derivatives and financial innovation methods are few, and management tools of exchange rate are relatively limited [1]; On the other hand, with the continuous reform and development of Vietnam's economic policies, especially after Vietnam's accession to the World Trade Organization in 2007, its participation in economic globalization has been accelerating. Vietnam's economic

growth is relatively rapid, and accordingly, the foreign exchange market and exchange rate are more susceptible to external economic shocks [10].

Vietnam has also been constantly reforming its exchange rate system, and the formation and influencing factors of the exchange rate are in constant development and change. The ways in which the Vietnamese economy and the international market affect the exchange rate of the Vietnamese Dong need to be further clarified, especially whether Vietnam's fragile foreign exchange market can withstand the impact of international currency shocks, and how exchange rate management policies should be implemented in response to these features. Therefore, the research in this paper has important practical significance. The analysis of Vietnam's exchange rate changes and the study of its influencing factors are a very meaningful topic of research, which is very important to Vietnam's trade balance and economic development. Discussing how to maintain a stable exchange rate on that basis is conducive to promoting stable economic growth. This paper puts forward relevant policy recommendations.

2 A Theoretical Analysis of the Exchange Rate Changes of the Vietnamese Dong and the Influencing Factors

2.1 Trends in the Exchange Rate of the Vietnamese Dong

Figure 1 shows the changes in the exchange rate of the Vietnamese Dong from 2005 to 2020. The exchange rate is measured by the number of Vietnamese dong that can be exchanged for a unit of U.S. dollar, and exchange rate changes are closely related to the exchange rate system and exchange rate policies implemented by Vietnam [9, 11]. It can be seen that the Vietnamese Dong has been under a depreciation trend, but the exchange rate has shown different characteristics at different stages. From 2005 to 2007, the exchange rate of the Vietnamese dong was relatively stable with relatively small fluctuations; from 2007 to 2011, the exchange rate of the Vietnamese dong rose rapidly, and the rate of currency depreciation continued to accelerate; from 2011 to 2020, the exchange rate of the Vietnamese dong continued to remain stable.

Before the 2007 global financial crisis, Vietnam implemented a system of "fixed" pegged floating exchange rate [2]. The official exchange rate fluctuation range in the year was 1%, and the exchange rate of the Vietnamese dong was relatively stable, maintaining at the level of 16,000 VND/USD; From 2007 to 2011, affected by the financial crisis, the devaluation pressure of the Vietnamese dong increased a lot, and Vietnam implemented an "adjustable" pegged exchange rate system. The official exchange rate fluctuation range during the year was relaxed to 3%-5%. In 2011, the exchange rate reached 21,000 VND/USD; Since 2012, with the continuous growth of Vietnam's domestic economy and a better macroeconomic situation, the Vietnamese monetary authorities gradually tightened the range of exchange rate fluctuations, and the depreciation rate remained relatively stable. However, due to the interest rate hike of the FED, the Vietnamese Dong is still facing depreciation pressure, and there is little room for appreciation [3].

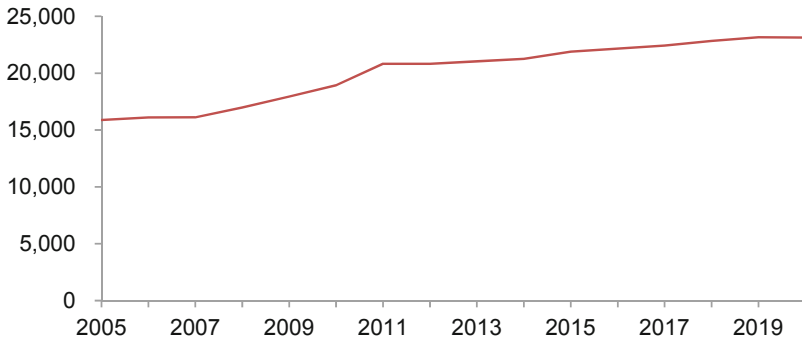


Fig. 1. Changes in the exchange rate of the Vietnamese Dong

2.2 Factors Influencing the Changes in the Exchange Rate of the Vietnamese Dong

The formation of the exchange rate is the result of the combined effects of multiple influencing factors [4]. Guo Yingying (2015) [20] constructed a Markov zoning conversion model to study the factors influencing the exchange rate of RMB. The results have shown that such long-term factors as national foreign exchange reserves, money supply and foreign trade environment will all affect the changes in exchange rates. From a short-term perspective, domestic interest rates, price levels, and changes in international market interest rates are the main factors influencing the exchange rate of a country. Li Yanfeng (2017) [21] established a simulation model of exchange rate overshooting to study the influencing factors behind the phenomenon of exchange rate overshooting. The results have shown that the interest rate hike policy of the FED, the domestic and foreign RMB exchange rate markets, market depreciation expectations, and the segmentation of the RMB pegged exchange rate system are all major factors affecting the fluctuations of the RMB exchange rate. The exchange rate market, market depreciation expectations, and the division by the system of crawling peg of RMB's exchange rate. The research conducted by Li Jianwei (2017) [22] found that the direct cause of the rapid depreciation of the RMB exchange rate was the massive outflow of hot money after the new round of exchange rate reform. The devaluation of the RMB is essentially a reasonable correction of itself.

Therefore, the factors affecting the exchange rate of the Vietnamese Dong can be roughly divided into two aspects, domestic and foreign. Domestic factors include gross domestic product, money supply, foreign exchange reserves, inflation rate, import and export balance, etc.; In terms of foreign factors, the United States is the world's largest country and has a dominant position in economic globalization and the world market. U.S. economic policies have obvious spillover effects on the exchange rates of other countries. Therefore, in terms of foreign influencing factors, this study mainly considers the impact of U.S. interest rates and U.S. inflation rates on the Vietnamese Dong. The next part will specifically analyze the impact of these factors on the exchange rate.

In terms of domestic influencing factors, the first factor is GDP. The growth of GDP increases the wealth of domestic residents, increases import demand, and increases

demand for foreign currencies, thus resulting in a depreciation of the domestic currency and an increase in the exchange rate; Liu Ya (2018) [19] studied the macroeconomic factors affecting the RMB exchange rate and found that GDP has a significant impact on the exchange rate. The second factor is the money supply. When the country implements a loose monetary policy, the money supply of the local currency increases, the value of the local currency depreciates, and the exchange rate rises; Pham (2019) [7] and Qian Qianqian (2011) [16] found that money supply and monetary policy were important factors affecting currency exchange rates. The third factor is foreign exchange reserves. Foreign exchange reserves reflect the country's international purchasing power. The more foreign exchange reserves, the stronger a country's international purchasing power. The local currency will thus appreciate and the exchange rate will thus fall; Zhang Li (2010) [15] and Qian Qianqian (2011) [16] analyzed the RMB exchange rate and found that foreign exchange reserves were an important factor affecting the RMB exchange rate. The fourth factor is the inflation rate. When inflation occurs in a country, the price of domestic goods relative to foreign goods rises, the international attractiveness of domestic goods decreases, the local currency depreciates, and the exchange rate rises; Choudhri and Hakura (2006) [17], Nogueira and Leon-Ledesma (2007) [18] analyzed the relationship between exchange rates and prices in 69 countries, and found that a country's inflation and exchange rate were closely related. The fifth factor is the difference between imports and exports. The import and export balance is an important part of the balance of payments and has a relatively direct impact on the exchange rate. Based on the data of 14 developing countries in Asia, Dumrongritikul and Anderson (2016) [12] studied the factors influencing exchange rate; Man (2018) [5], Phan and Jeong (2015) [8] specifically analyzed the impact of the trade balance on the exchange rate of the Vietnamese Dong. Both studies have found that the higher the import and export balance, the greater the net export, the more goods exported by the country, the less of the domestic currency, thus leading to the appreciation of the local currency and the decline of the exchange rate.

In terms of foreign influencing factors, since the U.S. dollar is now the world currency and occupies a dominating position in the international market of foreign exchange settlement, the economic conditions of the United States will also affect the changes of exchange rate of the Vietnamese Dong. This paper mainly analyzes two factors. One is the level of interest rates in the United States. The higher the interest rate in the United States, the more attractive it is to international investors in the international market. Demand for the US Dollar increases, the US Dollar appreciates, and the Vietnamese Dong depreciates, and the exchange rate of the Vietnamese Dong rises; Thomas (2012) [14] studied the exchange rates of currencies of sub-Saharan African countries against the US dollar and found that the exchange rates of various countries were significantly affected by the fluctuations in the interest rates of the United States. The second is the level of inflation in the United States. The higher the inflation in the United States, the more expensive the U.S. goods, the less Vietnam imports from the U.S., and the less demand for U.S. dollars, the demand for the Vietnamese Dong rises, leading to the appreciation of the Vietnamese Dong, and the decline of the exchange rate of the Vietnamese Dong; Fabio (2005) [13] used the VAR model to analyze the impact of US

inflation on the exchange rate of Latin America, and found that US inflation had an obvious impact on the currency and macroeconomics of Latin American countries.

3 An Empirical Analysis of the Factors Affecting the Exchange Rate of the Vietnamese Dong

After the theoretical analysis of the previous part, this part establishes a measurement regression model to conduct an empirical study, with the exchange rate of the US Dollar to Vietnamese Dong as the explained variable. The explanatory variables include domestic variables and foreign variables. Among them, domestic variables include gross domestic product, money supply, foreign exchange reserves, inflation rate, import and export balance, etc. The money supply uses M2 data. The inflation rate is measured using the “previous year = 100” consumer price index data. The import and export balance is equal to the export value minus the import value, that is, the net export value. Since Vietnam’s exports are smaller than imports, net exports are negative most of the time. Foreign variables include the interest rate in the United States and the inflation rate in the United States. Among them, the interest rate in the United States adopts the federal funds rate. The time interval of the data is 2005–2020, and the data sources are Wind database and the official website of the World Bank.

It can be seen from Fig. 1 that during the sample period, the changes in the exchange rate of the Vietnamese Dong have obvious segmented characteristics. Taking 2011 as the segmenting point, before 2011, the exchange rate changed drastically, but after 2011, the exchange rate changed smoothly. Therefore, in the empirical analysis of this paper, in addition to the analysis of the full-sample time interval, it also performs segmented regression based on time, including two sub-sample regressions in 2005–2011 and 2011–2020. This paper establishes multiple linear regression models, as shown in Eqs. (1)–(2):

$$E = \beta_0 + \beta_1 GDP + \beta_2 M_2 + \beta_3 FER + \beta_4 CPI + \beta_5 NET + \mu \quad (1)$$

$$E = \gamma_0 + \gamma_1 GDP + \gamma_2 M_2 + \gamma_3 Rate_{USA} + \gamma_4 CPI_{USA} + \mu \quad (2)$$

Because too many explanatory variables can lead to the problem of multicollinearity, this paper uses two regression models to study the factors influencing the exchange rate of Vietnamese Dong. Among them, Eq. (1) mainly studies the influence of domestic factors on the exchange rate of the Vietnamese Dong, and Eq. (2) mainly studies the influence of foreign factors on the Vietnamese Dong. E represents the exchange rate of the U.S. Dollar to the Vietnamese Dong; GDP represents the gross domestic product of Vietnam; M_2 represents the money supply of the Vietnamese Dong; FER represents foreign exchange reserves; CPI represents consumer price index, that is, the inflation rate; NET represents net exports; $Rate_{USA}$ represents the interest rate of the United States; CPI_{USA} represents the inflation rate of the United States. β_i and γ_i are the coefficients of the corresponding variables, and μ is the random fluctuation term. The descriptive statistics of the variables are shown in Table 1.

Table 1. Descriptive statistics of variables

Variable	Unit	Measure	Mean value	Standard error	Maximum value	Minimum value
E	VND/USD	16	20091.43	669.42	23155	15875
GDP	Billion VND	16	2589664.75	181812.26	3847182	1588646
M2	Billion VND	16	4643870.45	847266.16	11146949.09	648573.73
FER	100 Million USD	16	33.7742	6.1169	94.8336	9.0505
CPI	First half of year = 100	16	107.3731	1.4778	122.97	100.63
NET	Million USD	16	-2316.59	2486.7516	19954.4	-18028.7
Rate _{USA}	Percentage	16	2.5609	0.2888	5.2234	1.1373
CPI _{USA}	Percentage	16	1.9941	0.2881	3.8391	-0.3555

Before regression, it is necessary to perform unit root tests on all variables to avoid spurious regression. Since all variables are not stable in the level value, after ADF test, all data are stable in the case of first-order difference. Therefore, all regression samples in this paper are data with first-order lag. The results of the unit root test of the variables are as shown in Table 2. It can be seen that M2(-1), FER(-1), CPI(-1), Rate_{USA}(-1) and CPI_{USA}(-1) are stable at the 5% significance level, and GDP(-1) and NET(-1) are stable at the 10% significance level. The following regression can be performed.

Table 2. Results of the unit root test of variables

Variable	ADF test value	1% critical value	5% critical value	10% critical value	P Value
GDP(-1)	-2.7503	-4.0044	-3.0988	-2.6904	0.0905
M2(-1)	-4.3721	-4.8864	-3.8289	-3.3629	0.0218
FER(-1)	-3.5240	-4.2970	-3.2126	-2.7476	0.0314
CPI(-1)	-3.9180	-4.1219	-3.1449	-2.7137	0.0140
NET(-1)	-3.6643	-4.8000	-3.7911	-3.3422	0.0611
Rate _{USA} (-1)	-3.8348	-4.8000	-3.7911	-3.3422	0.0467
CPI _{USA} (-1)	-4.0099	-4.8864	-3.8289	-3.3629	0.0380

3.1 Domestic Factors Affecting the Exchange Rate of the Vietnamese Dong

This paper first analyzes the domestic factors influencing the exchange rate of Vietnamese Dong based on the full sample data, and the regression results are as shown in Table 3. It can be seen that gross domestic product, money supply, foreign exchange reserves and net exports have a significant impact on the exchange rate of the Vietnamese Dong, while the inflation rate has an insignificant effect on the exchange rate of the Vietnamese Dong. Both GDP and money supply have a significant positive impact on the exchange rate of the Vietnamese dong, and the impact coefficient is significant at the 1% significance level, which is in line with theoretical expectations. Faster domestic economic growth, or more money supply can both cause the depreciation of the Vietnamese Dong, which will increase its exchange rate; Both foreign exchange reserves and net exports have a significant negative impact on the exchange rate of the Vietnamese Dong, and the impact coefficient is significant at the 1% significance level, which is in line with theoretical expectations. Larger scale of foreign exchange reserves or higher net exports can both cause the appreciation of the Vietnamese Dong, and thus the exchange rate of the Vietnamese Dong will fall.

Table 3. Regression results of full samples of domestic influencing factors on the exchange rate of Vietnam Dong

Variable	Coefficient	Standard error	T statistic	P value
GDP(-1)	0.0141	0.0016	8.5642	0.0000
M2(-1)	0.0020	0.0004	4.9415	0.0008
FER(-1)	-66.9483	11.7724	-5.6868	0.0003
CPI(-1)	26.1443	19.4898	1.3414	0.2126
NET(-1)	-0.0778	0.0174	-4.4671	0.0016
Constant	-7373.903	4745.299	0.9449	0.3670

Next, this paper conducts a segmented time regression of the exchange rate of Vietnamese Dong. Table 4 shows the regression results of domestic factors influencing exchange rate of the Vietnamese Dong from 2005 to 2011. The results are consistent with the results of full-sample regression. During this time period, both the gross domestic product and the money supply have a significant positive impact on the exchange rate of the Vietnamese Dong, and both foreign exchange reserves and net exports have a significant negative impact on the exchange rate of the Vietnamese Dong.

Table 5 shows the regression results of domestic factors affecting the exchange rate of the Vietnamese Dong from 2011 to 2020. During this time period, the effects of gross domestic product, money supply, inflation rate, foreign exchange reserves and net exports on the exchange rate of the Vietnamese Dong were not significant. Combining the results of the full sample and sub-sample regression, it can be found that domestic influencing factors mainly played a role in 2005–2011. During this time period, their impact on the exchange rate of the Vietnamese Dong was significant. In 2011–2020, domestic factors

Table 4. Regression results of domestic factors affecting the exchange rate of the Vietnamese Dong from 2005 to 2011

Variable	Coefficient	Standard error	T statistic	P value
GDP(-1)	0.0087	0.0028	3.1088	0.0111
M2(-1)	0.0011	0.0006	1.9427	0.0807
Rate _{USA} (-1)	538.1449	137.2436	3.9210	0.0029
CPI _{USA} (-1)	-24.5637	112.7636	-0.2178	0.8319
Constant	4483.965	2443.349	-3.0179	0.0145

did not have a significant impact on the exchange rate of the Vietnamese Dong, which is closely related to the deepening of Vietnam's globalization.

Table 5. Regression results of domestic factors affecting the exchange rate of the Vietnamese Dong from 2011 to 2020

Variable	Coefficient	Standard error	T statistic	P value
GDP(-1)	0.0084	0.0003	24.566	0.0259
M2(-1)	0.0010	0.0001	9.8662	0.0643
FER(-1)	-131.3718	3.8520	-34.103	0.0187
NET(-1)	-0.0850	0.0046	-18.173	0.0350
Constant	4005.431	465.1792	8.6105	0.0736

3.2 Foreign Factors Influencing the Exchange Rate of Vietnamese Dong

First, this paper analyzes the foreign factors influencing the exchange rate of Vietnamese Dong based on full sample data. As shown in Table 6, the U.S. interest rate has a significant effect on the exchange rate of the Vietnamese dong, and the direction of the impact is also consistent with theoretical expectations. As for the impact of the U.S. inflation rate on the exchange rate of the Vietnamese Dong, although the coefficient sign is consistent with expectations, the result is not significant. The interest rate of the United States has a significant positive impact on the exchange rate of the Vietnamese dong. The higher the interest rate of the United States, the higher the value of U.S. Dollar and the lower the value of the Vietnamese Dong, resulting in a decline in the exchange rate of the Vietnamese Dong.

Next, this paper conducts a piecewise regression of the exchange rate of Vietnamese Dong. Table 7 shows the regression results of the foreign influencing factors of the exchange rate of the Vietnamese Dong from 2005 to 2011. U.S. interest rates and inflation rates had insignificant effects on the exchange rate of the Vietnamese Dong, reflecting the limited participation of Vietnam in internationalization from 2005 to 2011, and the US

Table 6. Results of full sample regression of foreign factors influencing the exchange rate of Vietnam Dong

Variable	Coefficient	Standard error	T statistic	P value
GDP(-1)	0.0114	0.0011	9.5907	0.0107
M2(-1)	0.0021	0.0009	2.4084	0.1377
Rate _{USA} (-1)	344.9846	268.4740	1.2849	0.3275
CPI _{USA} (-1)	-26.492	214.0819	-0.1237	0.9128

economy had little influence on the exchange rate of the Vietnamese Dong. At this stage, the exchange rate of the Vietnamese Dong was mainly affected by domestic factors.

Table 7. Regression results of foreign factors influencing the exchange rate of Vietnam Dong from 2005 to 2011

Variable	Coefficient	Standard error	T statistic	P value
GDP(-1)	0.0033	0.0016	2.0168	0.1371
M2(-1)	0.0002	0.0003	0.6278	0.5746
FER(-1)	-10.1451	7.2685	-1.3957	0.2571
CPI(-1)	0.1737	8.8268	0.0196	0.9855
NET(-1)	-0.0166	0.0129	-1.2871	0.2884
Constant	13759.35	2516.319	5.4680	0.0120

Table 8 shows the regression results of foreign factors influencing the exchange rate of the Vietnamese Dong from 2011 to 2020. The U.S. interest rate and inflation rate had a significant impact on the exchange rate of the Vietnamese Dong, and the direction of the impact is in line with theoretical expectations. This reflects the increasing degree of Vietnam's participation in internationalization from 2011 to 2020. The exchange rate of the Vietnamese dong was increasingly influenced by foreign countries, while the degree of influence by domestic factors was lowering.

Combining the results of the full sample and sub-sample regressions, it can be found that foreign influencing factors mainly played a role in 2011–2020. During this time period, their influence on the exchange rate of the Vietnamese Dong was more significant, while in 2005–2011, the influence of foreign factors on the exchange rate of the Vietnamese Dong was not significant.

Table 8. Regression results of foreign factors influencing the exchange rate of the Vietnamese Dong from 2011 to 2020

Variable	Coefficient	Standard error	T statistic	P value
GDP(-1)	0.0036	0.0002	12.8539	0.0001
M2(-1)	131.7598	4.1535	31.7222	0.0000
RateUSA(-1)	730.7110	214.9559	3.3993	0.0193
CPIUSA(-1)	-705.4975	76.3214	-9.2437	0.0002

4 Conclusions and Recommendations

This paper first analyzes the trend of the exchange rate of the Vietnamese Dong from 2005 to 2020, then it analyzes various factors affecting the exchange rate of the Vietnamese Dong from the theoretical level, and it finally establishes a regression model from the empirical perspective to study the domestic and foreign factors affecting the exchange rate of the Vietnamese Dong. It analyzes the full sample and sub-samples in the empirical analysis, and draws the following conclusions: (1) The Vietnamese Dong has been under a trend of devaluation, but the exchange rate has different characteristics at different stages. Before the global financial crisis in 2007, Vietnam implemented a “fixed” pegged floating exchange rate system, and the exchange rate of the Vietnamese Dong was relatively stable; From 2007 to 2011, affected by the financial crisis, Vietnam implemented an “adjustable” pegged exchange rate system; Since 2012, the Vietnamese monetary authority gradually tightened the floating range of the exchange rate, and the rate of exchange rate depreciation has been relatively stable. (2) Generally speaking, the domestic inflation rate in Vietnam has no significant impact on the exchange rate of the Vietnamese dong, while the gross domestic product, money supply, foreign exchange reserves, import and export balance, U.S. interest rates and U.S. inflation rate all have a significant impact on the exchange rate of the Vietnamese dong. However, in different time periods, the order of the influencing factors is different. (3) Before 2011, the exchange rate of the Vietnamese Dong was mainly affected by domestic factors. Since 2011, as Vietnam’s connection with the global economy became closer, the exchange rate of the Vietnamese Dong is mainly affected by foreign factors.

Therefore, in order to maintain the stability of the exchange rate of the Vietnamese Dong, measures can be taken from the following two perspectives: In terms of domestic economic policies, the government should reasonably control the issuance of Vietnamese Dong and provide a stable currency supply; It should improve the management system of foreign exchange reserves, avoid the ups and downs of foreign exchange reserves, and maintain the stability of foreign exchange reserves; It should adjust the industrial structure, improve the structure of import and export trade, increase exports and trade surplus to stabilize the exchange rate. In terms of participation in the international market, it should adopt a more active exchange rate system, do well in exchange rate management, effectively respond to and hedge against short-term fluctuations in exchange rates, and stabilize the foreign exchange market.

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Machine Learning Based Quantitative Pricing for US Airbnb Renting Program

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Abstract. In this paper, price analysis and prediction are carried out for shared homes in the Boston area on Airbnb, and price performance is tested through the processing and analysis of platform data. Through the test, we found that not only the house itself and geographical location, but also the landlord's own situation, the landlord's attitude and the landlord's professionalism have a great impact on the price. In the end, we found that the model fits the data best in terms of the performance of gradient boosting, with Rmse at 169.53 and R2 at 0.26.

Keywords: Machine learning · Statistical modelling · Data mining · Airbnb · Pricing

1 Introduction

In recent years, with the rapid development of the global economy, the sharing economy has become an important means to stimulate economic development. The value of the share of the benefits create a match between consumers who have a particular resource (asset or skill) and those who need it at an acceptable transaction cost at a given time [1]. As far as the implementation costs are concerned, markets rely more on (but are not limited to) formal coercive means, while social relations on which the sharing economy depends mainly rely on informal execution mechanisms and social normative reciprocal mechanisms to solve the execution costs [2]. Shared home stays are part of the market for the sharing economy, with policies as loose as the sharing economy and more convenient facilities. In order to achieve the goal of rapid growth of the global economy, shared accommodation has become an effective measure to help people in poor areas develop their economy, improve their life quality and expand local tourism influence and income. As the widening gap between countries, the population is shifting to developed areas, and the land resources in developed areas become scarce, while large amounts of land in poor areas can not be exploited. The economic differences between developing and developed countries have increased, while most developing countries lack core competitiveness and their economic development potential lags far behind those of developed countries. The local landscape, which is different from that of other regions, has become one of the important approaches to develop local tourism. But traditional hotels not only fail to improve the experience for tourists, but also lack

more local cultural feelings. In order to improve the local economic development, such as the people of Qinling area, the old houses into new villas for tourists to live in. As a result, tourism has been boosted throughout the region, and local people have benefited from sharing homes. More reasonable pricing can attract more tourists. If the price is too high or too low, it can lead to an abnormal number of tourists, resulting in lower income or being out of pocket. At present, in many countries, there is a similar type of Airbnb online booking short-term rental platform, such as Ctrip and Piglets, which can make homestay reservations. Compared to traditional hotels, self-catering accommodation for guests and hosts have a better privacy protection. The provider of the property also does not need to be professional, which can't achieve the reuse of idle resources, not only to inject vitality to the market, but also to promote sustainable development.

Therefore, in order to promote the development of the shared economy, stimulate a new round of economic progress and achieve the goal of getting rid of poverty in China, we adopt the method of machine learning and built a model to obtain more accurate data for the pricing analysis of shared homestays.

We need to use several models for machine learning. For example, the Lasso method was first proposed by Robert Tibshiran in 1996 and published in the Journal of the Royal Statistical Society, one of the 'Big Four of Statistics' [3]. Although it has been more than two decades, it is still widely used and the methods developed by it are endless.

Because of the improved data acquisition ability, the data dimension is higher, and sometimes the number of features is higher than the number of data collected, which is also the main problem of high dimensional data at present - sparseness.

And because the accuracy is not high under the least squares and the variance is large (i.e. the data is too dispersed), it requires a high-precision and well-interpreted model to deal with this problem. Breiman pioneered the improvement of the least-squares method: non-negative garotte [4]

$$\begin{aligned} \beta &= \arg_{\beta} \min \sum_{i=1}^N (y_i - \beta_0 - \sum_{j=1}^p c_j x_{ij} \beta_j^{ols}) \\ &st. c_j \geq 0, \sum_{j=1}^p c_j \leq t\tau \end{aligned} \quad (1)$$

By shrinking factors and improving accuracy, it is easy to explain the model.

Frank J et al. propose to find a constant to constrain the parameter: the vanity L [5], which is the paradigm form of lasso regression when Q is 1. Using Modeling Lasso, the unimportant feature coefficient can be compressed to 0, which not only achieves the estimation of parameters, but also achieves the reduction of data dimension. Therefore, under the original linear model, the calculation of parameters can be added to the penalty, which can improve the accuracy of the model, and reduce the negative impact of overfitting.

$$Q(\beta) = \|y - x\beta\|^2 + \lambda \|\beta\|_1^2 \quad (2)$$

Ridge regression, which appeared earlier than Lasso, was the first method to solve overfitting under the least squares. Ridge regression, also known as 'Ridge Regression Estimation', is an improved method of least square estimation, which is suitable for the correlation between independent variables or the situation that some variables change too

little, that is, linear regression model Ridge regression shrinks the regression coefficient by adding penalty to capacity [6]. Unlike Lasso, Lasso can crush some features to 0, thus selecting the main features. Ridge regression plays a role similar to Lasso in processing fitting. Lasso reduces the coefficient of OLS by a fixed proportion, with a slope equal to that of OLS. However, ridge regression has been reduced relatively to the coefficient of OLS, and the slope will decrease to a certain extent.

$$Q(\beta) = \|y - x\beta\|^2 + \lambda\|\beta\|_2^2 \quad (3)$$

The variable is the parameter for controlling contraction: the larger the variable is, the more the coefficient tends to 0.

Elastic networks are the methods proposed by Hui Zhou to improve lasso regression [7, 8]. Because of the disadvantages of linear regression, penalties can improve accuracy in many cases. Hoerl, A.E. Kennard, R. The ridge-back approach proposed is a method of continuous reduction [9]. Tibshirani, R. A lasso regression method is proposed, which is the least-square-second regression by adding L1 penalty to the regression coefficient [3]. At the same time, Fu, W compares lasso regression, ridge regression, and bridge regression [10]. He finds that each of these three algorithms can not be replaced by the remaining two. Lasso regression performs well in practical applications, but to some extent there are some drawbacks. For example, Segal, M., Dahlquist, K.-Conklin, B. Studies have found that the accuracy of the model is affected when the amount of data is much larger than the feature dimension [11]. The elastic network is the combination of ridge regression and Lasso. The L2 regular item for ridge regression does not limit the number of features, but it can effectively prevent overfitting of a feature. The L1 regular item of Lasso limits the number of features. It is hoped that the filtered variables will gain higher weight. Therefore, elastic networks can filter and regularize variables at the same time.

$$Q(\beta) = \alpha\|\beta\|^2 + (1 - \alpha)\|\beta\|_1$$

$$\alpha = \frac{\lambda_2}{\lambda_2 + \lambda_1} \quad (4)$$

When α is 1, it is a ridge regression, and when α is 0, it is a lasso regression. Random forest is proposed by LEO B [12], by not putting back in the original sample set N to select b subdetection data set. b Subdata sets are forested trees, with n samples in each dataset, m randomly selected for gini impureness test ($m \ll n$), and selected the most categorical variable as the classification threshold. Random forest further introduces attribute selection in decision tree selection on the basis of building bagging integration based on decision tree. The deterministic size of classification categories is determined by judging the size of information entropy. The larger the information gain in the decision tree, the better the feature selection is. Random forests provide better accuracy, better performance when working with high-dimensional data, and higher unbiased estimates when generated internally.

KNN algorithm is a simple classification algorithm and a supervised machine learning algorithm. KNN algorithm is an instance-based text classification algorithm [13]. First, for a test text, it can calculate the text similarity of each text in the training sample

set to find the most similar training text based on the text similarity. Then, on this basis, each text class is scored, which is the sum of the similarity of the document between the text that belongs to that class in the training document and the test text. Once the scores of the class to which the text belongs are counted, they are sorted by points. The core of the k nearest neighbor is to select k values, estimate that the desired feature belongs to a certain category, and divide all features. Similarity is measured by the distance between the test and the sample set. The general distance is European, calculating the distance between the prediction point and all points, sorting it, and finally seeing which category is the most. European distance expression:

$$d(x, y) = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + (x_3 - y_3)^2 + \cdots + (x_n - y_n)^2} \quad (5)$$

As an important integrated learning method [14], the idea of boosting algorithm originated from the PAC learning model proposed by Valiant, which can improve the weak learning machine with prediction accuracy only slightly higher than random guessing and change it into a strong learning machine with high prediction accuracy [15]. In 2001, Friedman proposed the gradient Boosting algorithm (gradient Boosting, GB), which, when building a model, reduces the residuals of the previous model in the direction of the gradient, thus allowing the strong learner to optimize the loss function to a minimal degree [16]. Gradient Boosting uses negative gradients as an indicator of the errors made by the previous base learner, and corrects the mistakes made in the previous round by fitting the negative gradient in the next round. Then boosting is more focused on the sample of previous learning errors. The negative gradient is based on the function space gradient drop method. The function space gradient drop method is a classic method to optimize the loss function, and its minimized parameters.

$$\theta = \theta - \alpha \frac{\partial}{\partial \theta} L(\theta) \quad (6)$$

Shared homestay is a new type of accommodation based on a platform. It is a tri-lateral relation between the client and the landlord. Compared with traditional hotels, the autonomy of the landlord and the choice of customers are more diverse. Shared homestays are more competitive and have a beautiful industry prospect. According to previous studies, most of them are aimed at the influencing factors of housing pricing, the volatility strategy of housing prices, and the relations between the reasonableness of housing prices and the popularity of housing in order to seek better pricing strategies.

According to the research of Wu Lihua and others [17], we collect data on Airbnb guests in Beijing, divide the data into regions, and select five regions with as perfect samples as possible. The reasonableness of housing prices is divided by the standard deviation, and the standard deviation and mathematical expectation are used as the standard for dividing housing popularity. Finally, the chi-square test is used to verify the correlation between the two. It is concluded that the more reasonable the house price is, the higher the popularity of the house is.

On the one hand, some scholars will study the influencing factors that affect house pricing. Among them, Yang Shuai et al.'s research is more inclined to the moderating effect of national values on the sharing economy [18]. It is concluded that under different values, house pricing will be positively affected to varying degrees. The research of

Wang Chunying and Chen Hongmin is the influencing factors that tend to share homestays [19]. Based on the platform data of Xiaozhu Short-term Rental, the quantitative analysis is carried out with different influencing factors different from traditional hotels, and the quantile and OLS methods are mainly adopted. They select ten sets of data, nine influencing factors, and classify the variables into three categories. From the characteristics of houses, the location of houses and supporting facilities, the characteristics of the landlord and the comments of the guests, this paper analyzes the factors affecting the price of the house. Some scholars have studied the price fluctuation strategy of house prices. For example, Rome et al. researched the interaction between shared homestays and traditional hotels based on data from the Airbnb platform [20]. The author divided the hotels into low-end and high-end hotels. Research shows that in areas with a high penetration rate of shared homestays, that is, areas where shared homestays account for a relatively high proportion, low-end hotels will adopt low-price strategies when setting prices, but only on weekends. And high-end hotels will sell rooms at high prices anytime. In Gibbs' research, it is concluded that compared with traditional hotels, the pricing of shared homestays on Airbnb will hardly change, but those who have multiple homes and pursue high-end services will adjust their prices according to the festival [21].

Based on these previous studies, we found that there is a certain lack of direction to help landlords make reasonable prices. We can help landlords meet the needs and benefits of bilateralization through the influencing factors of housing prices.

2 Data Preprocessing and Feature Engineering

The data comes from <https://www.kaggle.com/airbnb/boston?select=listings.csv>.

The data is a table of shared home ownership and prices in the Boston area on Airbnb [22]. There are 3,585 rows and 95 columns of data. Price is the dependent variable of the study and the remainder is the argument. Of these, 41 variables have missing values, 4 have neighbourhood_group_cleansed, has_availability, license, jurisdiction_name have no information. Since some of the data in the argument has too little effect on the results, we will do further filtering.

Considering that the quantitative analysis of machine learning has already been done and the variables of the URL type have little influence on the results, these columns are deleted. Indexing id as a column, scrape_id, last_scrape, requires_license and experiences_offered variables are consistent and therefore have no reference to the results. The summary, space, description, neighborhood_overview, notes, transit, access, interaction, house_rules are used as variable parameters of non-quantitative analysis. Host_id reacts to the same information as host_name and has less impact on the results, so both are deleted. Host_since belongs to the object type variable. We will clean the data first, and separate the variable according to '-', and divide them into three columns, year, month, day. For host-location, we filter keywords and present the same neighborhoods, cities, and countries. For host_response_time, we use Label Encoder to filter the variables, which are 0 in 'within a few hours', 'within a day' as the number 1, 'within a day' as the number 2, 'a few days or more' as the number 3. Given the general similarity in landlord response times, we consider using majority to fill in the missing values. Similarly, there are general similarities in host_acceptance_rate and

host_response_rate, and they are filled in in the same number of people. At the same time, because these two columns are percentages, the percent sign is removed and filled. In host_is_superhost, 0 for false, 1 for true. Host_has_profile_pic, 0 for true, 1 for false. Host_identity_verified, 0 for false, 1 for true. Is_location_exact, 0 for false, 1 for true. Instantbookable, 0 for false, 1 for true. Require_guest_profile_picture, 0 for false, 1 for true. Require_guest_phone_verification, 0 for false, 1 for true. Host_neighbourhood is very similar to host_location, so we don't quantify the column. For host_verifications and amenities columns, we split them according to ',' and then calculate the number of elements for each variable in the column to reorganize the classification. Zip-code can reflect the information in street, neighborhood, neighborhood_cleansed, city, state, market, smart_location, country_code, country, so we only use zip-code to describe the performance of the specific location information of the house. For property_type, we also use Label Encoder to 'House', 'Apartment', 'Condominium', 'Villa', 'Bed and Breakfast', 'Townhouse', 'Entire Floor', 'Loft', 'Guesthouse', 'Boat', 'Dorm', 'Other', 'Camper/RV' is replaced by 0,1,2,3,4,5,6,7,8,9,10,11,12, and missing values are filled in in large numbers. Room_type will be 'All home/apt', 'Private room', 'Shared room' with 0,1,2 instead. Bed_type will be replaced by 'Real Bed', 'Pull-out Sofa', 'Futon', 'Airbed', 'Couch' with 0, 1, 2, 3, 4. Because the categories between these variables are related to each other, we choose Label Encoder. We use the price column as a dependent variable. And for machine learning, we remove the dollar sign, as well as the thousands and hundreds of ','. Weekly_price and monthly_price are more than half missing in order to ensure the reliability of the data, and there is a strong correlation between these two arguments and the dependent variables, so we remove these two columns. Security_deposit, clean_fee and extra_people because of the particularity of the three sets of variables. If there is a lack, it normally does not charge the relevant fees. So we will be the missing value of these three sets of variables with 0 instead, and we want to do some data cleaning work, the dollar sign removed. Calendar_update only reflects the time limit of the data and does not have an effective effect on prices. So we do not use the column, first_review and last_review. In order to reduce the data dimension, we will subtract the two columns, with the least amount of data to reflect more information and make up a new column of comment time differences. We observed that there was a part of the data in the number_of_review that was 0, and we could tell that there were no valid comments under these houses. When we rated the comments, we replaced the missing variables with outliers that were not within the scoring range. And in review_per_months, the missing value is replaced by 0 because some of the comments are not recorded.

3 EDA

In order to visualize the data, we take the number of dependent variables when working with box diagrams. It does not change the original distribution of the data, but makes the data more visual. But in later data processing, we still use the original data.

On the whole, the outliers are concentrated in high segments and 0 score. In view of the situation of 0 points, it is mentioned in the data introduction that since some housing reviews does not exist, so we use new category instead. There are roughly the following reasons for carefully considering the non-existence of comments: 1. Housing has not

been successful in external rental 2. The number of rental transactions of housing is smaller, so the review score is less. 3. Some customers do not do so, or the landlord does not provide these services or replace them in a better way. As a result, there are too many outliers and a large gap between the data maximum and the minimum value. But the flatter case means that the data is more concentrated between 25 and 75%. 0 points will be deducted for houses that can reflect the correct registration. Comments from 8 to 10 points also showed outliers, and observed that the maximum value of high segments was generally higher than the medium and low segments. But because the median of each segment is very close, in addition to the 4 points (middle and low segments) outside the boxes are relatively flat, so the housing check-in situation can not be effectively fed back on the price. But by looking at the outliers of the high segment and the upper quartile, a better check-in system can give the house a better price. Analyzing the reasons for the low feedback, we can find that there are more factors that affect price, and it is difficult for individual variables to better guide the results. So we look for information elsewhere in the box chart, and all the segmented data is more centralized and effectively represents the check-in of each type of house. And based on outliers, we found no bad reviews on higher-priced homes. Analyzing the 4 points (medium and low segments) separately, we found that the data were not concentrated, indicating that the poor conditions of the check-in system appeared in several sets of variables with large price differences. But they were also limited to the normal data in the box chart, i.e. a more concentrated part of the overall price. This is also one of the reasons why the check-in system has less impact on prices. Compared to landlords with higher prices but higher general prices, if there are some other shortcomings, it is only by improving the user experience, or by reducing prices, that the house can be successfully rented out (Fig. 1).

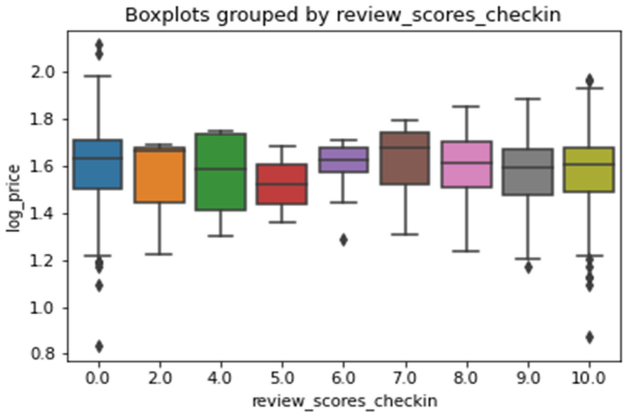


Fig. 1. Boxplots by review_scores_checkin

For the data `room_type`, the box chart shows that the price distribution of all home/apt is more widely distributed, the price is higher than that of the private room and the shared room and that the outliers are more distributed and the price is higher. A median closer to the lower quartile indicates that the data is more price-oriented and therefore the overall data is cheaper. But the price of all room/apt is slightly higher overall than the median for both. Private rooms and shared rooms are cheaper, more concentrated, flatter and have relatively small outliers. It is worth noting that the minimum value between the three is very close, indicating that at low prices the three room types, the impact on price is small. If you look only at the impact of room-type on price, the overall private room box is higher, the gap is larger, the maximum, the upper quartile, the median is significantly higher than both. So all home/apt has a better pricing performance than the private room and the shared room (Fig. 2).

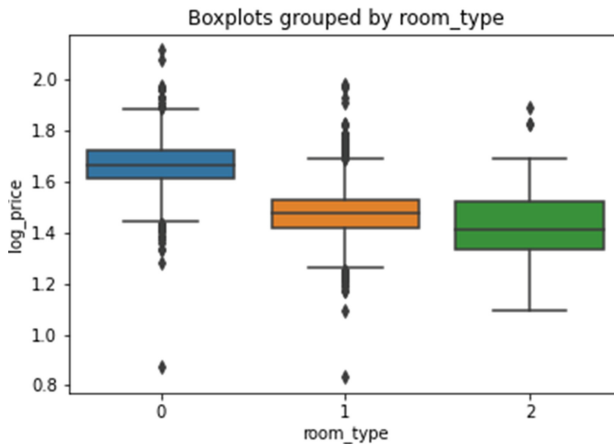


Fig. 2. Boxplot by room_type

Box diagram is `_location_act`. The true overall data is higher than false one. Both blocks are relatively flat, and the data is more expressive. In the median performance, the true value is significantly higher than false, and the median of false is offset down to the quartile, and the overall data is offset to the low price. The median true is in the middle of the box, which is higher than the case as a whole. The data is biased towards the high price distribution. In terms of outliers, both have certain outliers, and the distribution of outliers is similar. There are some ultra-high price data for true outliers.

The more accurate the position information is, the higher the price positioning can be. In terms of the analysis of the reasons, one is because the location information is accurate, which can make the housing type information more clear, so that customers have a more accurate understanding. The second one is objective location information is vague. Detailed address may have accurate door number, etc., and the fuzzy address may not have such conditions because of the housing itself problems, further reflecting the defects of the house itself (Fig. 3).

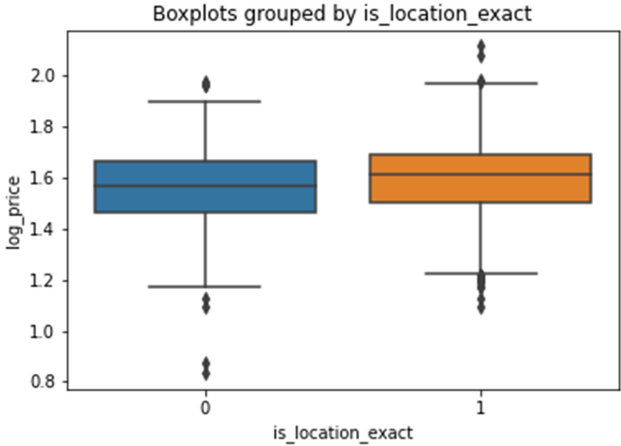


Fig. 3. Boxplot by is_location exact

On the whole, with the increase of the number of rooms, the house prices also showed a certain increase. Although the median of 0 rooms is slightly higher than the data of 1 room, the difference between the two is very small. Because of the large number of outliers in 1 room, and offset to high prices, the two boxes are almost the same position. The median is offset from the lower quartile. Therefore, we judge that the difference between 0 rooms and 1 room in the pricing is not big but has a similar performance. There are two reasons. One is that the rental of housing will have a low-price problem, lower than the low price may cause losses to landlords, and the other is that when the number of rooms is the same, but the room size, configuration is not the same. Therefore, there will be some high-priced room type. When the number of rooms is from 0 to 3, the box is flat. The data is relatively concentrated, which has a certain representative, of which the median of 2, 3 is located in the middle of the box. The data distribution is relatively biased to the normal distribution. The number of rooms fell at 4 to 5, the median of 4 rooms was higher than the 5 rooms, and the box fell a bit. The overall data improves with the number of rooms, and prices perform better, with the best performance in 4 rooms. At the same time, both boxes are higher than 0 to 3 rooms. Data set is not as good as the first three, indicating that when the number of rooms to a certain extent, it can not bring more impact on the price. Therefore, when the number of rooms increases within a certain range, the price performance will be further effectively increased. But when the number of rooms exceeds a certain number, the expressiveness of the number of rooms on the price becomes weak. In this article's data, 4 rooms are the best price expressive (Fig. 4).

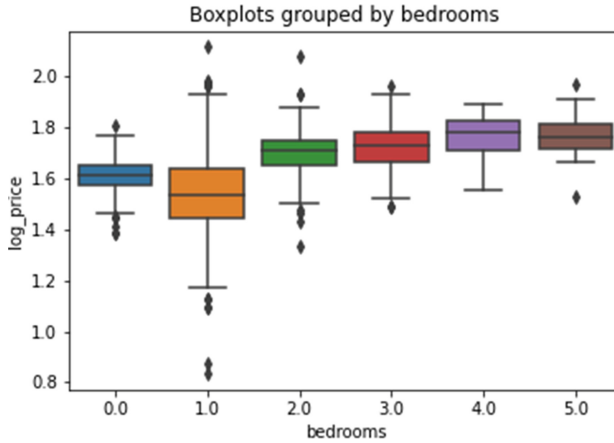


Fig. 4. Boxplot by bedrooms

In block diagram cancel _ policy, four blocks are flat, and the data is relatively concentrated, which is very representative. The median of moderate and flexible is closer, which is quite different from the super_strict. Of these super_strict were higher than the other three. Outliers tend to be mild and strict. In terms of the analysis of the moderate type, the median is near the lower quartile, and the overall data is offset at a low price. But there are four data of the largest outliers, indicating that the low-cost housing type of cancellation policy is more moderate, but moderate policy not only appears in the low-cost housing type. The flexible type is closer to the moderate, but the overall graph is relatively more offset to the high price, the median is offset from the lower quartile like the moderate, and the overall data is more present at the low price, with a high degree of coincidental with the moderate type. At the same time, the group of data outliers are less. Outliers and the maximum value are closer, indicating that the flexible type has a higher prevalence, because the low-cost room type is mostly using flexible and moderate cancellation policy. The overall graph of the strict type is higher than the first two, in which the minimum and maximum values are close to the first two, but the median value is close to the upper quartile, indicating that the data is more likely to be higher. Outliers are also more discrete, but largely dispersed to higher prices. Super_strict types of data are significantly higher than the first three and more representative. The median is much higher than the first three box parts. Although the median is close to the lower quartile, it coincides less with the first three, and the outliers are discrete to higher prices. Generally speaking, considering the high price of the room type, the cost of the landlord will be higher due to the cancellation, and the landlord will lose more source capital at the same time because the next tenant can not be found in a short time. On the other hand, the strict policy of describing also reflects the impact of housing pricing. The landlord pricing will take into account the economic benefits of time. Limit individual financial loss based on different degrees of cancellation policy. Lower-priced models will reduce the number of target customers if they adopt a stricter cancellation policy, while high-priced housing models will suffer huge economic losses if they adopt a very loose cancellation policy. Therefore, before pricing, without taking into account other factors, you can base on the

desired unsubscribe policy to price, if you want to attract more users to adopt a loose policy. Then the loss of high-priced unsubscribe will be higher (Fig. 5).

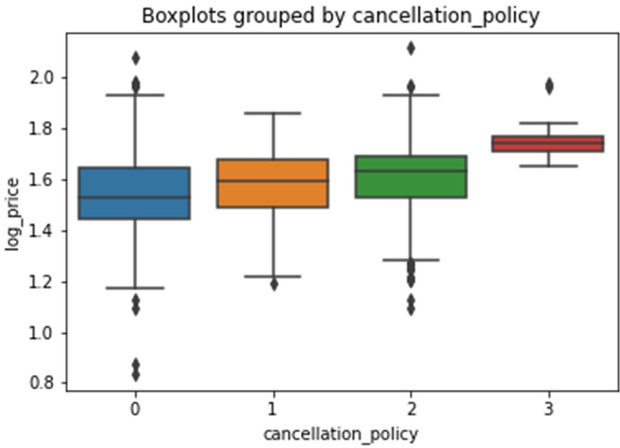


Fig. 5. Boxplot by cancellation_policy

For host-rule, we analyze from two angles, one is the landlord’s own character problem, one is the landlord’s professional problem, the other is the high-end of the service of the house itself or not. If the landlord himself is a strict character, the rules for housing provisions are relatively more. But this situation is uncontrollable factors, not within our consideration. According to Wang Chunying’s research, we found that when the supplier of the shared platform appears to be an extremely professional provider, the platform will give more favorable conditions and resources, while the amateurs will not be able to obtain the same amount of resources [23]. So when landlords are more professional, their rules for housing are more formatted, standardized, not extremely strict or lax, to some extent due to the allocation of resources and slightly higher prices than the equivalent housing. Combined with the price distribution curve, we selected the price at 400–500 host-rule to read and found that to a certain extent, the higher the price of the house, the general stricter the rules of the house, and the analysis of its causes has a stronger connection whether the landlord is professional or not. When a landlord is more professional, it will provide more comprehensive services, and the rules will be to some extent compared to less resources of amateur landlords more detailed. And when prices increase further, guests enjoy the leisure and comfort of life, and the landlord in the rules of nature will not limit too much.

And the overall description, are described as leaning towards the advantages of housing and landlord, without finding any shortcomings. From the point of view of advantages and disadvantages, it can not have an effective impact on the price. But the differences between variables are obvious for the details of the description. The reasons for this analysis are still relevant to the professionalism of landlords, and the conclusions are similar to those of the above-mentioned host-rule, in which the more professional landlords, summary and neighborhood_overview and description are described in more

detail and accurately, and pricing preferences are slightly higher than those of the same level of housing.

Space is consistent with summary content and is therefore not repeated. In both transit and interaction, there are different expressions from other samples, such as a more standardized narrative such as 'About us': 'Narrative after' than other samples, which also has something to do with the professionalism of the landlord. Analyzing transit separately, we found that in transit, the richest possible narrative would make users feel more comfortable, so there was a greater advantage in pricing than other homes. More self-description of the landlord in the interaction, a more comprehensive description and a kinder attitude can improve the customer's favorability, and if the tone of the interaction is cordial or not also has a certain relation with the final pricing performance of the house.

The description in access has a strong relation with the room_type and private-type in quantitative analysis. Access gives customers a range of activities, based on personal activity space, room type, etc., so this is not to be repeated here.

For the notes variable, we found that more landlords were willing to provide additional services, some did not fill in the category, and a few landlords made additional demands on customers. In terms of tone, most landlords have a more cordial and vivid tone. Amiable tone and extra services can give customers a better experience. Because the mechanized language of a professional landlord is not as good as the amiable tone, some provides extra service, and the amiable landlord has a better pricing performance (Fig. 6).

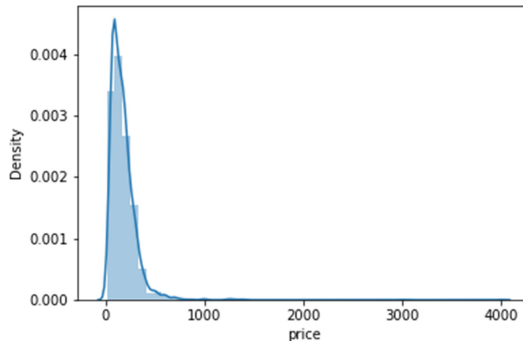


Fig. 6. Price distribution

The price curve is distributed to the skewed as a whole, and the extreme value of the data is approximately around 0.005. If very few abnormal data are not taken into account, the overall distribution is approximately normal. The overall data are concentrated in 0 to 1000 and the data distribution is relatively dense. Some of the most representative of local housing price data are from 0 to 1000. After we take the whole data, we observe the data. The data extremes move closer to 1000, increasing the intensity. After log, the dependent variable is approximately normal distribution. Although the density of data distribution is unchanged, we retain the original value characteristics in order not to change the original information of the data. In the machine learning that follows, we will

still use the original dependent variables to preserve more real, accurate, and realistic information (Fig. 7).

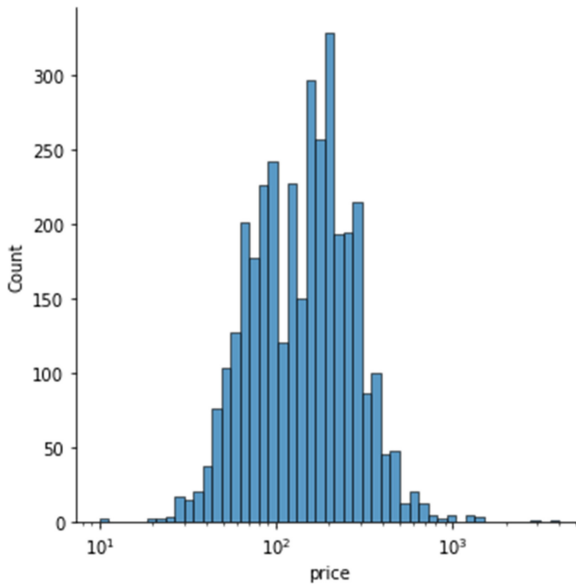


Fig. 7. Price centralization distribution

Heat attempts have less correlation between the overall arguments, with the main high correlation arguments occurring between host-listings-counts and calculated_host_listing_count, and between the comment scores of each group. Since each group's comment score is 10 points, the values between the comment scores are closer and more relevant than the range of other variables. But each set of data can reflect the different circumstances of the house itself, providing effective and different information. And the model used in machine learning is more advanced, eliminating some of the highly self-correlated data effects and thus retaining this part of the variable. Host-listings_counts have a strong intrinsic connection to calculated_host_listing_count, and the heat attempts to clearly show that there is a strong connection between the two. So we consider removing calculated_host_listing_count in the next machine learning. Observing several sets of variables with significant influence factor variables, host_listing_count is a general positive correlation. Latitude have a general positive correlation, room_type there is a strong negative correlation, tending to the whole room of the house has better expressiveness; There is a general positive correlation between the reviews, with weak negative correlations and near-no effect between the groups of reviews. The impact of the remaining variables is relatively weak, but this does not mean that these variables have no effect on the dependent variables, considering the small gap between the data and other reasons, largely because most of the samples are less differentiated in the variables. That is, the Boston area housing situation in these areas is generally the same, or the market in the screening of goods has no significant impact on the market. Therefore,

we suggest that when pricing houses in the Boston, priority should be given to the type of room, the number of rooms, the number of rooms and the number of beds, as well as the type, additional costs, geographical advantages and so on. Especially, the two variables `host_listing_count` in `clean_fee` are the landlord's own choice, rather than the house itself. According to Wang Chunying and others, professional landlords can provide more suitable extra fees because they are more experienced and more sophisticated in management, so that landlords with more houses can obtain more traffic and pricing performance (Fig. 8).

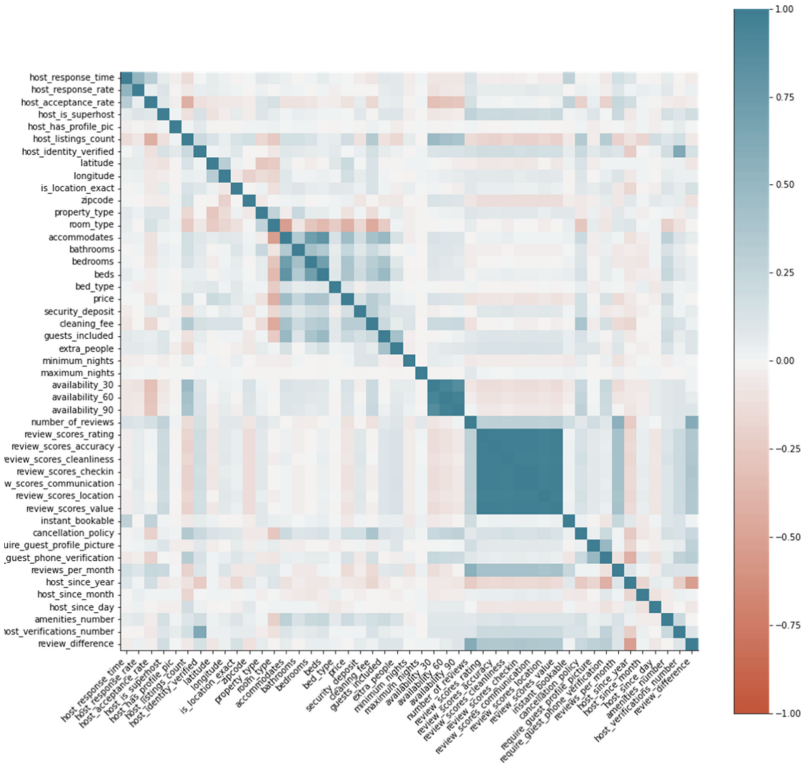


Fig. 8. Heat attempt

4 Experiments

The model gradient boost performance is obviously better than the other types. The analysis of lasso, ridge, elastic net feedback value is lower because the experimental data in high-dimensional performance is not significant linear relation. The random forest algorithm overfits the noisy classification, and we can also find some data that are lowly relevant in the thermal effort. But the weight of these variables is magnified in the random forest. At the same time, the value division of data is also relatively large,

Table 1. Model performance

	KNN	Lasso	Elasticnet	Randomforest	Gradientboost	Ridge
Rmse	180.98	175.79	175.66	174.05	169.53	175.66
R2	0.15	0.20	0.21	0.22	0.26	0.20

and the influence on random forest algorithm can not be ignored. KNN is a relatively lazy algorithmic model. The classification of categories is divided according to distance. There is no standardization evaluation, and a sample size of larger data. If the distance does not meet KNN’s needs, the model feedback will be affected. We analyze the reasons for the higher occurrence of the model Rmse, taking into account that the distribution of dependent variables is affected by a few outliers, so we exclude some outliers for model comparison. We will base on the image in the displot, the part greater than 500 culled, from the original 3585 sets of data, reduced to 3519, to lasso algorithm. For example, the value of Rmse and r2 has been greatly improved, From the original 175.79 and 0.20 to 60.44 and 0.62, the correlation between features and dependent variables has also been greatly improved. But in order to give back the most realistic data, we still take the most primitive data rendering (Table 1).

5 Conclusion

Compared with other scholars’ related research, more variables are introduced for influencing factor analysis. And on the basis of machine learning, the conclusions and experiences of previous people are used for non-quantitative analysis, so that more factors can be reasonably included in it. The traditional pricing model analysis mainly introduces the landlords’ own situation from the aspects of the house itself, geographical location, related facilities, etc., in order to make a more comprehensive analysis. In model analysis, we use models such as gradient boosting to bring in data for fitting and higher-end models to process data. Because of the high data dimension, there is inevitably a certain collinearity between the data. The most important effect on model data fitting is the distribution of dependent variables. Because a small amount of data distribution is too scattered, the whole data on the right side of the tail is extremely deviated from the high-priced data. At the same time, there are many shortcomings in the article, such as non-quantitative analysis. It can only be broadly classified samples, but can not be professional to make efficient extraction of information groups for targeted analysis.

This paper does not carry out detailed classification and detailed analysis of each variable. I hope that in future research, there will be a detailed analysis of various characteristics in order to explore the specific size of the impact of features on the results; The prediction is more accurate; Also, the study of this paper is limited to the development relation between residential accommodation and does not take into account similar competition, such as traditional hotels, policy impact, etc.. Combined with different categories of products in the market, the same category of different nature of products analysis, can make more comprehensive and in-depth exploration of the development of shared homestay pricing forecast.

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Analyzing the Data of NESCAFE Sustainability Campaign and the Effectiveness of the Key Opinion Leaders Utilization

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Abstract. KOL promotion plays a more and more important role in the modern digital marketing. However, not all the brand campaigns are successfully run, and the rates of return are less than satisfaction. This paper goes through the open data of NESCAFE Sustainability Campaign in the year 2021, collected from the Chinese mainstream social media platforms (Microblog, RED and WeChat) and the data collected from the offline cooperative Cafes, analyzes the effectiveness of key opinion leaders (KOLs). Using key opinion leaders on the social media becomes a basic and popular way to promote the brands and the corresponding activities nowadays. The Liana Technologies website [10] states that the use of KOLs can help gain the genuine and honest of consumers for the KOLs will not risk losing their reputations when suggesting a brand. The problem is, according to the KOLs' data from the NESCAFE 2021 Sustainability Campaign, that KOLs are not as efficient as the NESCAFE has assumed in advance in the promotion period. Professor Jonah Berger from Wharton School of the University of Pennsylvania states several principles that make things contagious. This paper analyzes the result of the NESCAFE Sustainability Campaign data during the warm-up period and analyzes how can some of the professor Berger's principles explain the KOL promotion.

Keywords: Marketing · KOL · Brand value · Campaign promotion

1 Introduction

NESCAFE has invited about 25 key opinion leaders (KOLs) during the 2021 Sustainability Campaign on the three Chinese mainstream social media platforms (Microblog, RED and WeChat) to promote their online and offline environmental-friendly activities. However, the open data of the KOLs, including the number of shares, comments and likes, and other responds offline are not as considerable as the NESCAFE has assumed in advance. To maximize the effectiveness of KOLs and improve the promotion period of a campaign, variety media tunnels should be used simultaneously to better target the consumer groups. This paper analyzes the NESCAFE campaign data during the warm-up period to figure out what factors relate to the principle's states by Professor Berger

[1] will influence the effectiveness of KOLs utilization and how to improve the utilization by clarifying the brand value, relating closer to the promotion, and raising more discussions.

1.1 Key Opinion Leaders and Digital Marketing

The concept of key opinion leader (KOL) first appeared in the 1940s, came up by Paul Lazarsfeld, a famous communications theorist who had made great contributions in social psychology and communication [9]. According to Lazarsfeld, comparing to the power of contents in advertisements, the common views of the public rely more on the opinion leaders [14].

In the mid-1950s, a study contracted by Pfizer about what influenced doctors in the United States to adopt a new drug made Lazarsfeld's group extend the concept of KOL into the medicine industry [4].

With the development of modern internet, digital marketing has been playing an important role in advertising, to which the concept of KOL has also extended. Paper research conducted by Krajnović et al. [8] argued that the digital marketing being a roll booster in the improvement of business performance and increasing propagation. Digital marketing can increase the interaction between brands and their consumers which will improve consumers' understanding to the brand value [15].

Key Opinion Leaders influence public practices more effectively than other authentic forms [5]. KOLs' reputation could be transferred from themselves to the brands they advocate, helping the consumers form trust to the brands [11]. When consumers' perceptions of the brand have changed, so followed their behaviours [7].

1.2 Theoretical Background

In professor Jonah Berger's book "Why Things Catch On (2013)", he stated six important rules STEPPS which would make things go virus: Social currency, Triggers, Emotion, Public, Practical Value and Stories [1]. In this paper, social currency, triggers, and practical value principles will be discussed.

People like to talk about novel things to make them look cool [1]. The reason why influencers on the social media have powerful impacts toward the followers is that most of them looked fascinating and they catch up with the latest trend; or they themselves become the trend. Social currency then is the trade measure to exchange social reputation and respect with trendy ideas and affairs [1].

Trigger is an anchor which remind people of something [1]. This concept is important in marketing for the form of the advertisements could be diverse and limited in contents because of the budget and other externalities. Content limitation means different part of the ads should convey specific information of the brand so that it could be easier for consumers to remember the key value. Diversity shows the holistic impression of a brand. Both characteristics need to be related to the brand directly once the advertised signal is captured by the market. The signal is the trigger. Trigger answers the question of how people could relate to a brand.

The third principle is the practical value. Practical value is the content crafted by the brand to make them seem useful [1]. In more general and practical words, practical value

is what the brand can provide to the public and how will the value improve consumers' live standards. Practical value answers the question of why people choosing a brand.

2 Campaign Reviews

The NESCAFE used KOLs to promote their Bring Your Own Cup (BYOC) action on the World Earth Day and three days afterwards (April 22nd to 25th), which was also the warm-up period for the Sustainability Campaign. The NESCAFE has contacted 28 boutique cafes from four Chinese cities: Beijing, Shanghai, Hangzhou, and Qingdao, gathering them together to offer free coffee on April 22nd and discount coffee from April 23rd to 25th if the consumers brought their own cups. The consumers would get one sustainability badge designed with NESCAFE's logo and an environmental-friendly icon as a gift. The BYOC action would be recorded when the consumers scanned the activity code and transferred into virtual points on the NESCAFE mini program on WeChat. The virtual point later could be exchanged into NESCAFE sustainability accessories, which were environmental things like Dupont paper bags and coffee cups made from coffee debris, all printed with NESCAFE logos.

About 25 KOLs on the Chinese mainstream social media platforms, Microblog, RED and WeChat, were paid to promote the whole campaign, only 10 of them were asked to visit one of the 28 boutique cafes to participate the BOY cup activity and record the whole process with photos and words, then posted the sustainability accessories online. Among these 9 KOLs, 6 of them were from Microblog, with the total followers of 19.65 million; one of the 9 KOLs were from RED, with 280,000 followers; three of them were from the WeChat, with the total followers of 3,980,000 (see Table 1. For the followers' information). The remaining KOLs were paid only to share the BYOC action warm-up contents released by the NESCAFE official account.

There were 15 posts within 6 days in total, received 38,845,828 readings, 18,200 shares, 17,599 comments and 44,967 likes (see Table 1. For more detailed online responses' information). The rate of total reactions over readings were only 0.2%. Dr. Dave [2, 3], a digital strategist who had stated that display ads on Google had an only 0.05 to 0.1% click through rate (CTR), which was very low, and that was back to year 2012. Compared to 0.05 to 0.1%, 0.2% seemed to be a normal rate even though it was not so high. However, the online advertising director Elisa Gabbert [6] argued that a good CTR for a competitive industry should be 2%, though the average CTR online was only 0.25%. The response rate could be lower than CTR for it required more actions to take, but 0.2% was not the final response rate for the NESCAFE BYOC action.

According to the data directly collected from the 28 boutique cafes over four cities, there were only about 700 people who had participated in the BYOC action on the World Earth Day (see Table 2. For more detailed offline responses' information). If we take 700 as the final response, the response rate for the NESCAFE BYOC action could only be 0.0018%, which was extremely low. Starbucks held BYOC action annually on the World Earth Day as well, and they have been continuously advocating the BYOC action as a normal routine. According to Starbucks website [13], at least in the US, Starbucks keep offering consumers a \$.10 discount on their beverage of choice as long as they join the BYOC action. Although there were no open data of Starbucks' 2021 Earth Day BOYC,

there were more Starbucks physical store in China, over 5,000 and were much more than the 28 boutique cafes temporarily cooperated with NESCAFE. Considering the high attentions people pay to the Starbucks' social platforms (for people are using them every day to purchase Starbucks online or to follow up the newest products and discount information.) It could be obviously seen that the result of Starbucks' promotion on the World Earth Day and their responses for their BYOC was much better than NESCAFE. In this case, the response rate of 0.0018% was a really bad performance.

3 Analysis

NESCAFE, the most famous instant coffee in the world, had held an unsuccessful warm-up in their 2021 Sustainability Campaign BYOC action by using only 10 KOLs online. There were three main aspects that had led to the failure.

3.1 Unmatched Brand Value

Professor Berger mentions in his book *Why Things Catch On* that it is important to show practical value in products to make people feel that doing something such as purchase a product is a good deal [1]. When people NESCAFE sells instant coffee and related instant coffee products like instant coffee machines such as Nespresso and Dutch Gust. The key values they create for the consumers, are time saving, fashionable and young lifestyle. BYOC is a good way to promote environmental-friendly value, but NESCAFE does not have physical stores, and they sell coffee directly in the plastic bottles in convenient stores. It was smart to contact boutique cafes to help NESCAFE promote, while only 28 cafes were not enough and how they related their brand value to those cafes were important. Boutique cafes provided a slow pace of lifestyle and required people to sit there either work or just have a rest for couple of hours and enjoy their lives. The initial direction of the campaign warm-up was wrong, which had built a weak foundation for the KOLs' promotion later. It would be a better idea if NESCAFE just printed their values on the plastic bottles or used biodegradable materials instead of plastic.

3.2 Weak Relation to the Promotion Purpose

Another marketing principle suggests by Professor Berger is that triggers are important to prompt people thinking about the related things [1]. What if people had paid attention to the NESCAFE's idea of protecting the environment and the value of the brand being successfully promoted by the KOLs online even the response rate was low? This was right but the consumer group of NESCAFE were not precisely targeted for the followers of the KOLs were not NESCAFE fans. The 10 KOLs and 28 boutique cafes all had huge consumer bases and large number of followers, but the types of the KOLs were food bloggers or fashion influencers. For the food bloggers, their followers might most be the college students who just got freed from high school campus and went to a new city to find places to eat. Fashion influencers usually are also followed by college students, or young white collars. It is true that the college students and white-collars are the target groups of NESCAFE, while NESCAFE paid so much money to those KOLs were not

just to promote their brand values, otherwise they could have used those money to invite just one superstars with much more followers and influences, or expand other tunnels like the convenient stores or the bottle print example mentioned above to be much more efficient), their main purpose was to lead the followers to those boutique cafes and participate in the BOYC action. Through the action, the consumers would feel more relate to the brand and better understand NESCAFE's environmental protection value, improving the brand's reputation. The key initial action after viewing the KOLs post, was to go to those boutique cafes. However, one KOL only went to one of the cafes, and only had one post content (see Table 1. For the KOLs' posts information). It was worse that none of the contents had mentioned about any other 27 cafes.

So, what about the whole information of the 28 boutique cafes? NESCAFE China [12] only posted one content about the cafes on Microblog, with only 37 shares, 45 contents and 57 likes (no viewing data). Another way to find those 28 boutique cafes, was much harder. People first needed to follow the NESCAFE WeChat account, and read the post with an ambiguous title on April 22nd, which was the day of the BYOC (they did not mention the boutique cafes until that day), clicked on the link in the middle of the article (an inconspicuous icon), registered as a Bean lover (name for the people who participate the BOYC), and then a tiny light colour icon would pop up under the big poster of a notice that consumer had successfully resisted. People had to click on the icon and finally, they would find the information about the 28 boutique cafes in tiny, light colour characters.

3.3 Lack of Discussion

Lack of discussion is the result of the first two factors. NESCAFE confused themselves and consumers about the value they could provide and the value they provided in the Sustainability Campaign. They also set up barriers to make people notice and participate in the BYOC action. Here comes the other principle mentioned by Professor Berger: the social currency [1]. If we want a brand to go popular, people need to talk about the brand, the product, or the activity automatically. What kinds of things will people talk actively? Cool things. That is why KOLs are so welcomed in marketing, for they are cool in all kinds of fields and people follow them to talk about them and even imitate them. The best result of KOL promotion is not making followers passively see the posts, but actively take the actions to follow the KOLs and chase the brand. Boutique cafes were cool, but the people who discussed them, were not the exact same group who would discuss NESCAFE. Relation is crucial. NESCAFE failed to relate the value, failed to remind people of the BYOC, and what about the BYOC itself? It was still unrelated. According to Table 2., most boutique cafes offered hand-made classic espresso. This was hard to relate to the brand NESCAFE itself. Even if people could finally pass through all the 'barriers' and got to one of the boutique cafes, participated in the BYOC action, what kinds of things would they talk about to their friends? They would talk most about the cafes, how good was the environments and the taste of those hand-made coffee.

While NESCAFE did make people talk about something, the NESCAFE logo accessories KOLs used to take the photos. Sadly, people had to use the virtual points they collected through the BYOC action to exchange those accessories.

Table 1. The KOLs' promotion open data from Microblog, RED and WeChat

NESCAFE SUSTAINABILITY CAMPAIGN WARM-UP KOL DATA											
Media Platform	#	Account	Links	Followers (10 thousands)	Date	Contents	#Reading	#Shares	#Comments	#Likes	Total Reaction
Microblog	1	@谷柚柚	https://weibo.com/2539007975/KcgIMn2o8	459	2021-04-23	NESCAFE official warm-up shares	84,919	613	728	983	80,275
			https://weibo.com/2539007975/Kd0ZOFcVl		2021-04-28	Boutique Cafe BYO cup content posts	93,136	3,203	2,308	4,465	
	2	@馋嘴番茄酱	https://weibo.com/6440187348/KcgIMIV5b	393	2021-04-23	NESCAFE official warm-up shares	3,335,701	1,311	825	3,708	
			https://weibo.com/6440187348/Kczv2pBcy		2021-04-25	Boutique Cafe BYO cup content posts	6,854,802	4,316	2,926	13,061	
	3	@一粒西瓜yo	https://weibo.com/6673451609/KcpMimHv3	296	2021-04-24	NESCAFE official warm-up shares	13,278,330	561	1,238	1,301	
			https://weibo.com/6673451609/KcRNwqXis		2021-04-27	Boutique Cafe BYO cup content posts	14,057,015	2,219	2,807	8,512	
4	@陈可爱o3o	https://weibo.com/1785625227/KcpMinMZh	191	2021-04-24	NESCAFE official warm-up shares	43,399	981	1,083	2,103		
		https://weibo.com/1785625227/Kd2p62FzR		2021-04-28	Boutique Cafe BYO cup content posts	87,720	527	1,084	1,501		
5	@ACui阿崔	https://weibo.com/2832410790/Kd1KwhP2G	390	2021-04-28	Boutique Cafe BYO cup content posts	733,481	608	1,544	3,687		

(continued)

Table 1. (continued)

NESCAFÉ SUSTAINABILITY CAMPAIGN WARM-UP KOL DATA											
Media Platform	#	Account	Links	Followers (10 thousands)	Date	Contents	#Reading	#Shares	#Comments	#Likes	Total Reaction
	6	@噜噜逛吃浙里	https://weibo.com/6502005134/KcgIMlUCP	236	2021-04-23	NESCAFÉ official warm-up shares	45,250	599	716	961	
			https://weibo.com/6502005134/Kd0ZP2Y9V		2021-04-28	Boutique Cafe BYO cup content posts	123,028	3,170	2,236	4,390	
	Total	/	/	1,965	6 days	11 posts	38,736,781	18,108	17,495	44,672	
RED	7	今天真好玩	http://xhslink.com/EVX6zc	28	2021-04-28	Boutique Cafe BYO cup content posts	4,147	92	24	108	224
WeChat	8	北京潮生活	https://mp.weixin.qq.com/s/OikDQnvHTVX6_Z7qUaD3w	163	2021-04-28	Boutique Cafe BYO cup content posts	19,551	0	29	29	267
	9	魔都觅食记	https://mp.weixin.qq.com/s/4uT4f8wfhouo7mRyjjTDzw	147	2021-04-27	Boutique Cafe BYO cup content posts	50,349	0	34	137	
10	吃喝玩乐在北京	https://mp.weixin.qq.com/s/YA6kaFBW87P9scm2JJzpFA	88	2021-04-29	Boutique Cafe BYO cup content posts	35,000	0	17	21		
Total	/	/		398	3 days	3 posts	104,900	0	80	187	
SUMMARY			/	# KOL	Days	Posts	# Reading	#Shares	#Comments	#Likes	Total Reaction
				10	1-6days	15	38,845,828	18,200	17,599	44,967	80,766

Table 2. NESCAFE sustainability campaign bring your own (BYO) cup free coffee data

NESCAFE SUSTAINABILITY CAMPAIGN BRING YOUR OWN (BYO) CUP FREE COFFEE DATA				
No	City	CAFE NAME	Free coffee offered (Type)	Free coffee offered (Quantity)
1	Hangzhou	AbutlambCoffee	All types in store	4**
2				
3				
4				
5				
6				
7				
8				
9			ROUTINE COFFEE	Americano, Latte, Cappuccino Flat White,Dirty (5)
10		No Big Deal	All types in store	1**
11	Shanghai	WABI COFE	Fresh brew coffee, Latte, Flat White, Dirty, Americano, Coffee Milk Shake (6)	*
12		Cafe Chez W	All the black and white coffee in store except for hand drip	*
13		56 rue de YONGKANG	Americano, White Coffee	*
14		argang	All the products except for hand drip and cakes	1*
15		In Dough We Trust	All types in store	*
16		Gregorius	Espresso,Americano, Latte, Cappuccino Flat White,Dirty (6)	*
17		Beijing	Wake UP&Coffee	Americano, Iced Americano, Soda Americano, Latte, Iced Latte,Oats Latte, Hot Chocolate, Dirty, Fig Tea, Bubble juice (10)
18	THE CORNER		All types in store	1*

(continued)

Table 2. (continued)

NESCAFE SUSTAINABILITY CAMPAIGN BRING YOUR OWN (BYO) CUP FREE COFFEE DATA				
No	City	CAFE NAME	Free coffee offered (Type)	Free coffee offered (Quantity)
19		HALF COFFEE	Americano, Flat White, Latte Special made: never give up 、 on the way 、 life is struggle (6)	*
20		Cabo coffee	All types in store	*
21		café clark	Americano	*
22		1/4 coffee lab	Dirty, Colombia SOE (2)	6*
23				
24	Qingdao	李想珈	Classic Latte, American Latte (2)	3*
25		planb	Spanish Latte, Eisbock Latte, Flat White, Oats Latte, Grape Fruit Coffee (5)	3*
26				
27				
28		VANILLA COFFEE	SOE	*
SUMMARY				7**

* All the data are collected directly from the boutique cafes. With data privacy concern, all the BYO cup activity related free coffee offered data are covered with mosaic.

4 Conclusions and Future Proposal

To maximize the effectiveness of the KOLs' utilization and improve the promotion process, the brand first needs to clarify their core values, be clear about what they can provide to the consumers and how will the value relate to the KOL's values. The brand value is the beacon of the promotion, building a strong foundation for the future. However, value is still an abstract concept, it is important to figure out the specific purpose using the power of KOL. Therefore, the contents KOL posts should be well connected with the direct purpose of the promotion. The official voice needs to be loud as well, for the KOL is only the assistant during the whole campaign. And the last but not the least, people need to be encouraged to discuss the campaign, not just focus on the KOL. The brand itself is the core after all.

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Statistic Knowledge Behind the US Election System

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Abstract. In this essay we examine the statistical significance of electoral college system in US Presidential Election. We compare it with general election to see whether those two different election systems make a difference in determining the result of an election. We start with the model that only contains several states with the same number of voters. We first calculate the theoretical probability that the current candidate in the lead during the middle of the election differs from the final winner. We then using MATLAB to build up a simulation of the election by Electoral college and the election by popular votes. We compare our simulated results to the predicted outcomes from the theoretical probability to check the correctness of our simulation program. Finally, we will incorporate all the states into the program to generate two simulated presidential elections in US, one using popular votes and another using electoral college. This paper will end in a conclusion of the comparison between these two simulated elections.

Keywords: US election · Electoral college · Popular votes · Comparison

1 Introduction

It is well known that the results of the US presidential election is determined by electoral votes rather than popular votes. Each state gets a certain number of electoral votes according to its population, and if a candidate wins over half of popular votes in a state, he can take all of the electoral votes belonging to that state. This “winner takes all” rule sometimes leads to the discrepancy between the election result by popular votes and the election result by electoral votes. For example, Donald Trump has won the presidential election in 2016, but he actually got less popular votes than Hillary Clinton.

This paper aims for exploring the statistic knowledge behind these two voting mechanics and find their differences in a mathematical way.

2 Literature Review

There is a great body of literature that discusses the statistical significance of the US electoral voting system. It has happened multiple times in history that a candidate with a plurality of the popular vote did not also win the Electoral College. This discrepancy

between the result of two election processes is worth studying and has attract the attention of many researchers. Some researchers build forecasting models to predict the outcome of an ongoing election based on different voting methods [?]. Other researchers explored how the electoral college system affect the voting power of individuals-that is, their influence on the outcome [1]. Some even argue that voters in different states will have different voting power: electoral college system does not represent large states and small states equally in the election [2]. Allocating the appropriate number of votes to each state is also difficult to accomplish, as it does not account for population changes between censuses pretty well [3]. The methodology of this essay is to analysis the statistical differences between popular votes and votes by electrical college. To be more specific, this essay will measure how likely that the leading candidate in an ongoing election will change.

3 Analysis and Discussion

Since there are usually only two candidates in the final stage,a voter can only choose between these two candidates. Therefore,a voter’s choice is binary. Assume that each candidate has an equally 50% chance to be voted by a voter. Then if we denote X to be the random variable representing number of votes one candidate gets in an election with 1000 voters, then the distribution of X is $X \sim \text{Binom}(1000, 0.5)$. Next, it is possible to approximate this binomial distribution into normal distribution.

To begin with, it requires the use the following four theorems:

Theorem 1.1. Suppose $X \sim \text{Binom}(n, \pi)$, $Y \sim \text{Binom}(m, \pi)$, and X and Y are independent. Then we have $X + Y \sim \text{Binom}(m + n, \pi)$.

Theorem 1.2. Let X_1, X_2, X_3, \dots be a sequence of iid random variables from a distributionthat has a mean μ , standard deviation σ , and a moment generating function defined on an interval containing 0. Then.

$$\lim_{n \rightarrow \infty} P\left(\frac{\bar{X}_n - \mu}{\sigma/\sqrt{n}} \leq z\right) = \Phi(z) \tag{1}$$

where $\bar{X}_n = \frac{X_1 + \dots + X_n}{n}$. In other words, we have

$$\frac{\bar{x}_n - \mu}{\sigma/\sqrt{n}} \xrightarrow{D} \text{Norm}(0,1)$$

This implies that $\bar{X}_n \approx \text{Norm}(\mu, \sigma/\sqrt{n})$.

Theorem 1.3. Let X be a random variable and a be a constant, then it follows that.

$$\text{Var}(aX) = a^2 \text{Var}(X) \tag{2}$$

The proof of the above three theorems is omitted in this paper but can be viewed in the book”Foundations and applications of statistics: an introduction using R” [4]. The forth theorem is a theorem about the operation rules on expected values and variances.

Theorem 1.4. Let X, Y be two discrete independent random variables and denote $Z = X + Y$. We have

$$E(Z) = E(X) + E(Y) \tag{3}$$

$$Var(Z) = Var(X) + Var(Y) \tag{4}$$

Proof: To begin with, since we have $Z = X + Y$, it follows trivially that.

$$E(Z) = E(X + Y) + E(Y) = E(X) + E(Y) \tag{5}$$

According to the definition of variances, we have

$$\begin{aligned} Var(Z) &= \overline{(Z - E(Z))^2} \\ &= \overline{((X + Y) - (E(X) + E(Y)))^2} \\ &= \overline{(X - E(X))^2} + 2\overline{((X - E(X))(Y - E(Y)))} + \overline{(Y - E(Y))^2} \end{aligned}$$

Since X, Y are independent from each other, we know that the average value. $\overline{((X - E(X))(Y - E(Y)))} = 0$. Thus, we get

$$\begin{aligned} Var(Z) &= \overline{(X - E(X))^2} + \overline{(Y - E(Y))^2} \\ &= Var(X) + Var(Y) \end{aligned}$$

finishing the proof

Now, let $X = \sum_{i=1}^{1000} Y_i$ where $Y_i \sim \text{Binom}(1, 0.5)$. By the property of binomial distribution, we have that $E(Y_i) = 1$ and $Var(Y_i) = 1 * 0.5 * (1 - 0.5) = 0.25$.

According to theorem 1.1, since each Y is independent, we get $X \sim \text{Binom}(1000, 0.5)$.

This means that $E(X) = 500$ and $Var(X) = 100 * 0.5 * (1 - 0.5) = 250$. Notice that this finding tells us that in an election with 1000 voters, the distribution of the number of votes gotten by one candidate has the mean value of 500 and variance of 250.

To simplify the computer calculation, the first step is to transform the binomial distribution of X into a normal distribution. Let $\bar{Y} = \frac{1}{1000} \sum_{i=1}^{1000} Y_i$. We have $X = 1000\bar{Y}$. Since 1000 is large enough, by the Central Limit Theorem we can have

$$\bar{Y} = Norm\left(0.5, \sqrt{\frac{0.5 * (1 - 0.5)}{1000}}\right) = Norm\left(0.5, \sqrt{\frac{0.25}{1000}}\right).$$

Because $X = 1000\bar{Y}$, by theorem 1.1 and 1.4, we then have that

$$X \approx Norm\left(500, \sqrt{250}\right).$$

Thus, it becomes clear that after transforming the distribution of X from binomial to normal, X still has a mean value of 500 and standard deviation of $\sqrt{250}$. This leads to the conclusion that the number of votes one candidate can get in an election with 1000 voters follows the distribution $Norm\left(500, \sqrt{250}\right)$.

4 Odds of Winner Changes in Popular Votes

In practice, in an election, voters do not submit their votes at the same time: some may vote earlier and some may wait till the ending time approaches. Therefore, analyzing the possibility that the winner changes at the middle of the election is an interesting question.

For example, suppose there is an election between the candidate A and Candidate B. Divide the election into two stages based on time. Let some voters vote in the first stage, and after the first stage is finished, let another group of voters vote in the second stage. Then it seems meaningful to calculate the possibility that the final winner of the election differs from the winner of the first stage.

Statement 1.5

If the number of voters in the second stage of election is the same as the number of voters in the first stage of the election, then the possibility that the winner of the election changes from the winner of first stage to the other candidate is exactly 0.25.

Proof: Assume that N voters vote in first stage and another N voters vote in the second stage. And assume without loss of generality that the current winner after the first stage is A. To begin with, in order to let the final winner changes to B, candidate B has to earn the favor of N voters who vote later. It is trivial that the possibility that candidate B gets more votes from the N newly added voters than A is 0.5. But notice that it alone can't guarantee that the total number of votes gained by B surpasses the number of votes gained by A. It is also necessary to assure that the winning margin of A in the first stage of the election is smaller than the winning margin of B in the second stage. Since the two elections have the same number of voters, the possibility that the winning margin of A in the first half of the election is smaller than the winning margin of B in the second election is also 0.5, as these two variables follows exactly the same distribution. Thus, the possibility that the winner changes to B is $0.5 * 0.5 = 0.25$. It then leads to the conclusion: the possibility that the final winner of the election changes from the winner of the first stage to the other candidate is 0.25.

It is also possible to find the possibility that winner changes even when the voters of the two stages are not equal. To do this, the essay will prove the following proposition:

Proposition 2.1. Suppose that an election is divided into two stages. N people votes in the first stage and M people votes in the second stage. Then the possibility winner of the two stages changes is.

$$\frac{1}{\pi} * \arctan\left(\frac{\sqrt{M}}{\sqrt{N}}\right)$$

Proof: Denote X as the variable representing the number of votes candidate A wins in the first stage and denote Y as the variable representing the number of votes candidate A wins in the second stage. Then the winning margin of candidate A in the first stage is $X - (N - X) = 2X - N$. Let $Z_1 = 2X - N$. Denote its expected value $E(Z_1)$ as μ_1 and its standard deviation as σ_1 .

By theorem 1.4 and theorem 1.3, we have $\mu_1 = 2 * \frac{1}{2}N - N = 0$ and $\sigma_1 = \sqrt{\text{Var}(2X - N)} = \sqrt{4 * \frac{N}{4}} = \sqrt{N}$.

Similarly, it is known that the winning margin of candidate A in the second stage is $2Y - M$. Let $Z_2 = 2Y - M$. Then following the same steps as we did previously, if we denote $E(Z_2)$ as μ_2 and the standard deviation of Z_2 as σ_2 , we can have

$$\mu_2 = 2 * \frac{1}{2}M - M = 0$$

and

$$\sigma_2 = \sqrt{\text{Var}(2Y - M)} = \sqrt{4 * \frac{M}{4}} = \sqrt{M}.$$

Next, according to the pdf functions of Normal distribution, we know that the pdf of Z_1 is

$$f_{Z_1}(x) = \frac{1}{\sigma_1\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu_1}{\sigma_1}\right)^2}$$

And the pdf of Z_2 is

$$f_{Z_2}(y) = \frac{1}{\sigma_2\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{y-\mu_2}{\sigma_2}\right)^2}$$

Notice that the two stages do not affect each other, so Z_1, Z_2 are independent. Thus, we know that the pdf function for the joint distribution of Z_1 and Z_2 is

$$f(x, y) = f_{Z_1}(x) * f_{Z_2}(y) = \frac{1}{\sigma_1\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu_1}{\sigma_1}\right)^2} * \frac{1}{\sigma_2\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{y-\mu_2}{\sigma_2}\right)^2}$$

Thus, since $\mu_1 = \mu_2 = 0$, $\sigma_1 = \sqrt{N}$, $\sigma_2 = \sqrt{M}$, it follows that the joint pdf of Z_1, Z_2 is

$$\begin{aligned} f(x, y) &= \frac{1}{\sigma_1\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu_1}{\sigma_1}\right)^2} * \frac{1}{\sigma_2\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{y-\mu_2}{\sigma_2}\right)^2} \\ &= \frac{1}{\sqrt{N}\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x}{\sqrt{N}}\right)^2} * \frac{1}{\sqrt{M}\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{y}{\sqrt{M}}\right)^2} \\ &= \frac{1}{\sqrt{2\pi}\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{\sqrt{N}} + \frac{y^2}{\sqrt{M}}\right)} \end{aligned}$$

According to the definition of Z_1 and Z_2 , we know that the winner changes if and only if $Z_1 < 0$ and $Z_1 + Z_2 > 0$, or $Z_1 > 0$ and $Z_1 + Z_2 < 0$. Thus, we know that the possibility that winner changes is

$$\int_{-\infty}^0 \int_{-x}^{\infty} \frac{1}{2\pi\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{\sqrt{N}} + \frac{y^2}{\sqrt{M}}\right)} dydx + \int_0^{\infty} \int_{-\infty}^{-x} \frac{1}{2\pi\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{\sqrt{N}} + \frac{y^2}{\sqrt{M}}\right)} dydx$$

By symmetry of the pdf of normal distribution, it is easy to show that

$$\int_{-\infty}^0 \int_{-x}^{\infty} \frac{1}{2\pi\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{N} + \frac{y^2}{M}\right)} dydx = \int_0^{\infty} \int_{-\infty}^{-x} \frac{1}{2\pi\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{N} + \frac{y^2}{M}\right)} dydx$$

Thus, without loss of generality, it is enough to only consider the integral

$$\int_{-\infty}^0 \int_{-x}^{\infty} \frac{1}{2\pi\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{N} + \frac{y^2}{M}\right)} dydx.$$

Next, define the variable r such that $r^2 = \frac{x^2}{N} + \frac{y^2}{M}$. Then according to the parametric description of a circle, we can find $-2\pi \leq 2\pi$ such that $\frac{x}{\sqrt{N}} = r \sin \theta$ and $\frac{y}{\sqrt{M}} = r \cos \theta$. By the definition of triangular functions, we immediately knows that $\tan \theta = \frac{\sin \theta}{\cos \theta} = \frac{x\sqrt{M}}{y\sqrt{N}}$. Since the boundary of the integral above is that $y > -x$ and $x < 0$, we know that $0 > \frac{x}{y} > -1$.

This implies that

$$0 > \tan \theta = \frac{x\sqrt{M}}{y\sqrt{N}} > -\frac{\sqrt{M}}{\sqrt{N}}.$$

Due to the fact that arctan is a strictly increasing function, we also have

$$0 > \theta = \arctan\left(-\frac{\sqrt{M}}{\sqrt{N}}\right).$$

and this will be our boundary for θ . Moreover, by using Jacobian matrix, since

$$r^2 = \frac{x^2}{N} + \frac{y^2}{M},$$

we have

$$dxdy = \sqrt{NM} * d\left(\frac{x}{\sqrt{N}}\right) d\left(\frac{y}{\sqrt{M}}\right) = \sqrt{NM} \begin{vmatrix} \frac{\delta(x/\sqrt{N})}{\delta r} & \frac{\delta(x/\sqrt{N})}{\delta \theta} \\ \frac{\delta(y/\sqrt{M})}{\delta r} & \frac{\delta(y/\sqrt{M})}{\delta \theta} \end{vmatrix} * drd\theta = \sqrt{NM} r dr d\theta$$

With all those information gathered by substituting θ and r into the original integral, we have

$$\int_{-\infty}^0 \int_{-x}^{\infty} \frac{1}{2\pi} e^{-\frac{1}{2}\left(\frac{x^2}{N} + \frac{y^2}{M}\right)} dydx = \int_0^{\arctan(-\frac{\sqrt{M}}{\sqrt{N}})} \int_0^{\infty} \frac{1}{2\pi} e^{-\frac{r^2}{2}} * r dr d\theta$$

Let $u = \frac{-r^2}{2}$, we have $du = -rdr$. Substitute r by u in the integral function, we have

$$\begin{aligned} & \int_0^{\arctan\left(-\frac{\sqrt{M}}{\sqrt{N}}\right)} \int_0^\infty \frac{1}{2\pi} e^{-\frac{r^2}{2}} * r dr d\theta \\ &= \int_0^{\arctan\left(-\frac{\sqrt{M}}{\sqrt{N}}\right)} \int_0^{-\infty} \frac{-1}{2\pi} e^u * du d\theta \\ &= \frac{-1}{2\pi} \int_0^{\arctan\left(-\frac{\sqrt{M}}{\sqrt{N}}\right)} e^u \Big|_{-\infty}^0 d\theta \\ &= \frac{-1}{2\pi} \int_0^{\arctan\left(-\frac{\sqrt{M}}{\sqrt{N}}\right)} 1 d\theta \\ &= \frac{-1}{2\pi} * \arctan\left(-\frac{\sqrt{M}}{\sqrt{N}}\right) \\ &= \frac{1}{2\pi} * \arctan\left(\frac{\sqrt{M}}{\sqrt{N}}\right) \end{aligned}$$

Thus, we concluded that

$$\int_{-\infty}^0 \int_{-x}^\infty \frac{1}{2\pi} e^{-\frac{1}{2}\left(\frac{x^2}{\sqrt{N}} + \frac{y^2}{\sqrt{M}}\right)} dy dx = \frac{1}{2\pi} * \arctan\left(\frac{\sqrt{M}}{\sqrt{N}}\right).$$

It then follows immediately that the possibility that winner changes is

$$\begin{aligned} & \int_{-\infty}^0 \int_{-x}^\infty \frac{1}{2\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{\sqrt{N}} + \frac{y^2}{\sqrt{M}}\right)} dy dx + \int_0^\infty \int_{-x}^\infty \frac{1}{2\sqrt{NM}} e^{-\frac{1}{2}\left(\frac{x^2}{\sqrt{N}} + \frac{y^2}{\sqrt{M}}\right)} dy dx \\ &= \frac{1}{2\pi} * \arctan\left(\frac{\sqrt{M}}{\sqrt{N}}\right) + \frac{1}{2\pi} * \arctan\left(\frac{\sqrt{M}}{\sqrt{N}}\right) \\ &= \frac{1}{\pi} * \arctan\left(\frac{\sqrt{M}}{\sqrt{N}}\right). \end{aligned}$$

Notice that $\lim_{x \rightarrow \infty} \arctan(x) = \frac{\pi}{2}$, so we know that

$$0 < \frac{1}{\pi} * \arctan\left(\frac{\sqrt{M}}{\sqrt{N}}\right) < \frac{1}{2}.$$

5 Odds of Winner Changes in Electoral Votes

After the possibility that winner changes in an election by popular votes is calculated, the next goal is to get possibility that the winner changes during the two stages of an election by electrical votes. To proceed, the following theorem is needed:

Theorem 3.1. Let A, B, C be three states with the number of electrical votes a, b, c respectively. Divide the election into two stages and denote the possibility that the winner changes between the two stages as f . Then if the sum of the squares of any two distinct elements in $\{a, b, c\}$ is smaller than the square of the rest element, the possibility that the electrical winner changes during the election is.

$$F = f \left(\frac{3}{2} - \frac{3}{2}f + f^2 \right)$$

Since it is shown that $0 \leq f \leq \frac{1}{2}$, we get.

$$\frac{3}{2} - \frac{3}{2}f + f^2 > 1,$$

which means that F is always bigger than f .

Notice that the above case is limited to three states with the property that the the sum of votes in any two states is smaller than the third.

To simplify the calculation, when considering more than 3 states, it is beneficial to set the electrical votes of each state to be equal. Moreover, in practice, since there will usually be more voters in the first stage of the election and few voters in the following up stage, it is also reasonable to assume that N is much bigger than M . With those assumptions, we automatically have $\frac{\sqrt{M}}{\sqrt{N}} \approx 0$. Since

$$f = \frac{1}{\pi} * \arctan \left(\frac{\sqrt{M}}{\sqrt{N}} \right).$$

the value of f will be very small. This means that the winner in each state is very unlikely to flip. Thus, this essay will only consider the cases wherethe flip of the winner of only one state can change the final winner of the election by electrical votes. The essay utilizes the following statement.

Theorem 3.2. Suppose there are $2k + 1$ states and $\frac{\sqrt{M}}{\sqrt{N}} \approx 0$. Denote the possibility that winner changes by popular votes as f . Then the possibility that the electrical college winner changes during the election is approximately.

$$\frac{(2k + 1)!}{(2^k + k!)^2} * f.$$

Next part of the proof is to show that $\frac{(2k+1)!}{(2^k+k!)^2} \geq 1$. In order to achieve that, an induction on k is constructed.

Proof: Base case: when $k = 0$, we have.

$$\frac{(2k + 1)!}{(2^k + k!)^2} = \frac{(1)!}{(1 * 1)^2} = 1 \geq 1.$$

Inductive hypothesis: There exists $k \in \mathbb{N}$ such that $\frac{(2k+1)!}{(2^k * k!)^2} \geq 1$.

Inductive step: We want to prove that the statement holds for $k + 1$ as well. To begin with, by our inductive hypothesis, we get Divide

$$\frac{(2(k + 1) + 1) !}{(2^{(k+1)} + (k + 1) !)^2} \text{ by } \frac{(2k + 1) !}{(2^k * k!)^2}$$

we have

$$\begin{aligned} & \frac{(2(k + 1) + 1) !}{(2^{(k+1)} + (k + 1) !)^2} * \frac{1}{(2k + 1) ! / (2^k * k!)^2} \\ &= \frac{(2(k + 1) + 1) !}{(2^{(k+1)} + (k + 1) !)^2} * \frac{(2^k * k!)^2}{(2k + 1) !} \\ &= \frac{(2k + 3) !}{(2^{2k+2} * (k + 1) !)^2} * \frac{(2^k * k!)^2}{(2k + 1) !} \\ &= \frac{(2k + 3) (2k + 2)}{2^2 * (k + 1)^2} \\ &= \frac{(2k + 3) (2k + 2)}{(2k + 2)^2} \end{aligned}$$

Since $2k + 3 > 2k + 2$, we know that

$$\frac{(2(k + 1) + 1) !}{(2^{(k+1)} + (k + 1) !)^2} * \frac{1}{(2k + 1) ! / (2^k * k!)^2} > 1$$

This implies that

$$\frac{(2(k + 1) + 1) !}{(2^{(k+1)} + (k + 1) !)^2} > \frac{(2k + 1) !}{(2^k * k!)^2} \geq 1.$$

Since $>$ is a total order, we immediately get that

$$\frac{(2(k + 1) + 1) !}{(2^{(k+1)} + (k + 1) !)^2} \geq 1.$$

finishing the inductive step.

Therefore that we can get the same conclusion by looking at the graph of (Fig. 1)

$$f(x) = \frac{(2x + 1) !}{(2^x * x!)^2} \geq 1 :$$

This finding implies that when the voters of the first stage is much larger than the voters of the second stage and we have an odd number of states, then the chance that the electoral winner changes during the election is bigger or equal to the chance that the popular votes winner changes.

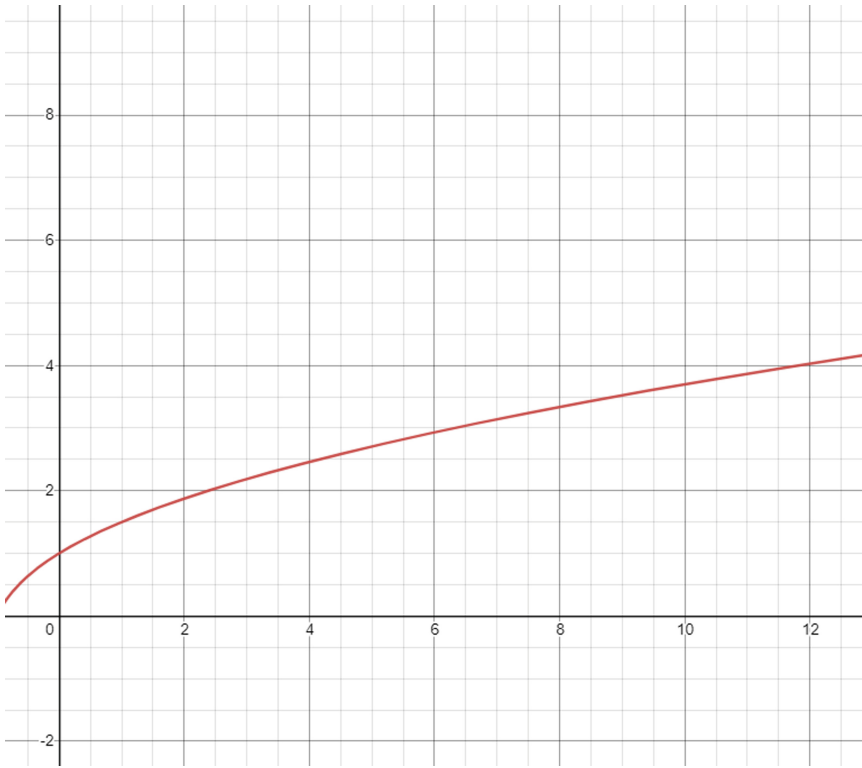


Fig. 1. The graph of the function $f(x) = \frac{(2x + 1)!}{(2^x * x!)^2}$. It is monotonically increasing in the first quadrant and has a local minimum of 1 at $x = 0$.

6 Computer Simulations

To test whether the whole proof above is correct, it is helpful to calculate the possibility that winner by popular votes changes among the three states: Alaska, Vermont, and Wyoming. The election is designed such that 60 percent of people vote in the first stage and 30% of people vote in the second stage. According to Proposition 2.1, the possibility that the winner by popular votes changes during the election should be.

$$\frac{1}{\pi} * \arctan\left(\frac{\sqrt{0.3}}{\sqrt{0.6}}\right) \approx 0.196.$$

A computer simulation in MATLAB is then built by using a sample size of 50, and each individual sample contains a possibility derived from 1000 elections. The generated result is as follows (Fig. 2):

The center of the distribution is very close to 0.196, conforming to the theoretical estimate.

Next, since the three chosen states have same number of electoral votes, it can be used to do the test of proposition 3.2. Suppose that 95% of people votes in the first stage and 5% of people vote in the second stage.

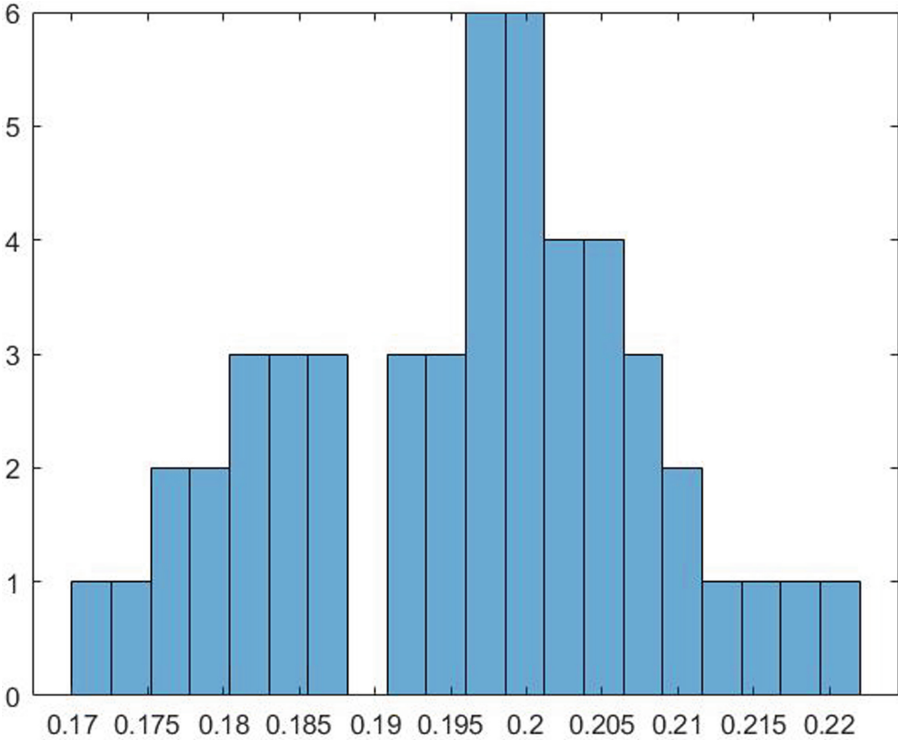


Fig. 2. This histogram visualizes the resulting probabilities of 50 computer simulations. It is normal in shape and shows that the probability interval between 0.195 and 0.2 contains the highest number of data points.

According to proposition 3.2, since there are 3 states, the chance of an electoral winner change is

$$F = \frac{(2k + 1)!}{(2^k * k!)^2} * f = \frac{(2 * 1 + 1)!}{(2^1 * 1!)^2} * f = \frac{3}{2} * f.$$

And by Proposition 2.1, f should be around

$$\frac{1}{\pi} * \arctan\left(\frac{\sqrt{0.05}}{\sqrt{0.95}}\right) \approx 0.0718.$$

So ideally, we should have

$$F \approx \frac{3}{2} * f = 0.1077.$$

And it seems that the result generated by computer simulations correspond perfectly with the theoretical possibility. These are strong indications that the computer simulation program works properly (Fig. 3).

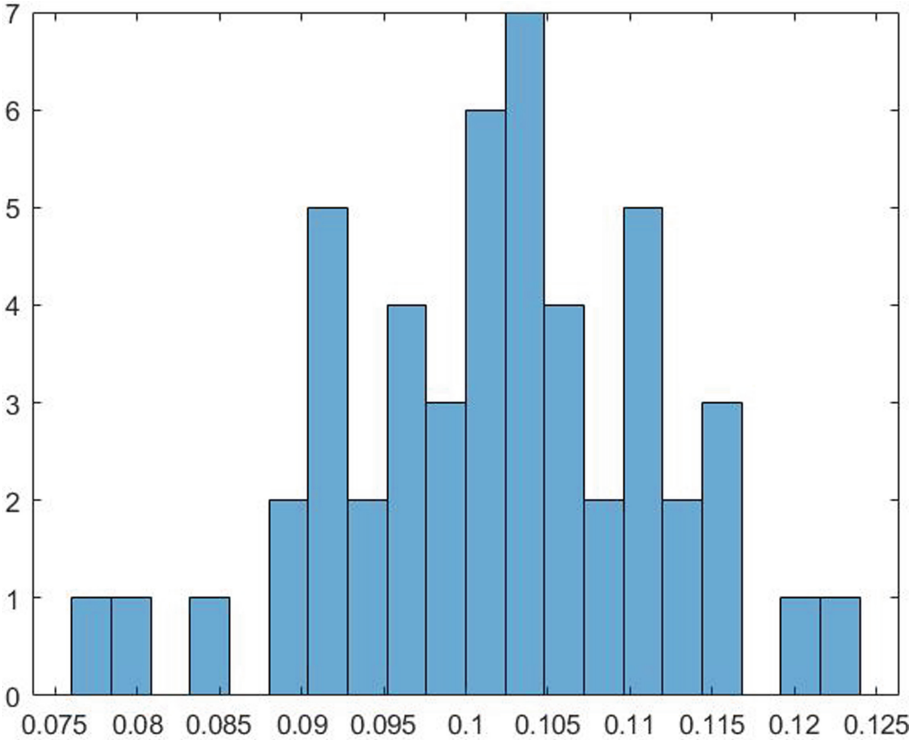


Fig. 3. The histogram of the probabilities that the winner changes during an election, gotten from 50 computer simulations using the new parameters. It centers around the interval from 0.1 to 0.105.

7 Conclusion

It is inspiring that the result after taking all states of US into the analysis is still the same as the result gotten from only these three specific states. The result also reveals the pattern that the possibility that the winner by electoral votes changes is always bigger than the possibility that the winner by popular votes changes. This implies that it is possible to prove more general forms of theorems elucidated in this essay. However, it will require plenty of more work. And since the simulation program of election is checked to function appropriately, it is justified to rely on the computer technologies to obtain the conclusion: the winners are more likely to change during the election if electoral votes rather than popular votes are used to determine the winner. This interesting difference, to some extent, makes US presidential election more competitive and unpredictable, encouraging voters to make their choice more wisely.

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Analysis of Insurance Industry in the U.S. Stock Market Based on Fama-French

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Abstract. A catastrophic outbreak has hit the globe, which there was no country can avoid. Every industry had hit by the COVID-19. This study aims to evaluate changes in insurance industry of American stock market during three stages of epidemic. As an industry that helps people avoid risk, the extent to which the insurance industry is affected indirectly shows how people are living under the pandemic. The data was adopted from the resource library of Kenneth R. French website. Also, Fama-French five-factors model was selected to analyze the index of given factors from March 2019 to June 2021 which divided to three periods. Afterwards, the multiple linear regression was conducted to obtain the parameters. According to the t-Stat and coefficients, market, profitability and investment style factors had more dramatic changes. The results indicate that investor preferred small companies and robust profitability companies. However, it has more opportunities for speculation, in the remission of COVID-19. It should be recommended that results can help the investors choose safer in investments of insurance industry.

Keywords: Fama-French five-factors model · COVID-19 · Insurance industry

1 Introduction

1.1 Background

The impact caused by COVID-19 was not only reflected in people's livelihood, but also had impact on the financial industry. According to current authoritative statistics, the COVID-19 crisis has caused a total loss of 255 million jobs by the beginning of 2021, four times the damage of the 2008 financial crisis. Generally, the decline in globe financial markets was still giant. If taking January 1, 2020 as the base to research the changes of the stock market in 2020, it can be found that the stock market of the United States experienced a larger decline in 2021. Especially in March, with many circuit breaker. European stocks were down about 40%. In May 2020, The Asian Development Bank (ADB) illustrated that the global economic cost of the Novel Coronavirus outbreak this year could be between \$5.8 trillion and \$8.8 trillion, or almost 10% of global Gross Domestic Product, more than double its earlier estimate as lockdown measures paralysed economy.

To study the ways that how the COVID-19 attracted financial, this article uses the Fama-French five-factors, which is one of the Capital Asset Pricing Model (CAPM) variants. CAPM mainly studies the relationship between the expected return rate of assets and risky assets in the securities market and how equilibrium price is formed, which is the pillar of the price theory of modern financial market and widely used in investment strategies. The key point of CAPM is to learn the quantitative relationship between risk asset return and risk, that is, how much rate of return investors should get in order to compensate for a certain degree of risk. The significance of CAPM is clarifying that the expected return rate of named securities is the addition of risk free interest rate and risk compensation, and also revealing the internal relationship of securities return. CAPM has well acknowledged by mostly securities theorists.

In 2019, COVID-19 had shocked all aspects of the world and human. So it's important to find ways which can cope with the crisis. Pak reviewed the response, epidemic situation, health situation and economic issues in different countries during the pandemic. The outbreak has not only become a public health crisis but also affected the global economy. The graph about COVID-19 number of cases shows that the number of confirmed COVID-19 of Europe and U.S have exceed China, the origin of epidemic. The ends shows that there were evident negative relationships between the daily number of COVID-19 cases and various stock indices. It concluded that financial markets will continue to be volatile and economic activity still to be disrupted, for that, it is necessary to epidemic preparedness [1].

The changes in financial markets during the pandemic are evident. Ali and Rizvi researched the influence of COVID-19 crisis on fluctuations in financial markets returns. They divided the spread of COVID-19 around the world in two parts, epidemic and pandemic, and three phases, only in China, spread to Europe and then to the North America. They collected and calculated dataset of the daily prices and returns of MSCI indices for the nine countries most affected by the outbreak. Using Exponential GARCH to understood the volatility of markets. In addition, in order to improve reliability of what they discussed, they utilize bivariate regressions. The conclusion is that financial markets has high level of volatility and uncertainty during the pandemic [2].

On the one hand, Huang et al. surveyed the ways that brand equity influence stock performance during the COVID-19 crisis. With the study of the stock market people found that brand equity has a positive impact on stock returns. The consequence, which came from analyzing 4 typical stock performance indicators: $R_{w_Rreturn}$, Abnormal Return, Systemic_Risk and Idiosyncratic_Risk and data of U.S listed firms confirmed The COVID-19 provides an opportunity to reassess whether brand equity mitigates stock crashes. The research, which shows top brands firms gone through higher stock returns, lower systematic risk and lower idiosyncratic risk during COVID-19, additionally it's stable, provided evidence about effect of brand equity on stock performance during the COVID-19 [3]. On the other hands, Salisu et al. investigated unknown response of emerging stock markets during the pandemics and epidemics (UPE), including COVID-19. By using new datasets due to pandemics and the global fear index for COVID-19, and building new models, they evaluated the stock return predictability of 24 emerging market stocks. In addition, what the contributions are examining the hedging effectiveness or vulnerability with the uncertain data bring from UPE, testing if the information of the

uncertainties can be used to generate the more accurate prediction of the emerging stock markets, considering a newly constructed global fear index and examining whether the response of the stock markets to pandemics is influenced by the level of integration. It can be concluded that uncertainty due to UPE impacted negatively more on emerging market stocks [4]. The stock market index is a vital indicator of stocks, and one can hedge risk with it. Farooq and Qudoods made a statistical analysis of stock market indices of 9 countries to study capital market efficiency. Lo and Mackinlay test, includes the rank variance ratio test, shows the rejection of the random of the random walk hypothesis in market efficiency's weak form. It's concluded the price was set without taking into account all factors which provides chance to interest arbitrage. Therefore, the research, estimates stock markets efficiency in a long period, includes COVID-19's wave, can be undertaken in the future [5].

As a part of financial products, insurance industry is closely related to people's life, this paper also focus on the fluctuation of it in the epidemic. Pius et al. made a comprehensive analysis of the impact of COVID-19 on the insurance industry, which took Ghana as an example from March to June 2020. Insurance in Ghana plays an important role in national economy, as the same time, it's economy has taken a hit during COVID-19. As the pandemic spreads, the likelihood of a banking increases based on the study. The rapid growth in health, travel and business claims influenced insurance industry, whose policy doesn't cover epidemics, in Ghana. The reaction on COVID-19 of insurance firms were poor at first, but recovered quickly [6]. Therefore, the loss continue to the end of 2020 and have a bounce back. In order to learn the beneficiaries of insurance, Bundorf and Kim analyzed the cross-section data from the US Census Bureau's 2020 HPS to understand the situation of insurance coverage changed during the COVID-19 pandemic. Over 50% study population is women who from 50 states. The rates of ESI declined for much of 2020, even after the early days of the epidemic. At the same time, employment was rising. People who returned to work did not recover their employer-sponsored coverage is provided. Enrollment in public programs increased throughout the year rather than private insurance. Overall, enhancing monitor and strengthen of the health insurance safety net is still a challenge [7]. Especially because of COVID-19, the unemployment rates had rose and the number of confirmed cases increased. I want to know if the health insurance took effect. Garrett and Gangopadhyaya offered a base case scenario of coverage changes for every level of unemployment rates that is divided into 15%, 20% and 25%. More and more workers lose their jobs and salaries with COVID-19 spreading. However, the medical insurance still is uneven across the country. The results show more workers and their dependents losing ESI will be eligible for Medicaid in states. Additionally, former workers habituated to having insurance coverage for themselves and dependent and who may have concerned if they have need for medical care. For that, increasing the federal matching rate could provide the crucial resources needed to protect the states most in need better [8].

A lot of crisis are unpredictable, however, I can anticipate the loss and prepare for it. John searched numerous articles, which forecast financial impact of other epidemics and pandemics, and emphasized economical and social impact of COVID-19. It is predictive that sketching the research on pandemics and finance by drawing on a variety of literatures predicted events such as COVID-19 on financial markets and institutions. It is

an obvious way that pandemics affect financial systems through huge economic costs. In banking, loans to the poor by microfinance institutions are more vulnerable. If COVID-19 could be considered insurance is a question to underwriting. In addition, discussed the impact of COVID-19 on governments and public, financial markets and costs of capital [9]. There are still a lot of questions for economists to ponder. And incorporating new technology into the response strategy can reduce the damage relatively. Douglas W et al. discussed how to use digital financial infrastructure to confront the unexpected challenges due to pandemics and manage the impending economic fallout. On account of it is difficult for finance to predict the possible crisis for now, people should pay more attention to the tools that support financial inclusion, sustainable development and achievement. As global crisis, unlikely the Global Financial Crisis of 2008, COVID-19 is a health and geopolitical crisis, which is spreading to financial markets and the real economy. Every country needs to continuously develop and upgrade digitization and use different digital tools to cope with financial and health crisis [10].

According to the Fama and French five-factor's more explanatory characteristics, this study aims to analysis the impact of COVID-19 on the insurance industry. By using multiple regression analysis, it is clearly to know that five factors affect significant changes in the insurance industry. Next, combined with the definition of five factors to research the changes of each factor, in-depth understanding and forecast the development of the insurance industry.

2 Methods

Fama and French five-factors added two factors, profitability (Robust Minus Weak, RMW) and investment patterns (Conservative Minus Aggressive, CMA), on the based of Fama and French three-factors, which includes markets, market capitalization (Small minus Big, SMB) and book-to-market ratio (High Minus Low, HML). Fama and French five-factors model is builds on the contents of Fama and French three-factors model.

The Fama and French three-factors model:

$$R_i - R_f = \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML + \varepsilon_i \quad (1)$$

This paper mainly uses the Fama French five-factors model:

$$R_i - R_f = \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML + \beta_4RMW + \beta_5CMA + \varepsilon_i \quad (2)$$

In the model, means return on assets i , refers to risk-free interest rate and represents the market rate of return. is also regarded as market risk return rate. is normal residual value term.

Compared with Fama and French three-factors, RMW and CMA of Fama and French five-factors reflect the growth of the company. High profit and low investment indicate that the company is in the entrepreneurial stage. High profits and high investment indicate that the company is in the stage of rapid growth; Low profits and high investment show that the company's prospects are grim.

This model help us study the relevance of the impact of various factors on the insurance industry before, during and after COVID-19.

3 Results

The daily five-factor dataset from the Kenneth R. French database are divided into three phase over time. May 2019 to February 2020, March 2020 to December 2020 and January 2021 to June 2021 respectively are the early stage of the epidemic, the most serious period of the epidemic and the relatively moderate period of the epidemic. Meanwhile I selected the stock data of insurance from 49 industry to research the effects of COVID-19 on it. Through multiple regression analysis of the above data, the three following tables were obtained (Tables 1, 2, 3).

Table 1. Multiple regression results of insurance industry before COVID-19 (2019.3–2020.2)

	Coefficients	Standard error	t Stat	P-value
Intercept	0.009	0.027	0.356	0.722
MKT	0.885	0.032	27.972	0.000
SMB	0.041	0.060	0.691	0.491
HML	0.212	0.061	3.466	0.001
RMW	−0.509	0.100	−5.116	0.000
CMA	0.436	0.118	3.699	0.000

Table 2. Multiple regression results of insurance industry during COVID-19 (2020.3–2020.12)

	Coefficients	Standard error	t Stat	P-value
Intercept	−0.008	0.041	−0.205	0.838
MKT	0.947	0.019	49.689	0.000
SMB	0.344	0.049	7.012	0.000
HML	0.469	0.040	11.618	0.000
RMW	−0.114	0.082	−1.390	0.166
CMA	0.056	0.105	0.536	0.592

According to these above tables, in the case of P-value less than 0.05, which means these factors are valid for analysis, the coefficients of MKT and HML both increased during the COVID-19 and decreased in the COVID-19 remission, in other words, first it became significant and then became insignificant. SMB is only effective in the epidemic. Before COVID-19, RMW was smaller than 0, but had become bigger than 0 after COVID-19 remission, CMA is just the opposite.

Table 3. Multiple regression results of insurance industry in COVID-19 remission (2021.1–2021.6)

	Coefficients	Standard error	t Stat	P-value
Intercept	-0.023	0.050	-0.467	0.641
MKT	0.818	0.065	12.546	0.000
SMB	-0.130	0.083	-1.570	0.119
HML	0.564	0.066	8.530	0.000
RMW	0.290	0.120	2.420	0.017
CMA	-0.501	0.131	-3.812	0.000

4 Discussion

4.1 MKT

In every section of COVID-19, the coefficients of MKT were all smaller than 1, which shows that the insurance industry's stock price was insensitive to markets and has been less affected by the market. In February 2020, the S&P 500 fell 6.13%, but insurance industry shares fell 15.799% in average, far outperforming the overall market. Actually there is still has difference in three data, 0.885, 0.947 and 0.818, the bigger one means which has the stronger relationship with market.

The number of people starting to buy life insurance in 2020 has growing by 15 to 30%. It most likely because of the fear caused by the pandemic. In the past, the insurance industry was largely considered as the promoting products, however, this epidemic has brought people enlightenment, which disasters are unpredictable, more and more people started accepting insurance as a way to avoid or reduce risk. The reason of the coefficients in the COVID-19 remission decreased may be people took a chance in the easing of the epidemic. At the same time, due to home isolation, less and less American decided to go to hospital, insurance company claim rates reduced, too. This is good for insurance companies.

4.2 SMB

The computing method of market capitalization is using the median to divide the stocks in the sample into two groups, that is, small and large groups, and using the smaller one minus the bigger one. The t-stat before and in remission of the COVID-19 were bigger than 0.05 which shows that there is no significant difference between the market and the stock price of the insurance industry. Therefore, the corresponding coefficients are invalid in this research.

The coefficients during the COVID-19 is bigger than 0, which means the revenue of small companies are better than big companies. Under normal conditions, many investors hold the opinion that small companies are more risky than big ones, fewer people bought insurance from smaller companies. Meanwhile, big companies have more products. Therefore, they have higher rate of return. However, during the pandemic,

the risk compensation effect of small companies was enhanced, big companies had to pay for high accident insurance and casualty insurance premiums, the people who buy marine insurance and property insurance were reduced, which attributed to a decrease in international trade. Small companies suffered less during the pandemic due to have a smaller in scope so they don't need have to pay out high premiums. Their business increased faster. More revenue and less loss, compared to big companies. By contrast, people are more optimistic about the prospect of smaller companies.

4.3 HML

The coefficients of HML always greater than 0 in each period, which means value stocks have outperformed growth stocks in insurance industry, and it kept getting bigger.

It is not hard to conclude although growth stocks is better than high-value stocks in potential. However, the growth stocks performance has been worse than value stocks' It is precisely because the stock price of the insurance industry had not fluctuated sharply during the pandemic, and the market's view of the future of the insurance industry has not changed much. With the development of the epidemic, value stocks may be at risk of a pullback after growth.

4.4 RMW

According to the definition, RMB shows the profitability of insurance industry by using robust data minus weak data. Before the COVID-19, the coefficients was less than 0, it could show that compared with robust companies, investors thought weak companies had more speculativeness and preferred weak companies. These weak companies have lower initial share prices, more space for growth and higher profit potential. Therefore, investors' preference lead to profitability that can't differentiate between rates of return. During the pandemic, a huge increase in premiums that companies have to pay, the revenue of overall insurance companies suffered squeezed and the share price fell. Investors had returned to rational thinking.

In remission of COVID-19, the coefficients final increased to greater than 0. Investors are focusing on robust companies who had ability to launch more products. For example, Safeco: 15% off premiums for April and May 2021. Famrrs: 25% off premiums for April 2021. Geigo: 15% off premiums for renewal or new policies. Hence, it could say recent investors prefer certainty.

4.5 CMA

CMA is a variate that describes whether investors prefer conservative or aggressive investment patterns and makes conservative ones minus aggressive ones. Due to t-Stat, the coefficients during the COVID-19 is indistinctive. This study only analyzes the data before the COVID-19 and in the remission of COVID-19. Before COVID-19, the coefficients was greater than 0 which means the market pattern is relatively stable. Investors also preferred conservative investment models.

In the remission of pandemic, the coefficients reduced to -0.501 , which reflects that the investment market opportunity is here again. Trading activities among investors began

to pickup. In addition, the acquisition news of insurance was more frequent than before the pandemic. In American capital market, for example, Brookfield Asset Management agreed to buy National Insurance for nearly \$5.1 billion in an all-cash deal according to the news in August 9, 2021. As one of the leading providers of solution in the insurance operation industry, Resource Pro announced that in September 2021, it has completed the acquisition of America Insurance Services Company (ILSA). On September 17, 2020, State Farm, the largest insurance company in the United States, announced the acquisition of auto insurance GAINSCO for approximately \$400 million in cash. The move by investors is aimed to consolidating the market.

5 Conclusion

This study classifies the data from March 2019 to June 2021. In order to evaluate the impact of the epidemic on investment in the insurance industry, the data were analyzed by using the Fama-French five-factors model and performing multiple regression. It was found that the market was insensitive in three periods because the coefficients of market were all smaller than 1. Stocks of small companies were more favored by investors than big companies because the risk of small companies was smaller than the big ones in pandemic. As the epidemic develops, value stocks were favored by more investors. Before the pandemic, the companies with weak profitability were more speculative. Nevertheless, investors were making more rational investment in robust companies in remission of COVID-19. The impact of the epidemic had brought more investment opportunities to the market and increased acquisition behavior. Moreover, this study suggests that the investors could pay more attention to stocks with small size and robust profitability.

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Exploration of New Marketing Methods

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Abstract. Under the influence of the arrival of the new media wave and the emergence of endless social platforms, marketing models have also appeared more ways to play. These new marketing models are easier than before to unknowingly implant products and concepts into users' brain, it also governs the user's purchase and use behavior. Here are a few so-called new marketing models.

Keywords: Situation market · Trigger · Data · Algorithm first section

1 Introduction

With the end of the first 20 years of the new century, no matter in areas where business development has matured in Europe, the United States and Japan, or in developing countries in Asia, China, with the changes in technology and people's constant familiarity with the laws of the objective market, Marketing methods are becoming more diverse and pervasive than ever before. Traditional marketing models include television advertisements, celebrity endorsements, and traditional paper advertisements. Compared with tradition, under the wave of new media brought by the Internet, new advertising is more people-oriented, more story-telling, more data-oriented, and new media support. No matter how you change and bring forth the new, focusing on product usage scenarios, big data analysis and price factors are always the magic weapon to win market opening and sales.

2 Analysis

2.1 Situation Drive You Make an Option

When the players are celebrating in NBA final champion, they often open a bottle of champagne. They are not likely to drink beer, red wine or Whisky. It is irrespective of the taste, the alcohol. May be the champagne has the similar pronoun with the champion? That is not enough. It is just because it can create an atmosphere. Specifically, once you open the champagne bottle, it will produce a sweet-sound, and people enjoy spray the champagne to each other. So the atmosphere produced by champagne are comprise of the sound, the taste, and the exciting feeling. So the situation emphasizes giving the users or buyers a certain experience that can trigger them make same option every time whoever win the champion. Similarly, when milk company advertise their dairy

product they will create a healthy lifestyle in the sunshine morning rather than tell their customer the milk function that can strengthen your bone with calcium. When you watch Nike's ads, it transmits a spirit of asking for more challenge and inspiring your breakthrough in the limit. You never found that it talk about what material they you used or the beautiful color. Mercedes-Benz makes the driver or the vehicle owner feel they are successful career and have an exquisite and decent life. Different situation contain different stimuli. All products we mention above, when you choose them, you may imagine the specific situation in which you are using them. The internal mechanism of the effect of situation marketing comes from the behavioral differences corresponding to different user's psychology. Therefore, only by establishing an effective connection between the user's psychology and the situation, can we maximize the value of the "situation" in marketing. It can be said that "insight into the user, directly touching the heart" is the core of scene marketing.

The practical value is important, but the situation is the trigger that makes you choose them instead of other competitors' product. Positioning is a systematic tool that can help you find a window in the user's brain. It is based on the concept that communication will happen in the right environment at the right time (Alries 2001). The limitation of determining when is the right time and circumstance is increasingly apparent.

2.2 Beyond the Practical Value, the Story of the Product Can Trigger Customer Movement

In China, there is orange brand called "Chu orange" the founder is an entrepreneur, who was very successful and respectable. But he went to jail for 12 years because of corruption. After he was back, he was already 74 years old. He, however, chose to start up again and started to grow orange in China. At the beginning he did not know any knowledge about any technique about agriculture and he failed again and again. Finally, after 10 years effort, he grows most sweet orange. From 2006 to 2013, "Chu orange" grow an average of 1.37 kiloton per year, In 2014, "Chu orange" Sales \$ 100 million, net profit reached more than 70 million. The legend is best format of advertisement. Successful companies find that reputation and image are the most important of all product features. Image Age architect David Ogilvy once said in a famous speech on this theme: Every advertisement is a long-term investment in the image of a certain brand (Alries 2001). The "Chu orange" become popular even craze most likely because of its founder's story. In his legend, he established an image of never giving up.

2.3 Data Analysis Can Demonstrate that What Practical Value the Customer Focus on and What Feature Can Attract the User

It is believed that the number can tell you what your next step will be. The algorithm can identify which information is relevant to you, and it can locate which information is your preference. It can calculate what is hot news, what is hot discussion, and what is trend. (Gillespie 2014) So, when people are surfing on the internet, cookie function can introduce their preference of information. It is easy for business to find trigger. There is a video app called Tiktok in China. It provides various short video content including cooking, sport and learning etc. The video can switch easily with a slide. Instead of the

method of content recommended by Facebook, Instagram, or YouTube, the TikTok uses algorithm to tailor content for the individual user according to what category of video they prefer to watch (Klug 2021). If you are interest in the content of video, you will be keep watching it. If not, you can change to another one. Depend on computer algorithm, the app can collect the data such as: how many seconds you stay on the same video, what kind of content you comment on even a critic, and which video you download. What is next? It can be found that you will be always exposed on the video you like and you cannot stop it. One's action is driven by his or her thinking both rationally and emotionally. When you control customers' emotion, your product will definitely catch on. For creators, the purpose of understanding the algorithm and exploring the regular pattern of the algorithm is actually to optimize the user experience by catering to the algorithm. In this way, there is an endless loop where users give feedback to the behavior of the algorithm, and the algorithm gives feedback to the user's behavior (Klug 2021). So this is also a problem that the algorithm needs to solve, how users can break through the boundaries of their own knowledge or preferences. Another problem is that when users are endlessly indulging in their favorite content, the content at this time is like opium. Laws are needed to regulate the behavior of some algorithms. For example, after a certain amount of the same content can be recommended, the recommendation must be stopped or switched to other types of content.

2.4 Simple Common Sense Can Change the World

After Huang Zheng, a Chinese merchant, had lunched with Warren Buffet, he recalled that What Buffett said was actually very simple, something my mother could understand. The greatest significance of this meal to me may make me realize the power of simplicity and common sense. Reasonable even cheap price turn out to be strongest trigger pushing consumer choose the product. Huang Zheng may understand the true meaning of common sense and He start up Pinduoduo which is the one of the e-commerce platform in China. The success of Pinduoduo is determined by a simple and common sense—cheap price. You can't imagine that customer can buy an Apple mobile phone for a penny. Another reason for the success is to choose second- and third-tier cities with a larger population base for publicity and promotion. The price factor is a very important consideration in determining the purchase process. It is an important value that many consumers evaluate before making a purchase decision (Arjuna and Ilmi 2020).

2020 witness about 3million new electric cars that were registered. 1.4 million new register come from Europe, which is the first time leading position for European market. 1.2 million from China and 295000 from America (Global EV outlook, 2021). On August 26, according to Cleantchnica's statistics, as of the end of the second quarter of 2021, Tesla Model 3 sold more than 1 million vehicles worldwide. This result made Tesla Model 3 the world's first model with sales exceeding one million. Electric car. Although Tesla have other flagship vehicle such as Model X, what can help Tesla dominate the market is still the Model 3 with lower price. An interesting phenomenon is that after the completion of the Tesla Shanghai factory, the sales of Tesla model 3 after being made in China for nearly half a year have been close to the sales of the past two years. This fully shows that prices can move the mass market, which may be simpler and rude than any marketing method. So, applying regional differential pricing strategy can increase

sales in different regions: taking low-price competition strategies in areas with lower consuming levels, and appropriately increasing prices in areas with higher consuming levels (Dai 2020).

In the mobile phone market competition, at that time there were already big-name mobile phones such as Apple and Samsung occupying most of the market share, but Xiaomi mobile phones were still emerging. Now Xiaomi mobile phones have occupied most of the domestic and even global mobile phone market. Because the founder of Xiaomi also wanted to let more people use smartphones, so while ensuring the performance of the mobile phone, the manufacturing cost of the mobile phone was kept to a minimum. Usually, buying an Apple phone in China sometimes costs 5,000–10,000 yuan, while Xiaomi's phone is less than 2,000 yuan. Such a low price and hunger marketing will inevitably not stimulate sales. At the same time, Xiaomi has also expanded its business to countries such as India where consumption levels are not high but there is a large demand for smartphones (Table 1).

Table 1. Worldwide smartphone shipments and growth Canals Preliminary Smartphone Market Pulse: Q2 2021

Worldwide smartphone shipments and growth Canals Preliminary* Smartphone Market Pulse: Q2 2021		
Vendor	Q2 2021 shipments (% share)	Annual growth
Samsung	19%	+15%
Xiaomi	17%	+83%
Apple	14%	+1%
Oppo	10%	+28%
Vivo	10%	+27%

Note: Percentages may not add up to 100% due to rounding

Source: Canals estimates (sell-in shipments). Smartphone Analysis, July 2021

3 Conclusion

If you want to succeed today, you must face the reality and consider the ideas that are already in the minds of prospective customers in reality (Alries 2001). It is getting harder and harder to innovate and create things that people don't have in their minds (Alries 2001). There was a cool ad slogan: Technology is people-oriented. The irony is that this was an ad slogan from Nokia, the once king of the mobile phone industry, but apparently it failed to do this, so it was eventually eliminated. On the contrary, the companies that are currently at the top of the wave, those that are truly people-oriented, are not only people-oriented in technology, but also people-oriented in products and marketing. Whether from the scene, technology or price, in the end, we are still unfolding around the constant cognition of human nature. The cognition of people's social attributes, the cognition of people's behavior, and the cognition of people's psychological attributes.

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The Impact of Covid-19 Epidemic on Global Food Security and Countermeasures

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Abstract. The global pandemic of COVID-19 epidemic poses a severe challenge to the maintenance of global food security. In the paper, the impact mechanism of Covid-19 epidemic on global food security is deeply analyzed, and the measures taken by China to deal with food production governance are taken as a case to prove it. On this basis, the governance measures to alleviate the impact of Covid-19 epidemic on global food security are put forward from many links of food supply chain, such as food production, food demand, food trade and food aid, which can provide reference for countries and international organizations to formulate effective policies to maintain food security.

Keywords: COVID-19 epidemic · Food supply chain · Global food security

1 Introduction

Apart from causing ill health and death, the novel coronavirus epidemic has also led to disruptions in production and loss of income. One of the most serious consequences may be the reduction of human access to food. On July 13, 2020, the “World Food Security and Nutrition in 2020” jointly released by the five United Nations agencies showed that [1] 690 million people in the world are currently hungry, and 130 million more will be hungry this year. In addition, 25 countries will face severe hunger risk this year, and the world is on the verge of the worst food security crisis in at least 50 years. According to the World Food Program, the number of people in severe food insecurity in 54 World Bank Group International Development Association (IDA) countries increased by 96 million in 2020, and the original 137 million at the end of 2019. By the end of 2020, the total number of food insecure people in the world reached 233 million.

Since 2020, the world hunger situation has deteriorated sharply. The impact of the COVID-19 epidemic may be the main reason for this situation. The COVID-19 pandemic and its prevention and control measures will affect the food system in many ways. First, restricted labour mobility and reduced access to markets may increase food waste while reducing food supply. It should be pointed out that the greater impact lies in the distribution of food. The restrictions on the spread of the virus are undermining the processing and transportation of food, increasing the delivery time and reducing the supply. Poor distribution of food may make food in some places scarce and thus more expensive, making it unaffordable.

The report of the World Food Program calls for the adoption of measures as soon as possible to mitigate the socio-economic impact of the epidemic. It calls on governments to work closely with relevant organizations to expand real-time monitoring of food security, reserve emergency humanitarian food and nutrition assistance for vulnerable groups, provide social security systems to vulnerable countries, increase support for food processing and transportation, and keep trade corridors open.

The global pandemic of the COVID-19 epidemic has posed a severe challenge to the maintenance of the global food safety belt. Based on an in-depth analysis of the impact path of the Covid-19 epidemic on global food security, this paper proposes governance measures to mitigate the impact of the Covid-19 epidemic on global food security from various aspects of the food supply chain, such as food production, food demand, food trade and food aid, which will provide reference for countries and international organizations to formulate effective policies to safeguard food security.

2 Literature Review

The “State of World Food Security and Nutrition 2021” was released globally on July 12 this year [2]. This year’s “State of World Food Security and Nutrition” is the first such global assessment report released after the outbreak. The report is jointly released by the Food and Agriculture Organization of the United Nations (FAO), the International Fund for Agricultural Development (IFAD), the United Nations Children’s Fund (UNICEF), the United Nations World Food Programme (WFP) and the World Health Organization (WHO). The heads of five UN agencies wrote in the preface of this year’s report: “Unfortunately, the epidemic continues to expose the problems in our food system, which are threatening the lives and livelihoods of people all over the world. The report pointed out that even before the outbreak, hunger had begun to spread. Efforts to tackle malnutrition are lagging behind. Countries facing conflict, extreme weather or economic recession, or with severe inequalities, are often facing more severe situations. The report points out that all these problems are the main factors causing food insecurity, which in turn will aggravate the severity of these problems. The report further pointed out that in many parts of the world, the epidemic has triggered a severe economic recession, further endangering food access.

Zhang Jiaolong starts from the political attribute of food [3], pays attention to the political motivation behind the pandemic’s negative influence on global food security, and use other non-economic factors to analyze this impact. Emphasizing the governance dilemma of global food security reflected by the epidemic, he pointed out the comprehensive perspective of human security and global governance, and puts forward short-term and long-term suggestions to deal with the challenge of the epidemic from the governance perspective. Li Chunding and Liu Yuanting analyzed the global food security risk under the epidemic from the aspects of production, trade and demand, and put forward corresponding countermeasures [4]. Wang Zhongjing and Wei Zhang [5] focused on analyzing the impact of the epidemic on China’s food security. The paper pointed out that due to the impact of the global epidemic, the supply and demand of the global food market are full of uncertainties, and effective measures must be taken to ensure the supply of important agricultural products, especially food, to ensure China’s food security.

The paper discusses the measures the Chinese government has taken to deal with the impact of the epidemic on food security, and puts forward further countermeasures from aspects of food production, food reserves and food security legislation.

Tewodaj Mogues [6] studied the main ways to affect the food market during the novel coronavirus epidemic, i.e. the impact on the production stage of the food supply chain, the middle and lower reaches of the food supply chain, and analyzed the relationship between demand side, price development trends and food security, analyzed the development trend and policy recommendations of international trade in food products, and proposed existing and proposed policies and interventions to expand access to food.

3 Analysis on the Mechanism of COVID-19 Epidemic Affecting Global Food Security

3.1 The Pandemic of the COVID-19 Epidemic Has an Impact on Food Production and Food Supply

In order to prevent and control the epidemic, more than 60 countries around the world declared a state of emergency, some of which were “states of war” or “states of war”. Measures adopted included closing border ports and restricting the movement of domestic personnel. These restrictive activities have affected the flow of labor, the transportation of goods, the supply of means of agricultural production and the production of grain. The trade disruption caused by the epidemic has affected access to factors of production in low-income countries that need to buy fertilizers, chemicals and improved seeds from abroad. The high concentration of factor supply-side markets, especially fertilizer markets, may magnify the risks faced by factor importing countries. In addition, anti-epidemic measures such as home quarantine will also restrict the flow of workers in the food and agriculture industry, to a certain extent aggravating the shortage of agricultural labor, delaying the farming season and affecting food production. Although the major crop agriculture in developed economies and some emerging markets has been highly mechanized, in low-income countries, the harvesting operation is still in the stage of combining labor, animal power and capital equipment. Rural areas may face labor shortage due to the increase in the number of patients infected by farmers.

3.2 The Epidemic Has Affected the Processing and Circulation of Food Supply Chains

Compared with the production stage, the downstream processing and circulation stages in the supply chain are more seriously disturbed. Post-production processing and trade are mainly carried out in cities with high population density and the surrounding areas of the cities, so they are at higher risk of infection and are more vulnerable to the government’s restrictive activities. The food processing sectors in Africa and Asia are mainly small and medium-sized informal enterprises, which are mainly dependent on workers and less dependent on mechanical processing. Their logistical and financial capabilities are not strong enough to maintain good hygiene and health standards in the workplace, which in turn increases their relative vulnerability. It is therefore highly probable that its processing business will be affected by the epidemic and shut down [7].

Even modern supply chains in developed economies have not been immune to the novel coronavirus epidemic. Farmers and consumers have been negatively influenced by backward and forward links respectively. In April 2020, over 4,900 positive cases have been identified [8] in about 500,000 employees in 115 meat processing plants in the US [8], which led to the temporary closure of 40 meat processing and packaging factories. As a result, the supply of beef and pork to retailers have been reduced by approximately 25% over the next three weeks. Belgian farmers, for example, face a potato glut and mass waste because a dish of potatoes that Belgians normally eat in restaurants and bars instead of home-cooking is no longer on sale. Such farm waste is also occurring in high-value perishable goods including fruits, vegetables, and milk, as demand links between farms and restaurants in industrialized countries are cut off, suggesting that supply chains lack the flexibility to adapt themselves to the new retail terminal structure.

3.3 Impact of Trade Protection and Export Restrictions Arising from the Epidemic on Food Supply

Since March 2020, Algeria, Turkey and other countries have increased their food reserves by suspending food import tariffs and exempting them from value-added tax. The uncertainty and pessimistic expectation of the future food supply in the international community have resulted in countries taking countermeasures one after another. Russia, Belarus, and other 14 food exporting countries announced that they would suspend or ban food exports or impose quotas on some agricultural products. Like Russia – the world’s largest wheat exporter, global food supply could largely rely on some of these countries. These countries’ policies of restricting food export may lead international food prices to sharp fluctuations, change market expectations of food supply and demand, and interfere with the global food supply chain, which may lead to food shortages.

At present, the initiative in international food trade is in the hands of a few big food countries, which is prone to the situation of “a few countries disturbing the whole world”. The epidemic has increased the uncertainty of food supply and demand, causing many countries to adopt export restrictions and “stationing grain” protection measures, including Vietnam, the world’s third largest rice exporter, Kazakhstan, the world’s major wheat exporter, Russia, India and other countries. Although these restrictions are temporary and most have ended, they have contributed to bad market expectations and panic.

3.4 Increase in Prices and Pressure of Hoarding Brought About by Food Speculation

With the development of commodity capital market, the relationship between agricultural products market, commodity capital market and foreign exchange market is increasingly close. Changes in the expected price of grain directly affect speculation in the futures market, increasing price volatility and uncertainty. The impact of the epidemic will bring about the expectation of food shortage and price rise. The commodity market will stimulate the rise in the price of food futures, superimposing the corresponding speculation, and further driving the instability and fluctuation of food prices (Fig. 1).

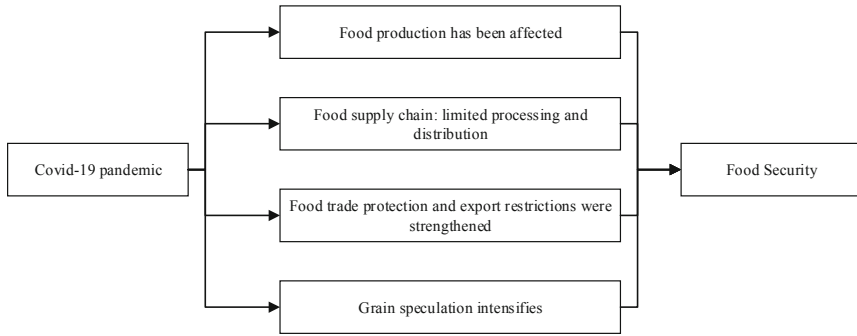


Fig. 1. Mechanisms of COVID-19 affects global food security

3.5 Management and Countermeasures of Food Production Under the Epidemic Situation-Measures of China

The key point to deal with the global food security risk is to increase the production and supply of food and reduce the shortage and shortage of food. In the short term, various measures are needed to encourage and increase farmers’ enthusiasm for grain production, increase the area of grain cultivation and reduce the impact of the epidemic on grain cultivation and processing. In the long run, the efficiency of grain production and the unit output of grain cultivation will be improved through measures such as agricultural science and technology innovation, digital agriculture and the development of vertical agriculture.

In the 2020 Government Work Report, China proposed that ensuring food and energy security is an important part of the government. In terms of food production and supply, China has mainly strengthened the work of the following parties.

We will adhere to the “trinity” protection of arable land in terms of quantity, quality and ecology, and thoroughly implement the plan of storing grain in the land. We will further strengthen the protection of arable land to ensure that the “red line” of 1.8 billion mu of arable land across the country is unbridgeable. We will intensify the construction of high-standard grain fields to ensure the completion of 1 billion mu of high-standard grain fields nationwide in 2022, laying a solid foundation for high and stable grain production. We will continue to carry out actions to protect and improve the quality of cultivated land. Measures such as deep tillage and subsoiling, straw returning to the field, soil testing and formula fertilization will be taken to protect and improve the soil fertility of cultivated land and store grain in the ground.

We will improve the agricultural science and technology innovation and service system, and promote the storage of grain in technology. We will raise the level of scientific and technological innovation in agriculture and speed up its popularization and use, so as to enhance our grain production capacity and our ability to prevent and mitigate disasters. Especially when the natural risks of grain production in the country this year are higher than in previous years, we should base ourselves on fighting against disasters to seize a bumper harvest, formulate a strong emergency plan, give full play to the supporting and leading role of scientific and technological innovation, promote the promotion of grain integration technology, and promote “grain storage in technology” by upgrading

high-quality varieties and their supporting technologies and agricultural machinery into two wings.

To better ensure food security, it is necessary to protect the main production areas and farmers' enthusiasm for growing grain. We will increase policy support for grain production, increase general financial transfer payments to the 13 major grain-producing areas, and increase the amount of financial awards and subsidies in major grain-producing counties. We will raise the subsidy standard for grain producers, adhere to the implementation and improvement of the minimum purchase price system for rice and wheat, and improve the emergency plan for the purchase price of grain. Under the background of the epidemic, the minimum purchase price of rice and wheat will be moderately increased. The implementation of the policy of "high quality and high price" will promote a steady increase in farmers' income. We will expand the types and coverage of agricultural insurance so that more food producers can enjoy the insurance's role.

4 Global Food Security Governance Under the COVID-19 Epidemic

4.1 Governance Measures for Food Demand and Consumption Under Epidemic Situation

The economic downturn, increase in unemployment and decrease in income brought about by the epidemic will reduce the ability of the poor to purchase and consume food and increase the risk of food security at the demand level. While food aid became more necessary during the novel coronavirus epidemic, some of the policies that provided such aid were affected by policies that sought to ease the health crisis. For example, 197 countries have taken measures to close schools. As a result, school feeding programs for children from poor families have been suspended. According to an estimate by the UN Food Program, 368 million children have thus lost the opportunity to receive school meals. Only some governments have enacted compensation measures, including food rations for school children to take home and cash grants for families of children.

In view of the impact of demand side, the first thing to do is to increase the income of residents, to ensure the stability of food consumption on demand side, and to enable people to obtain healthy meals under a limited income level. This will be the key to reduce the food security of low-income groups. In terms of specific control measures, in the face of the impact of the epidemic, we can adopt various ways to increase residents' income, such as tax reduction and fee reduction and direct subsidies, adopt employment promotion policies to reduce income inequality, and optimize the nutrition and food supply chains to reduce the cost of healthy meals, improve economic affordability and safeguard demand and dietary health.

Second, in order to achieve the goal of reducing food insecurity on the demand side, a trade-off should be considered between direct food distribution, food supply through food stamps and cash transfers. Direct food distribution has a relatively higher risk of causing the spread of the virus than digital food stamps or cash assistance, especially when logistics are not carefully managed and recipients have to wait in crowded spaces. Poor management and poor planning could also lead to riots and stampedes. In some

areas, food for distribution was too late and not enough to be distributed to all. Vietnam and Indonesia put forward an innovative allocation method during the novel coronavirus epidemic to better achieve the goal of maintaining social isolation. It is called “rice automatic teller machine”. Under this method of distribution, people (who need to register and qualify in advance in Indonesia) can extract a certain amount of rice from supervised distributors located in major cities. Due to the logistics requirements for transporting and storing large quantities of products, direct provision of food may require more operating costs than managing food coupons or cash transfers.

Compared with cash transfers, food distribution also has some potential advantages. First, if food security is the primary or sole objective of aid, the objective of food security may be partially weakened once beneficiaries have diverted cash for other, perhaps equally worthwhile, purposes. The second advantage of food distribution is reflected in the high volatility of food prices. In this case, the value of food transferred by cash may decrease rapidly. The amount of cash payments must therefore be adjusted in a timely manner to reflect rapidly rising food prices. Value-based, rather than volume-based, food coupons, like cash assistance, require similar adjustments.

In addition, there is also a need to tackle the worldwide problem of food waste, which consumes excessively from the demand side and consumes scarce food resources. The United Nations Food and Agriculture Organization (FAO) pointed out in its “State of Food Security and Nutrition in the World 2019” report that about one-third of the world’s food is consumed and wasted every year, with a total amount of about 1.3 billion tons per year. Therefore, promoting the international community to reduce food losses and waste and advocating conservation are important aspects to mitigate food security risks. The United Nations Food and Agriculture Organization has designated September 29, 2020 as the world’s first “International Food Loss and Waste Awareness Day” to promote food conservation.

4.2 Measures to Control Food Trade and Circulation Under the COVID-19 Epidemic

The lack of smooth food transportation and food export restrictions brought by trade protectionism are important factors that aggravate the food security risk during the epidemic. Judging from the world’s food supply and demand, what really triggers the risk of global food security is not the shortage of food supply, but the artificial obstruction of food supply, i.e. poor circulation and trade protectionism.

A few nations forced food trade limitations during the 2008 food price crisis, and some of them are currently re-adopting such measures. During that crisis, 33 countries have imposed food export restrictions from January 2007 to March 2011, to protect their populations from further increases in domestic food prices. After the novel coronavirus outbreak, in less than two months (March 18 to May 11, 2020), according to the statistics of Tewodaj Mogues [6], 22 countries have initiated export restrictions on one or more food products, and many countries have reduced food import tariffs to reduce domestic prices while adopting such measures. Export restrictions can have a significant impact if they involve staple foods, especially if the global market relies heavily on the countries where the restrictions are applied. Such restrictions are probably going to threaten food security in countries with high food dependency and relatively high levels of hunger. In

these nations, people living in urban areas have greater needs on imported goods than rural residents – even for the same commodity – and thus suffer more from food trade controls.

Specific measures for governance include strengthening global cooperation, ensuring smooth logistics and eliminating trade protectionism and export restrictions. At the same time, we will simplify the customs procedures, improve the efficiency of customs clearance, and promote the facilitation of food trade. We will support the development of cross-border e-commerce, break time and space constraints, promote trade and promote the global balance of food supply and demand. A multilateral approach must be adopted to ensure that all countries that adopt emergency food trade measures remain transparent to the international community regarding the details of such measures (e.g. by informing the WTO secretariat). In accordance with this approach, states should also undertake to exercise self-restraint and ensure the pertinence, temporality and appropriateness of these measures as far as possible.

The COVID-19 epidemic combined with natural disasters, to a certain extent, hindered the circulation of food and triggered restrictions on food exports, resulting in market panic and price increases, which in turn led to speculation in food commodity markets and commodity capital markets, exacerbating the risk of global food security. Speculation governance and measures for the food price stabilization are related to the national economy and the people's livelihood. It is necessary to strengthen speculation governance, crack down on speculation and stabilize food prices in order to ensure food security.

The main focus of controlling speculation and stabilizing prices is to maintain the stability of food supply and demand, especially to ensure food supply and eliminate fears and expectations of panic. This requires ensuring food circulation and free trade, strengthening international cooperation and increasing food output and supply. At the same time, it is necessary to crack down on and punish those who artificially create expectations of fluctuations in food prices, create price hikes and panic over shortages. We should establish an effective mechanism to prevent speculative capital from entering the food commodity market.

4.3 Food Aid Measures Under the COVID-19 Epidemic

Food production depends on natural conditions and labor force, and the uneven distribution of resources results in the imbalance of production between regions. Some parts of Africa have suffered successive droughts, locust infestations and COVID-19 epidemics, and the agricultural infrastructure was originally relatively weak. Coupled with political instability, the problem of food security is prominent. In a few extremely poor countries, the economy depends on the export of resource-based products and the food is heavily dependent on imports. Under the situation that the epidemic has led to a decrease in demand and price of resource products, the income of these countries has dropped sharply, the expenditure on imported food has increased, and the financial crisis has triggered a serious food security crisis.

Therefore, poor countries and poor people are the main affected groups of food security under the epidemic, and relief measures must be adopted. In terms of specific governance, on the one hand, the United Nations Food Programme (WFP) and relevant

regional food aid agencies are required to further strengthen food aid work, adjust surplus and deficiency, and ensure global food security. On the other hand, the world's major food producers and countries with food surpluses should actively participate in food aid to help the most backward countries get rid of poverty and hunger.

As the world's largest developing country and a responsible power, China actively participates in the governance of world food security, contributing "China's wisdom" and "China's contribution" to safeguarding world food security.

First of all, China has one-fifth of the world's population, and its grain output has reached one-fourth of the world's. The self-sufficiency rate of the three major grain producers exceeds 98%. China has basically achieved self-sufficiency in grain by relying on its own strength, and has changed from a grain recipient country to a foreign aid country. At the same time, since the outbreak of the epidemic, China has taken a series of measures to ensure food production and supply, advocating the "CD-ROM Action", stopping food waste and enhancing residents' awareness of food conservation. The achievements and effective measures have provided the world with solutions and wisdom to deal with food security.

Second, China has earnestly fulfilled the WTO commitments, expanded the opening to the outside world, gradually eliminated non-tariff measures such as import tariff quotas and licenses for related agricultural products, comprehensively strengthened international exchange and cooperation in agriculture, promoted participation in the formulation of international rules such as the International Food Code, actively participated in, sponsor or host important international agricultural conferences, and promoted the formation of consensus among countries on the governance of food security.

Finally, China has actively carried out agricultural foreign aid and cooperation. China has provided people's livelihood assistance to countries along the "the belt and road initiative" in areas such as poverty alleviation, agriculture and environmental protection, and helped underdeveloped countries and regions such as Africa to develop agriculture and food production.

5 Conclusion

The global pandemic of the COVID-19 epidemic has posed a severe challenge to the maintenance of the global food safety. The paper analyzes the impact mechanism of the Covid-19 epidemic on global food security from many aspects, including the impact of the pandemic on food production, the impact of the epidemic on the processing and circulation of food supply chains, the impact of trade protection and export restrictions on food supply, the price increase and hoarding pressure brought by food speculation. The paper analyzes the countermeasures of China's food production safety management under the epidemic situation. Further, the paper puts forward the management measures to mitigate the impact of the Covid-19 epidemic on the global food security from the aspects of food production, food demand, food trade, food aid and other aspects of the food supply chain, providing reference for countries and international organizations to formulate effective policies to safeguard food security.

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Performance Estimate of Term Structure Strategy of Commodities in Chinese Futures Market over the Recent Decade

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Abstract. Over the past few decades, the futures market has become more and more robust and welcomed more investors. This paper makes a back test to explore the feasibility and evaluate the performance of the term structure strategy of commodities in the Chinese Futures Market. In the context of the real futures market from 2010–2020, the strategy is simulated by longing the highest-20%-roll-return commodities and shorting the lowest-20%-roll-return commodities among the total 40 commodities with relatively high liquidity. It is witnessed that the expected return on average is 60.75% and the Sharpe ratio is about 0.7–0.9. Based on the predicted model, this strategy is recommended and expected to have a promising result. However, it requires investors to have a higher-risk preference and is dependent on the model flexibility and information efficiency.

Keywords: Commodity futures · Term structure · Backwardation · Roll return · Volatility · Weighting

1 Introduction

1.1 Idea

Investors trade commodities' future contracts with different expirations dates based on the relative prices between different expirations of futures contracts, since the black-box period before expiration would bring uncertainties to markets, especially for diverse contracts with different intrinsic properties. And the strategy source is from Eric pool.

1.2 Highlight

Strategy Overview. Term structure refers to the idea of trading based on the relative prices between different expirations of futures contracts for a given market. Traders benefit by speculating the shape of commodity futures graphs (x-axis as settlement days for

different contracts, y-axis as prices), which can be classified as backwardation (the current spot price is higher than distant-maturity contracts) and contango (the current spot price is lower than distant-maturity contracts). As time passes by, the price of distant-maturity contracts will converge to the current spot price [1]. As shown in Fig. 1, for backwardation, the prices of distance-to-maturity contracts will increase. For contango, distant-to-maturity contracts' prices will decrease over time. The spread is an indicator for investors to determine the specific distant-to-maturity contract to use by finding the largest slope between the fixed nearest-to-maturity contract and distant-to-maturity contract [2]. By calculating the roll return and listing them in order, investors can long/short a group of distant-to-maturity contracts to benefit from them.

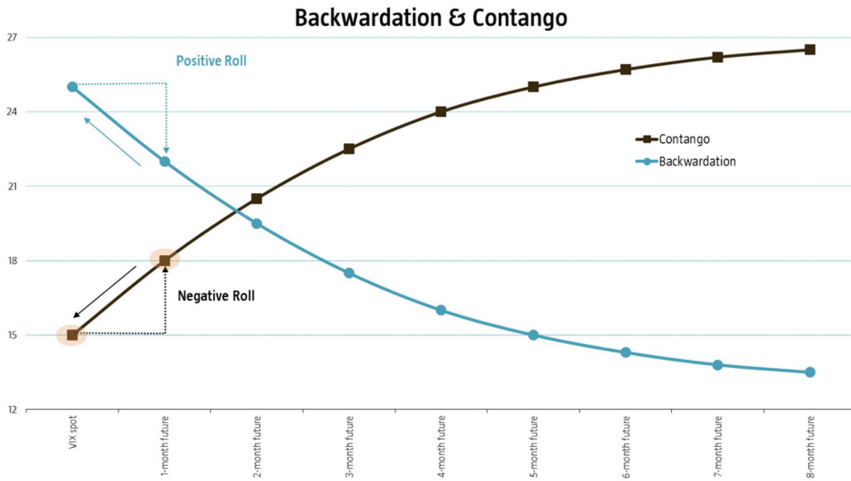


Fig. 1. Backwardation & Contango [3]

Economic Intuition. The fundamental idea behind strategy is that the price of commodity futures depends on the net position of the hedgers. It usually comes in two forms – backwardation (increase in the future’s price as maturity approaches) and contango (decrease in the future’s price as maturity approaches). Because traders anticipate the prices of distant-maturity contracts to converge to a value that is closer to the current spot price, they can profit from the spread, which is executable [1, 2].

Signal Generation. Annualized roll return is used to be the signal, indicating how profitable the futures are predicted to be through the action of buying or selling distant-to-maturity contracts, in other words, the rollover trade. The larger the annualized roll return is, the higher the expected benefit from that specific type of commodity.

Portfolio Construction. Among the total 40 commodities with relatively high liquidity traded at Shanghai, Dalian, Zhengzhou Futures Exchange, the top 20% ($40 \times 0.2 = 8$), which are most-back warded-commodities with the highest roll return are purchased(long) and short the bottom 20% ($40 \times 0.2 = 8$) most-contangoed-commodities

with the lowest roll return [2]. In terms of sizing, simple weighting method is used to give each commodity the same weight, rebalancing such a portfolio daily.

Performance Estimation. According to the past cases of commodities' term structure strategy, the return is expected to be about 11.97% (average annualized return from 2011 to 2018), far above the Benchmark Equivalent Comprehensive Commodity Index (-2.49%, average annualized return from 2011 to 2018). Thus, the strategy is expected to outperform the benchmark, possessing an annualized return of about 15% higher than that of the benchmark. Besides, the Sharpe ratio should be above 1, meaning that the extra return brought by risk offsets the risk itself, being worth taking risks for more returns.

2 Specification

2.1 Qualitative Analysis

The product prices in the futures market are volatile. This is mainly due to hedgers' varying long-short positions at different times – if the supply by short hedgers exceeds the demand by long hedgers, the contract's current trading price will be lower than its spot price at maturity, named as a backwardation. Inversely, when the hedger's demand exceeds supply, a contango occurs with trading price lower than spot price [2]. Besides, the market scenario could also be influenced by storage costs and interest rates.

Speculators utilize this opportunity by implementing the term-structure strategy whilst compensating for the unbalance. They primarily profit from the price difference between near-to-maturity and distant-to-maturity contracts, which would eventually converge overtime. In other words, the price of backward contracts are expected to increase towards the spot price overtime, and the inverse expectation of decreasing prices held for contangos [2].

This paper implements the strategy with longing the most back-ward contracts and shorting the most contangoed contracts, thus partially hedging the market risk. Therefore, in case of a pervasive market shock, the portfolio is only expected to suffer from the long contracts whilst still benefiting with those being shorted. Hence, the principle of maximizing returns with hedging risks is being followed.

2.2 Quantitative Analysis

Below are the statistics implemented to analyze the strategy's performance:

Annualized Rate of Return

$$\text{Annualized Rate of Return} = (V_p/V_0)^{(1/n)} - 1 \quad (1)$$

where: V_p : Final Value of the portfolio

V_0 : Initial Value of the portfolio

n : number of Year

The annualized rate of return is a simple index reflecting the performance of the strategy.

Annualized Volatility

$$\text{Annualized Volatility} = \sqrt{\text{trading days}} \times \sqrt{\text{variance}} = \sigma\sqrt{252} \quad (2)$$

The annualized volatility measures the risk of the portfolio. Commonly, smaller volatilities are desired.

Sharpe Ratio

$$\text{Sharpe Ratio} = (R_p - R_f)/\sigma_p \quad (3)$$

where: σ_p : std.dev of portfolio

R_p : Return of Portfolio

R_f : Return of Risk – free Asset (China 10 – year Treasury Bond)

The Sharpe ratio reflects the excess return relative to the risk-free asset per unit risk. Larger Sharpe ratios are desired.

Maximum Drawdown Rate

$$\text{MDD}(T) = (P - L)/P \quad (4)$$

where: P : Peak High (peak value before largest drop)

L : Trough Low (lowest value before new high established)

The Maximum drawdown rate indicates the largest potential risk. It is used to judge whether the strategy is acceptable or not based on individual risk preference.

Information Ratio (IR)

$$\text{Information Ratio} = (R_p - R_b)/\text{Tracking Error} \quad (5)$$

where: R_p : Portfolio Return

R_b : Benchmark Return

$$\text{Tracking Error} = \sqrt{\text{Var}(R_p - R_b)} \quad (6)$$

The Information ratio gives a detailed evaluation relative to a relatively standardized benchmark- the Zhonghan Commodity Futures Equally Weighted Trading Index is used as the benchmark in this paper.

2.3 Data

Universe. The universe consists of 40 commodities accessible from Shanghai, Dalian, Zhengzhou futures exchange. However, the total number of commodities' futures can be different every year since some commodities' futures have not been issued until recently, especially for categories of metals or chemical solutions. For example, nonethylene glycol (MEG) issued in 2018, LPG issued in 2015 and polished round-grained rice issued in 2015. In total, each commodity will have 5 to 23 different-expiration contracts as roll dates differ by categories like agricultural, energy and metals. Thus, there will be a total of 200 to 860 contracts.

Table 1 shows the detailed list.

Table 1. Commodity varieties and alternatives [4]

Commodity variety	Alternative varieties
All commodities	iron ore, coke, coking coal, linear low density polyethylene (LLDPE), polyvinyl chloride (PVC), No.1 soybean, No.2 soybean, soybean meal, soybean oil, palm oil, corn, corn starch, copper, aluminum, zinc, lead, nickel, tin, gold, silver, teal rebar, steel wire rod, hot rolled coil, crude oil, fuel oil, bitumen, natural rubber, and paper pulp, PTA, rapeseed meal, cotton, cotton yarn, white sugar, methanol, common wheat, strong gluten wheat, rapeseed, rapeseed oil, thermal coal
Agriculture	iron ore, coke, coking coal, linear low-density polyethylene (LLDPE), polyvinyl chloride (PVC), No.1 soybean, No.2 soybean, soybean meal, soybean oil, palm oil, corn, and corn starch
Metal	copper, aluminum, zinc, lead, nickel, tin, gold, silver
Black building materials	teel rebar, steel wire rod, hot rolled coil, crude oil, fuel oil, bitumen, natural rubber, and paper pulp
Energy and chemical	PTA, rapeseed meal, cotton, cotton yarn, white sugar, methanol, common wheat, strong gluten wheat, rapeseed, rapeseed oil, and thermal coal

Data Set. Since daily rebalance is targeted, the commodity futures contracts' daily prices are obtained. The data is divided into three categories: agricultural products, industrial products, and energy. Including all these three kinds of commodities makes the portfolio more diversified hence improved hedging. Finally, for every commodity, the cross-section slope between the nearest-to-maturity and distant-to-maturity are compared, and the most backward and contangoed contracts are selected.

Sources. The primary sources of data are East Money Information website and Shanghai, Zhengzhou, Dalian Futures Exchange websites. Wind has also been used as the supplement source for bid-ask spread data.

Time Series. Data has been collected from 2011–2018 (8 years) as in-sample data and 2019–2020 (2 years) as out-of-sample data. There will be 80% data for in-sample built up to guarantee the relative accuracy of optimization. The rest 20% data are out-of-sample for the sake of evaluating profitability.

Signal Generation. Annualized Roll Return

$$R_t = [\ln(P_{t,n}) - \ln(P_{t,d})] \times 365 / (N_{t,d} - N_{t,n}) \tag{7}$$

where: $P_{t,n}$: the price of the nearest-to-maturity contract at time t

$P_{t,d}$: the price of the distant-to-maturity contract at time t .

$N_{t,n}$: the number of days between time t and the maturity of the nearby contract.

$N_{t,d}$: the number of days between time t and the maturity of the distant contract.

In the futures market, there is a price difference between nearest-to-maturity and distant-to-maturity contracts. As explained, investors expect the distant-to-maturity contracts’ price to converge to the current spot price which is either higher or lower. Thus, the roll returns are generated as the signal.

Portfolio Construction. [Choose Commodities, and Set Weightings] The prices of the nearest-to-maturity and distant-to-maturity contracts used to calculate the annualized roll return. The top 20% ($59 * 0.2 \approx 6$) and the bottom 20% ($59 * 0.2 \approx 6$) commodities have been selected into the portfolio based on the roll-returns. Simple weighting is implemented by splitting our available funds into half, allocated for the top 20% and the bottom 20% of contracts. Then the money will be distributed evenly across each commodity. In this way, it’s easier for us to observe the performance of each commodity. Due to the similar liquidity of the top 20% and bottom 20%, the price volatility/ room for making profits is expected to be similar. Therefore, distributing capital evenly is reasonable.

Trade Execution. Transaction Costs.

Bid-Ask Spread: In China’s future market, there is a difference between ask price and bid price for commodities. All of the bids and ask prices on August 25 are listed and an average value of the spread for each commodity. Because three commodity categories are identified – agricultural, energy and metal, as shown in Table 2, where the average bid-ask spread for each category are found. In this way, bid-ask spread estimation would be more precise for the fact that the same category has a similar bid-ask spread.

Table 2. Average bid-ask spread of varieties

Category	Metal	Agriculture	Energy
Avg. bid-ask spread	12.49 bps	10.78 bps	9.89 bps

(Calculated by categories and inclined to the spread of distant-to-maturity contracts that mainly traded.)

Commission: China's brokerage companies also have the number of transactions by the number of commissions. Some futures have 0.5bps to 10bps of the contract price as their commission fee and others have 0.2 to 5 yuan per one hundred shares. In the real execution part, it is assumed that the commission fee for every commodity's future is 0.03%, almost the median of usual commission fee.

[*Trade poundage is the way that our country's existing Commodity Exchange collects poundage is to press clinch a deal commonly hand number computation, poundage of each hand capture is different because of breed and difference.]

Settlement Fee

Seller: warehousing fee, inspection fee, spot storage fee, futures storage fee, delivery commission.

Buyer: delivery fee, futures storage fee, spot storage fee, delivery fee.

3 Implementation

3.1 P&L Graph Cumulative Simple Return: (In-Sample)

(For Cumulative Return from 2011/2/9 to 2018/12/31 In-Sample data).

The cumulative P&L diagram and the summary statistics of the in-sample-data (2010–2018) see Fig. 2. The notion on each trading day is set to be 1,000,000 yuan. The overall shape of the diagram is rising upwards very well, indicating a very good return apart from a drawdown at the end of 2018 due to increasing international tensions and trading barriers. There is a significant period of negative returns at the start of 2011, which is consistent with the reality that the market enthusiasm fades and transaction volume drops considerably. But then it started to progress consistently with a visible peak in cumulative return at the beginning of 2018.

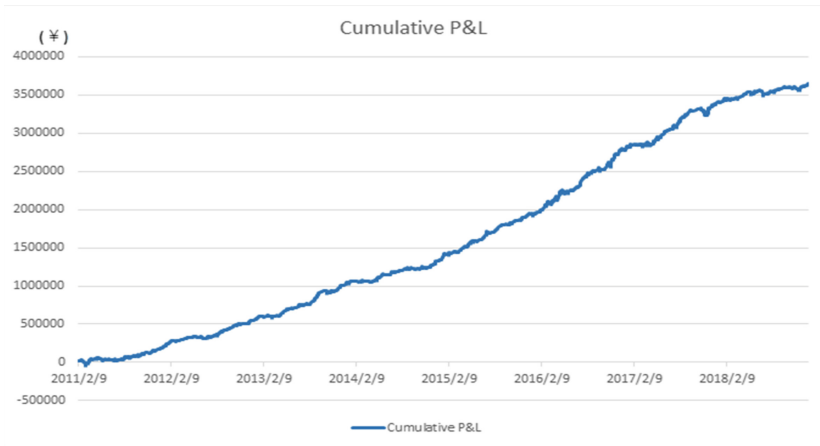


Fig. 2. P&L for IS

3.2 Statistics: (In-Sample)

Table 3. Summary statistics for IS

IS	2011	2012	2013	2014	2015	2016	2017	2018
Yearly return (%)	18.99%	35.23%	48.57%	30.37%	61.83%	84.12%	58.73%	24.79%
Yearly volatility (%)	9.82%	7.07%	8.35%	10.95%	10.19%	18.76%	16.78%	10.56%
Maximum drawdown (%)	3.75%	2.45%	2.70%	4.26%	4.12%	6.09%	5.96%	2.91%
Annualized return (%)	21.15%							
Annualized volatility (%)	12.21%							
IR	1.33							
Sharpe ratio	1.49							

3.3 Analysis: (In-Sample)

The Table 3 above presents the summary statistics relevant to the in-sample-data. Evidently, the strategy's return has been very optimistic, with no yearly returns below 15% and a median of 41.9%. Hence it is a very profitable portfolio. The yearly volatility has been controlled within the range of 7% to 19%, which is relatively large and indicates the portfolio could be slightly fragile. Based on the statistics, there is a trend that the yearly return peaked during 2015–2017, alongside an increase in volatility. This is expected because of the consistently fast-growing economy alongside these years, accompanied with a small cost of increasing uncertainty. The point is also reinforced by the comparably larger maximum-drawdowns in 2015 to 2017.

Overall, the in-sample-data justifies that the portfolio based on a simple terms structure strategy has been profitable, with the annualized return of 21.15%, a very good IR of 1.33 and a satisfactory Sharpe ratio of 1.49. This does come with a certain risk (with annualized volatility of 12.56%), indicating the strategy which has potential to be improved.

3.4 Differences from Expectation

The expected annual revenue is more than 30%. This has been mostly achieved – apart from 2011 and 2018 in which drawdowns have occurred. The volatility is slightly above 10%, which is relatively high considering the IS data. However, as the information ratio is greater than 1 and the Sharpe ratio is also greater than 1, which are some positive aspects of the strategy. Overall, the strategy’s return is reasonably good with an excellent Sharpe ratio, and a relatively larger average volatility compared to the initial expectations.

4 Validation Test

4.1 P&L Graph: (Out-of-Sample)

(For Cumulative Return from 2019/1/1 to 2020/12/31 Out-of-Sample Data).

The P&L diagram of the out-of-sample data (2019–2020) see in Fig. 3. Overall, the strategy still earn a very satisfying return by the end of the two years, however, there is a far greater degree of fluctuations evident compared to the in-sample results. The 2019 financial year has been challenging, accompanied with falling returns in the first half year, with more fluctuations in the second half. This is most likely a result of increasing global tensions, continuing from 2018. Then at the February of 2020, the portfolio’s return suddenly peaked by almost 800000 yuan, which corresponds to the beginning of the pandemic in China, where the whole financial market started to become profitable with an increasing degree of uncertainty. The peak is followed by a sharp decrease in April, where the return then started to increase at a considerable rate.

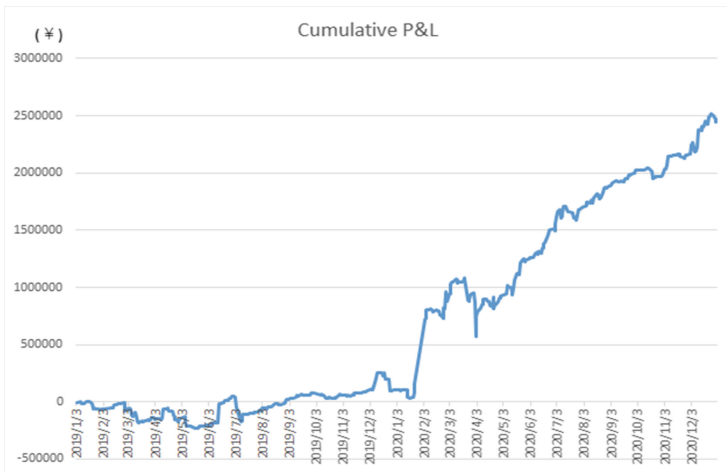


Fig. 3. P&L for OOS

4.2 Statistics: (Out-of-Sample)

Table 4. Summary statistics for OS

OOS	2019	2020
Yearly return (%)	10.27%	234.58%
Yearly volatility (%)	33.55%	85.93%
Maximum drawdown rate (%)	21.42%	19.43%
Annualized return (%)	85.70%	
Annualized volatility (%)	65.75%	
IR	1.09	
Sharpe ratio	1.26	

4.3 Analysis: (Out-of-Sample)

The Table 4 above presents the summary statistics relevant to the out-of-sample-data. As shown in the table, the yearly return rate in 2019 is 10.27%, and it is 234.58% in 2020. Evidently, the yearly return rate has created both the lowest point and the new high point of return. The yearly volatility in 2020 is even as high as 85.93%, and the maximum drawdown rate rises to about 20%, indicating that the out-of-sample data still shows high risks. However, the information ratio and Sharpe ratio are 1.09 and 1.26 respectively, though the risk is high, the yield has increased by 5 times.

Indeed, it seems unbelievable that the return of 2020 will be 234.58%. However, after searching the macroeconomic environment in that year, everything turns out to be reasonable. Here is a dataset collected from East Money Information to help to explain.

Evidently, even for individual commodities, the change in price can reach up to 3557.35%, followed by large numbers like 155.9%, 135.04%, etc. (see Table 5). Imagining how high the level is, having an yearly return as 234.58% for a whole portfolio is not weird and possible. In the past year when the overall market volatility was very strong, a high yield can still be maintained, indicating the stability of the return of this strategy, even in the turbulent market period can have an excellent performance.

4.4 Return

The overall return for the 2019–2020 period is decent. In 2019, the cumulative profit maintained a level of no-huge loss for the entire year. However, the return took off starting Jan 2020 and achieved 234.58% for the annual return. The covid-19 has helped with the drastic price changes of the commodity market. As investing confidence is reduced in the stock market, more investors would search for other areas of investment for diversification of portfolios, futures investment could be one of the choices to go into. With the foreign investment as well, since the interest rate decreases, in other countries

Table 5. Relevant contract's return in 2019 and 2020 [5]

Contract	2020	2019	Largest change in price
Fibre board	1505	41.15	3557.35%
Slab rubber	328.45	128.35	155.90%
Iron mine	1147	488	135.04%
Canola	6480	3204	102.25%
Silver	6877	33468	98.30%
Gold	454.08	277.8	63.46%
Glass	2037	1265	61.03%
Nickel	134180	86080	55.88%
Corn	2747	1780	54.33%
Hot rolling	4939	3254	51.78%
Starch	3110	2163	43.78%
Thread	4603	3244	41.89%
Wire rod	4799	3492	37.43%
Aluminum	16925	13230	27.93%

might lead foreign investors to search more ways of investment as the risk-free return rate has dropped to close to zero percent.

4.5 Risk

With respect to the average volatility to nearly 60%, our Sharpe ratio for 2019–2020 is 0.74, which is relatively mediocre due to high return and high risk. The long-short portfolio naturally hedges part of market risk. Facing a systematic (homogeneous direction) market risk, the portfolio will have at least one direction of position to earn profits while the other partially lose money. Liquidity risk is another issue for us to pay attention to. The contracts we trade on are those distant-to-maturity ones, so they usually have low liquidity that may cost a higher bid-ask spread for us to compensate. However, even if it is the case, our result still shows a strong profit worthwhile for us to take the liquidity risk. In a big picture, the economy has been in a long-term structure reform, and covid 19 has played a role of catalyst within and speeds up the changes. To better hedge the risk, we could apply more economic intuition and qualitative analysis on commodity selections, which we could be doing more research on the market trends and execute our choices. Therefore, we could greatly reduce the risks by selecting commodities which are more promising. The risk is mainly unavoidable market risk based on the fact that we are facing much more market volatility than before. When coming to the correlated risks, it is not guaranteed that the prices of commodities will always fluctuate in the same directions. To deal with such a correlated risk, we could group commodities by genres (agriculture, metal, mineral resources) for the fact that its price has a higher possibility to move along the same direction to hedge risks.

4.6 Operation

The data required for this strategy is transparent, publishing publicly on each Futures Exchange Website. Nevertheless, the accurate more-frequent data like by seconds or minutes and data like bid-ask spread of the past are harder to find. Accessibility is guaranteed while precision is not perfect. Also, there are basically two kinds of data which could be utilized: the raw data with more details and continuous data with more simplicity. Processing data is a little bit complicated as you need to deal with the rolling problem and consider trivial details about each contract (with both commodity-categories and expiration dates). What's more, since the portfolio is rebalanced daily, which is a high frequency, operational risk is also possibly high, but could be purposely lower. One could reduce the frequency of rebalancing to decrease the transaction cost as bid-ask spread to be the main component of the transaction cost of this strategy.

Implementing qualitative analysis to assist in the commodity selection process would reduce volatility. It requires daily rebalances and adequate data sources to support the whole operation process, which requires a great amount of effort to track the fluctuations of the prices and make changes to the portfolio according to them.

4.7 Future

Term Structure Strategy is the one commonly used by investors. Thus, the crowdedness of it is high, also accredited to a low sophistication. However, the methods to gain profit (profiting from convergence of price or profiting from price difference between distant and near contracts), methods of weighting, accuracy of signals could also make this strategy distinguishing. In this case, the decay of it will be slow. It can involve huge capital but could not be extended to other assets because it utilizes the natural features of commodities. In short, there is still a lot of room for improvement. And it's still a profitable strategy suitable to employ due to the impossibility of perfect market efficiency and the complex price structure of commodities.

4.8 Environment

The 2020 commodity market performance has offered investors a good amount of confidence to keep investing in the market. The operation process and data gathering is not too hard for investors to handle, which makes this strategy relatively easy to execute. If speculators want to do arbitrage, currently the special time would offer another opportunity if the covid era ends or a second wave of covid starts.

4.9 Correlation

The strategy results generated by the out of sample data, especially the net worth of our investment has high correlation with the macro market, and it did make profit based on the price fluctuations in the Covid period. In 2019, the total return rate was negative until the emergence of Covid 19 in China, which started from the Early January of 2020, and net worth of the investment has skyrocketed ever since. The government has reduced the interest rate and higher volatility is understood by the investors. The commodity market became a place for risk hedging and good selection for portfolio diversification because of the low value of risk-free return.

4.10 Trading Recommendation

It is a strategy with steady return and relatively high risk to investors with low risk aversion. Throughout the whole trading process, there are indeed aspects to improve on to get more precise results. In order to get more authentic transaction cost, opportunity cost and latency costs should be taken into consideration. Moreover, the calculation of bid ask spread is based on the current prices. There could be fluctuations on the spread with fair prices, more authentic and historical data are required to get more precise results. Also, it is better to include the day limit scenarios when trade is not allowed if change in prices has exceeded 10% in one day. It's hard to track the historical day limit records while it could be done when implementing this strategy in the future.

There are potential ways to increase the return as well. Bid ask spread is the main part of the transaction cost, the strategy's rebalancing frequency could be adjusted to monthly or weekly in order to reduce the transaction cost. The weighting method could be adjusted as well to boost the return. However, it depends on which level of risk is acceptable to specific investors. In this strategy, simple weighting is utilized, according to the table below. It has relatively lower return with lower volatility, higher maximum drawdown rate however. It could be said that there is a positive correlation between the strategy's annual return rate and its average volatility. The future market has higher market risk than the stock market, therefore investors could try the single species target method aiming for higher return. During the covid-19, future markets become more profitable for increasing volatility. Volatility is needed to generate higher returns. There are investors who purchase commodities to diversify their portfolio to hedge risk, it is recommended to construct a multi-assets portfolio to reduce the potential risk resulting from the higher market volatility.

To sum up, this strategy is highly efficient with a steady rate of return but a mediocre Sharpe ratio below one because of the high volatility, averaging 59.72%, much higher than the market average volatility. The maximum drawdown rate is also high, being nearly 20% in 2020. Covid has created investment opportunities for short term arbitrage, and it is likely to create more opportunities for incoming investors once there is a second wave of covid. For investors who can endure greater risks, this strategy has potential to generate considerable return (Table 6).

Table 6. Strategy performance with different weighting methods from HaiTong securities research report [6]

	Annualized %Return	Annualized %Volatility	Maximum drawdown	Calmar ratio
Equivalent weight (Simple Weighting)	11.27%	7.48%	0.17	0.66
ATR reciprocal weighted normalization	9.74%	6.25%	0.08	1.27
Reciprocal volatility weighted normalization	9.79%	6.18%	0.07	1.43
Single species target volatility 20%	14.42%	7.45%	0.08	1.72
Single species target volatility 30%	21.19%	11.17%	0.12	1.70
Single species target volatility 40%	28.17%	14.89%	0.16	1.71
Portfolio target volatility 10%	11.44%	5.87%	0.07	1.58
Portfolio target volatility 20%	21.91%	11.73%	0.14	1.53

5 Conclusion

Within this strategy, investors profit from the expectations of the potential convergence of the prices of distant-to-maturity to the near-to-maturity or current spot price level, and hedge risk by conducting long buying and short selling of different expiration-date-contracts. The overall expected return on average is 60.75% and the Sharpe ratio is about 0.7–0.9, differing by the weighting methodology, timing, and model parameters. The above result is based on a particular one that is appropriate and optimal. All in all, it is a relatively good strategy with a long-to-go developing process, but still depends on the investor's risk appetite. It tends to perform well under the circumstance of financial market turmoil.

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The Current Situation, Problems, and Countermeasures of China's Direct Investment in Africa

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Abstract. Since the founding of New China, our country has been committed to friendly cooperation and mutual assistance with all parts of the world. Especially since the founding of the People's Republic of China, we have been strengthening our solidarity and cooperation with Asian, African and Latin American countries and local people. Starting from the background of China-Africa cooperation, this paper analyzes the changes of China's investment in Africa and foreign countries in recent years, especially under the impact of the COVID-19 epidemic, so as to reflect on and discover all the problems of China's non-direct investment in different aspects, and put forward some suggestions in political, economic, social and cultural aspects, in order to help China's investment in Africa and even in all parts of the world in the future, so that the Chinese government and Chinese enterprises can avoid detours and obtain greater benefits.

Keywords: China-Africa cooperation · Outbound direct investment · International cooperation · Risk response

1 Introduction

From the end of the 1950s to the end of the 1960s, China has greatly strengthened its solidarity and cooperation with the countries in Asia, Africa and Latin America and the local people, vigorously supported the countries and people in sub-Saharan Africa in their struggle against colonialism and racism, and successively signed friendly treaties and economic and technological cooperation agreements with Ghana, Congo, Tanzania and other countries, thus strengthening the bilateral cooperation in politics and economy. At the same time, our country actively supports Angola, Zimbabwe, Namibia and other countries in their armed struggle for independence and the South African people in their struggle against white racism. The "two-Arab proposal" that allowed China to regain its seat at the United Nations soon passed, with African countries accounting for nearly half of the 23 countries that put forward the proposal. China-Africa cooperation has become an indispensable part of China since that time.

African civilization has a long history. Although it has been bullied by western powers, it still has great vitality and plasticity and its development potential is immeasurable. The African continent has vast land resources and a large amount of mineral resources.

In Guinea, which is called the “geological miracle”, alone, it has over 15 billion tons of high-quality iron ore, an estimated reserve of about 1,000 tons of gold, and a reserve of about 300 million carats of diamonds. The quantity of oil, copper, uranium, and granite is staggering. In addition, there are many developing countries in the African continent. Due to poverty and underdevelopment, most countries have persistent development needs. Just like China in the last century, they are eager for foreign investment and long-term cooperation with countries that are more developed than themselves. Therefore, if China-Africa cooperation can proceed smoothly, the world’s largest developing country and the continent with the largest concentration of developing countries will surely form a wonderful linkage at the economic level, which will surely have a great impact on the world.

With the help of China, many changes have taken place in Africa. Since the 1960s, China has started to support African railway construction. On September 5, 1967, the governments of China, Tanzania and Zambia signed the “Agreement on the Construction of Tanzania-Zambia Railway” in Beijing, and completed all the work in May 1976, with the railway officially put into operation. On June 10, 2020, Nigeria Lagos-Ibadan Railway, the first modern two-track standard rail line in West Africa built by China Civil Engineering Group Co., Ltd., officially opened for commercial operation. The operation of the railway has greatly improved the traffic conditions in Nigeria, promoted the social and economic development in Nigeria and brought convenience to the local people [2]. In addition, China has provided nearly 120,000 seats for overseas students in African countries, and opened a large number of Confucius Institutes and Confucius classrooms. The cooperation with Africa in culture and education has achieved remarkable results.

Since 2000, China’s investment in Africa has shown an overall growth trend, from US\$ 10.3 billion in 2000 to US\$ 208.7 billion in 2019, with an annual growth rate of about 18.1%. The bilateral trade volume with Africa’s two largest trading countries, the United States and France, to Africa, averaged less than US\$ 50 billion in 2018, only about one-third that of China in the same period. Tibor Nagy (2020) once said that when Africans began to yearn for investors, it was the Chinese who responded most [3]. Judd Devermont (2020) also pointed out that the trade volume between most European countries and Africa has a downward trend. AGOA has long helped African goods enter the US market. It is due to expire in 2025, so many African countries no longer think that it will be suitable for promoting economic relations.

At the Beijing Summit of the China-Africa Cooperation Forum in 2018, China and Africa unanimously adopted the Beijing Declaration on Building a Closer China-Africa Community of Destiny. On the basis of affirming the remarkable achievements China and Africa have made so far, the declaration calls for economic globalization to develop towards openness and inclusiveness, opposes hegemonism and protectionism, and makes continuous efforts to realize the common development and revitalization of China and Africa and promote community of shared future for mankind [4]. However, as China’s cooperation with Africa becomes more and more open, the challenges it faces are also increasing. On April 8, 2021, the U.S. Senate proposed the “Strategic Competition Act 2021”, which explicitly proposed to contain China’s influence in Africa. In addition, the rising conflicts of interests, the collision between values and ideology, and various

problems in Africa are gradually becoming a huge challenge to the internationalization of China-Africa cooperation.

In this case, we analyze the data of outbound direct investment and non-direct investment from various countries in recent years, observe the overall situation in the world today, reflect on the problems existing in China's current investment in Africa, and try to find appropriate solutions.

2 Analysis of the Current Situation of Direct Investment in Africa and Abroad

2.1 China's Outbound Direct Investment

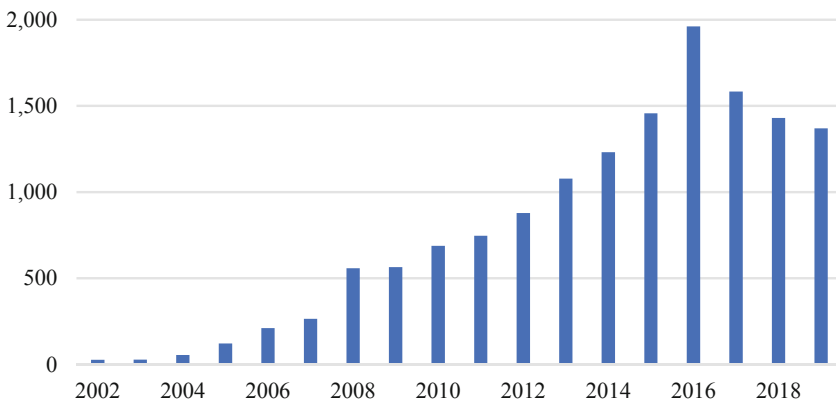


Fig. 1. China's outbound direct investment flows (USD billion)

In 2003, China's net outbound investment was only US\$ 2.85 billion, while outbound investment flows were mainly distributed in the relatively primitive mining and manufacturing industries, accounting for 67% of the total [5]. With the continuous development of China, China's outbound direct investment has changed significantly. Under the great pressure of the COVID-19 epidemic, China's industry-wide outbound direct investment in 2020 was US\$ 132.94 billion, down from US\$ 136.91 billion in 2019, but still ranked first in the world, and the stock of outbound direct investment was more than 60 times of 2003 [6]. The distribution of the outbound investment industry broke the shackles of the early outbound investment industry, and the proportion of leasing and business services increased significantly. At the same time, the local government's outbound investment also increased significantly [7]. All these indicate that China's outbound investment is gradually diversifying (Figs. 1 and 2).

In contrast, the world as a whole saw a significant decrease in the amount of outbound direct investment in 2020 due to the impact of the COVID-19 epidemic. In 2020, global FDI dropped from US\$ 1.5 trillion to about US\$ 895 billion, representing a decrease of about 40%, and this phenomenon is particularly obvious in the developed economies,

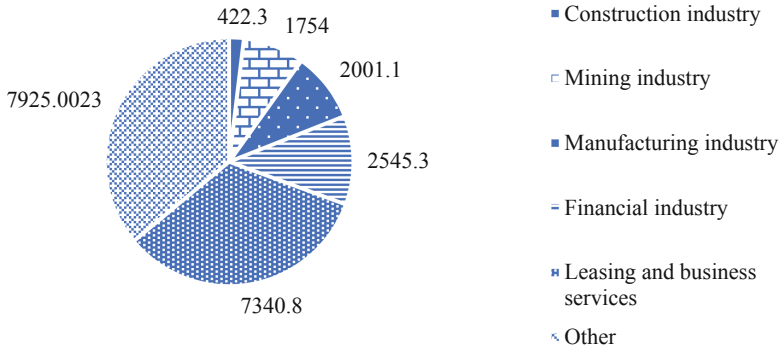


Fig. 2. Industry distribution of China's outbound direct investment flows in 2019 (USD billion)

where FDI declined by nearly 58% in 2020, while the decline in FDI in the developed economies has also greatly affected the developing countries. In developing countries, the number of newly disclosed greenfield projects fell by 42%, while financing transactions that are important for infrastructure construction fell by 14%. It is predicted that FDI will increase in 2022, and can return to the level of 2019 at most, but there is still great uncertainty due to factors such as virus vaccines [8].

2.2 China's Direct Investment in Africa

In 2020, China's investment in Africa was US\$ 2.96 billion, an increase of US\$ 260 million over 2019, but a decrease of more than 45% from US\$ 5.39 billion in 2018. Under the global impact of the COVID-19 epidemic, China is obviously not immune. In spite of this, China's outbound direct investment remained at US\$ 136.91 billion, ranking second in the world for the second year in a row. The stock of outbound direct investment was as high as US\$ 21,988.8, more than 60 times that of 2003. Accordingly, China's long-term investment in Africa has brought tremendous changes to Africa. Since China-Africa cooperation, Africa's economic situation has improved. In 2000, Ethiopia's per capita GDP was only US\$ 124, but by 2020 it had become US\$ 936. Tanzania's per capita GDP rose from US\$ 410 to US\$ 1076. While cooperating with China, a large number of African countries have achieved economic growth and are making continuous efforts to change the poverty situation. At the bilateral trade level, China-Africa cooperation has also achieved good results. According to statistics, from January to February 2021, China's main exports to Africa were telephones, auto parts, clothing, shoes and boots, plastic products, etc. The main imports from Africa were crude oil, copper, refined ore, etc. From January to February of 2021, the total value of bilateral trade between China and Africa was US\$ 339.5 billion, representing a year-on-year increase of 28%. Among them, exports to Africa reached 206.5 billion US dollars, up 50.9%. Imports from Africa reached US\$ 13.3 billion, up 3.6%. There is a big gap between China and Africa in the types of goods imported and exported. China's main imports from Africa are oil and derivatives, minerals, raw materials for agriculture and forestry, etc. and most of China's imports from Africa are resource-intensive countries. China's investment in resource-rich countries such as Congo (DRC), Angola and Ethiopia is relatively high.

Accordingly, Africa also seems to have difficulty in exporting higher-end goods, and it heavily depend on its own resources. It also seems to indicate that the categories of African exports have yet to be upgraded (Fig. 3).

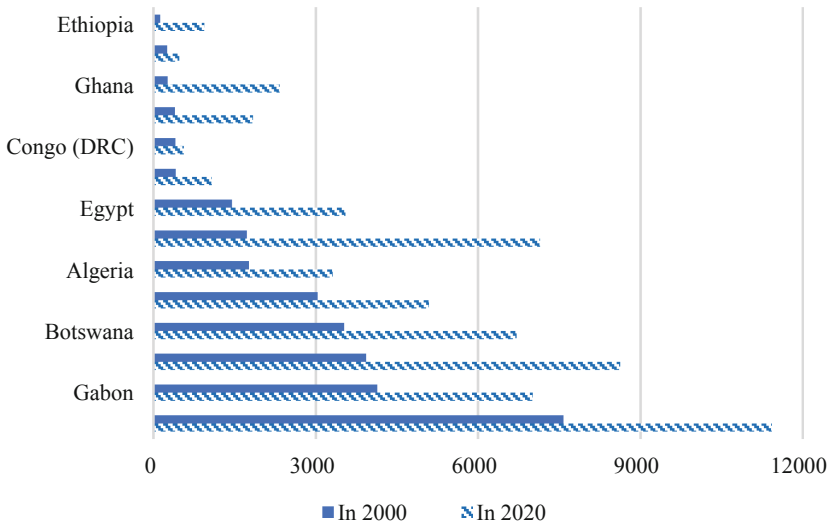


Fig. 3. Per capita GDP of some African countries (USD)

However, in recent years, the whole world's investment in Africa has been very sluggish. In 2020, FDI inflows to Africa fell by about 16%, returning to the level of 15 years ago. At the same time, the financial situation in sub-Saharan Africa is very grim due to the massive outflow of capital. In 2020, Africa's net sales of cross-border mergers and acquisitions, disclosed greenfield projects and international project financing agreements decreased significantly in terms of both quantity and total value. As a result, Africa's GDP decreased by nearly 3.5% in 2020. What's more, some African countries rely mainly on resource exports, and the impact is even more significant due to their single economic structure. In addition, the value of FDI restriction index in Africa is relatively high: although the value in Egypt and Morocco is relatively low, it is 0.587 in Algeria and 0.713 in Libya. In Libya, all the values are above 0.6, and many industries such as wholesale and retail even reach 1.0. However, most African countries do not even appear in the OECD statistical table [9] (Figs. 4 and 5).

In China-Africa cooperation, industrial parks outside China have played an important role. Up to now, there are more than 100 overseas industrial parks in China. Most of these parks are located in Asia, Africa and Europe, not only in developed countries and emerging economies, but also in some of the least developed regions in the world. The number of people employed in the agricultural sector in the African continent reached 38.5%, but they are also facing problems such as low degree of agricultural modernization, shortage of funds and barren land. Therefore, it is very necessary to build an agricultural park in Africa. In July 2011, China officially handed over "Mozambique-China Agricultural Technology Demonstration Center" to the Mozambican government.

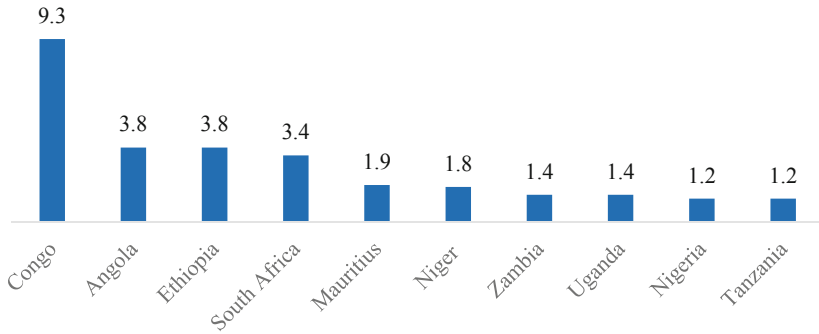


Fig. 4. China's direct investment in African countries in 2019 (USD billion)

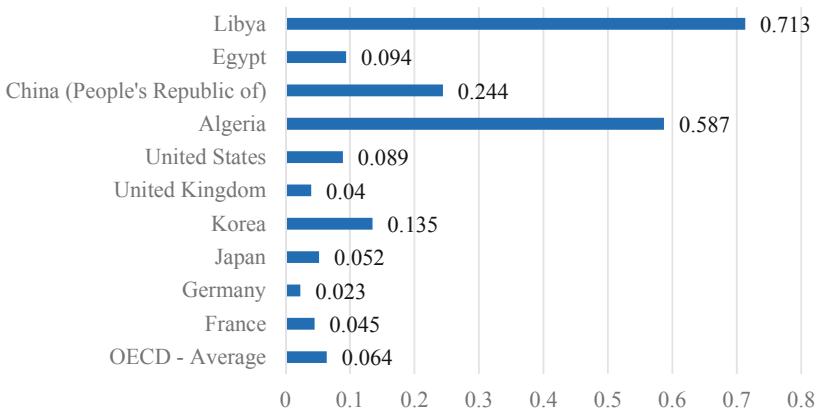


Fig. 5. Total FDI index (2019)

The total investment in the park of this agricultural technology demonstration center exceeded 400 million yuan. In the operation and management of the park, China not only introduced and researched and developed agricultural products, but also insisted on teaching the local people how to produce and manage, which not only solved the problem of food and clothing for the local people, but also improved the economic conditions of the local farmers and even Mozambique. The “Uganda-China Agricultural Cooperation Industrial Park” has solved the employment problem of 22,000 local people, trained more than 1,000 technicians and management personnel for Uganda, and helped Uganda earn US\$ 50 million in foreign exchange. The industrial park has driven the development of the local area, helped to solve the poverty situation in the area, and has a strong vitality [10].

3 Problems Faced by China's Direct Investment in Africa

3.1 Political Problems

There seems to be a long history of huge political risks to direct investment in Africa. Corruption is serious in Africa. According to a survey conducted by Transparency International, citizens in most countries are not satisfied with the local government due to the serious corruption. In Liberia, despite President Ellen Johnson-Sirleaf's efforts to curb corruption, corruption and nepotism still exist in most places, and even she herself cannot avoid being severely criticized for it [11]. According to the Transparency International survey, nearly 96% of Liberians believe that their national parliament is seriously corrupt, and the data in other parts of Africa are similar [12]. At the same time, conflicts in Africa often occur due to great ethnic and religious differences. One of the most famous is the "Rwandan genocide" carried out by the Tutsi and Hutu moderates on April 7, 1994, which killed a total of 800,000 to 1,000,000 people. In addition, the political situation in Africa is extremely unstable, and the fragmentation of political parties keeps conflicts between the parties [13]. On September 5, 2021, the leaders of Guinea's "coup" announced the dissolution of the government, the suspension of the constitution and the closure of the border. And sources said that Guinean President Conté had been detained by the country's "mutinous" special forces [14]. Such political risks have brought great insecurity to China's non-investors.

3.2 Economic Problems

In recent years, the scale of China's investment in Africa has grown considerably and some problems have been well solved. However, China still faces many challenges in the economic aspect. Judging from the current situation of Chinese enterprises, the average life span of small and medium-sized enterprises in China is only 2.5 years, while that of big companies is only 7 to 9 years, while that of big companies in Europe and the United States has reached nearly 40 years. In addition, most of China's enterprises are small in scale, backward in thinking mode, low in product science and technology, and lack of talents who are good at international investment, so they cannot compare with those in Europe and the United States. However, the number of small and medium-sized Chinese enterprises that are not investing in China is relatively large, and these companies cannot compete with Europe and the United States. On the other hand, China's large-scale investment enterprises in Africa, despite their huge strength, suffer from too much confinement and habitual direct control management, which makes them less flexible and lack talents who are familiar with the African region. As a result, it is very difficult for the companies to explore and develop in Africa themselves, which may make it very difficult for the companies to find investment opportunities in the first place [15]. At the same time, China has not given enough support to small and medium-sized enterprises, commercial banks have imposed too much restrictions on their borrowing, and the overall development of domestic financial hedging instruments is not perfect, which makes the survival of small and medium-sized enterprises more precarious. In fact, not only at home, but also some foreign countries have imposed many restrictions on foreign investors. For example, the government can control multinational companies by

limiting the number of wholly-owned enterprises, controlling the profit remittance rate of multinational companies, and even enacting legal provisions to control multinational companies.

If we turn our attention to Africa, we will find that there are huge risks in the African market itself. First of all, due to the impact of the epidemic, a large number of countries implemented blockade measures, which exacerbated the economic contraction of African countries, a large number of enterprises were unable to operate normally, causing a large number of people to lose their jobs, leading to a more significant poverty phenomenon [16]. According to the World Investment Report 2021, FDI flows to Africa face huge downside risks in the short term. The economic uncertainty in Africa is even more significant due to factors such as vaccine supply, economic recovery and policy support. According to statistics, in Africa only Seychelles had a per capita GDP above the world average in 2020. According to 2019 statistics, 33 of the world's 47 least developed countries were in Africa. In addition, infrastructure construction in Africa is backward, and there is a huge gap in development of transportation, water power and electricity, which results in insufficient supporting infrastructure for enterprises and limited development of enterprises. If an enterprise cannot get a good development, it will lead to a low income for residents, and a low income for residents will lead to a low consumption level. If there is no consumption demand, the market will naturally not develop well. All these will affect the efficiency of Chinese enterprises in Africa. However, the single economic structure has led to the fragility of the economic systems of some African countries, which have no means of adjustment in the face of major risks and have high systemic risks. In addition, the outbreak of the COVID-19 epidemic in recent years has also impacted the African economy [17]. Therefore, the national government and the enterprises themselves need to make great efforts to reduce the economic risks of the investment in Africa.

3.3 Social and Cultural Problems

Since the establishment of the China-Africa Forum in 2000, China has been committed to establishing and spreading a good image in Africa. A survey conducted from 2019 to 2020 showed that Burkina Faso, Mali and other countries have high recognition of China's development model, even surpassing the United States for a time. Abdelaziz Djerad, an Algerian political scientist, once said that because the Chinese government had provided great help to Algeria during the COVID-19 epidemic, Algeria would especially strengthen its cooperation with China and join in China's "the belt and road initiative" [18]. Although China's image has made gratifying achievements in Africa, it has declined in recent years due to various factors.

First, the western media have framed and criticized China. With the rise of China's national strength, China began to speed up its investment in Africa. China invested heavily in mining and investment in Africa, and continuously imported minerals, oil, timber and other resources from Africa. As a result, some westerners began to accuse China of plundering Africa's resources by investing in Africa, which is "neo-colonialism" [19]. German economics professor Axel Dreher and others conducted a study, which showed that China's capital inflows to Africa are more in favor of the birthplace of local leaders,

and found that some leaders will allocate a large amount of investment to their hometown so as to give them an advantage in the election, thus trying to show that China's investment in Africa is detrimental to the local democratic system [20]. In addition, some people think that the Chinese workers in the non-corporate squadron occupy the local jobs, the salary level in the non-corporate China is lower than that in the European and American companies, and the Chinese investment in the non-corporate China damages the local environment. Second, because Africa has been colonized for a long time, it is highly influenced by western thoughts, and the Chinese still have a long way to go to accept western culture [21]. The management model of Chinese enterprises has always been relatively strict, and the enterprises have a high degree of restraint on their employees, which may conflict with the western ideas of "freedom" and "democracy". Similarly, the trade unions in Chinese and western enterprises are also quite different. The trade unions in western enterprises have great power and can even decide whether a company lives or dies. This is beyond the imagination of the trade unions in Chinese enterprises. Third, China's export of African culture is very limited. The Chinese do not understand African culture, and the Africans' understanding of Chinese culture is also very limited. Even some people in the world have only known China in the last century. This is not conducive to people-to-people exchanges between China and Africa. They only pay attention to the construction of hard power instead of soft power. In the end, the loss outweighs the gain.

4 China's Countermeasures for Direct Investment in Africa

As pointed out above, China's direct investment in Africa may face various problems. In fact, in reality, these problems are far more than these. The ever-changing international situation has made the problems more and more complicated. There is still a long way to go to try our best to solve these problems.

4.1 Countermeasures to Political Problem

As a matter of course, we can not interfere in the politics of other countries. What we can do is to strengthen the management of political risks. Before investing in Africa, we should make a comprehensive assessment of the political situation in the countries where we invest, so that investors can fully understand the basic information such as local political stability, political parties, ethnicity and culture, and should not just rely on the previous experience of outbound investment to make haste. When the situation permits, investors can also go deep into the local area, conduct direct investigations and research in the country of investment, and ask scholars and experts in relevant fields at home and abroad for their opinions, and then consider the investment after having a relatively three-dimensional understanding.

4.2 Countermeasures to Political Problem

In the face of economic problems, both our government and enterprises should make efforts. For the government, it should actively contact the non-Chinese enterprises,

improve the degree of information disclosure, strengthen the service awareness, enhance the administrative efficiency, strengthen the supervision and protection of the non-Chinese enterprises, and use its international influence to strengthen the contact with Africa, act as a bridge for the Chinese enterprises to invest in Africa, and help the enterprises to improve their international operation ability and level, and to deal with various risks and challenges, so as to promote the high-quality development of outbound investment cooperation. At the same time, we should also strengthen the attention and training of relevant talents, so that talents who are familiar with Africa and outbound investment can provide help for our non-enterprise enterprises, so that enterprises can more quickly and comprehensively integrate with the international community. For enterprises, before investing in Africa, they should fully understand their own conditions and make a good assessment of whether they are suitable for investment in Africa. They should not blindly follow suit. They should give full play to their own advantages and formulate specific strategies in the face of the needs of African people. At the same time, they should also make full use of Africa's geographical advantages and some countries' preferential measures to Africa to reduce the cost of commodity export tariffs so as to achieve a win-win result. For non-investment industries, they should not be limited to energy-based manufacturing industries, but should increase social-related industries as much as possible, such as education, medical care, environment, etc. Of course, it is also a good idea to strengthen the construction of industrial parks, which will enable China to gather in non-enterprise groups to realize industrial agglomeration. This will not only help African countries, but also help China to help each other among non-enterprise groups, thus reducing production costs and personnel costs, making production more stable, making up for the unfavorable factors brought by overseas countries, and enabling Chinese enterprises to have capital to compete with European and American enterprises.

In addition, we can also focus on the emerging digital economic cooperation. The COVID-19 epidemic has greatly impacted African traditional enterprises, and made Africa realize the importance of the digital economy. Africa urgently needs to solve the problems of insufficient development of the Internet and high cost of the Internet. Chinese enterprises can make use of relatively perfect digital technology to cooperate online, effectively help Chinese enterprises in Africa, and reduce import and export costs and trade barriers, thus driving the development of bilateral import and export.

4.3 Countermeasures to Social and Cultural Problems

Facing social and cultural problems, first, we should realize that African governments and media play a major role in cultural exchanges between China and Africa. Due to the backward educational resources in Africa, the voices of African governments and media can play an important role among the local people. Therefore, we can pay more attention to the media opinion in Africa in the future, actively communicate with them, cooperate around the concerns of the local people, and let the voice of African media play a leading role. Second, we should pay attention to African personnel in China. There are many African students and African staff in China. They can feel the development of China, understand the positive benefits of China-Africa cooperation and try to send the right message to Africa through them, make their voices heard in the media and online, and guide local public opinion. Third, strengthen cultural exchanges between

China and Africa. There are great cultural differences between different parts of Africa. China needs professionals to look at the issue from the perspective of the local people. Africa also needs to jump out of the impression of China's "Confucius" and "kung fu". The two places need to continuously strengthen the training of talents, broaden the folk exchanges and use "culture" to build bridges for the people of the two places. Fourth, we cannot deny the importance of western media's voice in the world. When facing the responsibilities of western media, we need to tell our own stories. We should not only try our best to deal with the unfavorable factors caused by bad public opinion, but also help the friendly media to speak out in the west and improve the image of China overseas.

5 Conclusion

Starting with the historical origin of China-Africa cooperation, this paper points out the positive effects of China-Africa cooperation on both sides from China's need for Africa and Africa's need for China. At the same time, it also faces many challenges, emphasizing the necessity of China-Africa cooperation. Then it analyzes the status, changes and achievements of countries' investment in Africa and abroad in recent years, especially under the influence of the COVID-19 epidemic, and points out the problems existing in the political, economic, social and cultural aspects of China's investment in Africa, namely, the huge political risks in Africa itself, the development of China's small and medium-sized enterprises to be improved, the shortage of talents for China's investment in Africa, the risks in the African market itself, the stigmatization of China by the west, the great ideological and cultural differences between China and Africa, and the very limited export culture of China. And this paper gives appropriate solutions to these three kinds of problems, namely, strengthening risk management, attaching importance to the role of the government, attaching importance to personnel training, devoting to emerging projects, attaching importance to the role of African government and media, attaching importance to African personnel in China, and strengthening cultural exchanges. However, at the same time, most of the contents of this paper are based on the existing facts and are dedicated to analyzing the current situation to point out the problems, which are not sufficient for the future prospects. In the future, we can study the transformation and upgrading of China's investment in Africa, and inject new vitality into China's investment in Africa by studying the possibility and necessity of developing new fields such as high-end technology manufacturing, medical and pharmaceutical, digital economy, aviation industry, etc.

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How Does Blockchain Company Circle Improve Transaction Efficiency and Stay Competitive

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Abstract. This research paper focuses on the analysis of a blockchain company Circle. Since Circle is a company that primarily focuses on peer-to-peer transactions, the paper is going to talk about how its Messaging Features and its product CENTRE help to improve transaction efficiency by solving the problems of trust, speed, and security on the foundation of blockchain technology. The potential impacts that the problems might cause and the specific ways to solve the problems are going to be discussed. After talking about transaction efficiency, the main part of the paper, the paper is going to summarize the work done by others relating to the Porter's Five Forces Model, which is the theoretical foundation of the study, and an introduction about case study methodology. The paper is then going to shift its focus on one of Circle's business strategies of creating USD Coin that can help retain the company's competitiveness. And one of the use cases of Circle's USD Coin service is going to be discussed. Finally, the paper is going to summarize the finding of the study, which is focusing on the substitute effect of the five forces model, and provide implications for other companies like Circle to maintain or increase its competitiveness based on the discovery of the study.

Keywords: Blockchain · Porter's Five Forces Model · Case study methodology · Business strategy · Competitiveness

1 Introduction

As cryptocurrency continue to gain recognition and acceptance worldwide, the blockchain industry is quickly expanding. In this case, more and more blockchain companies have emerged over the past decade in order to boost the development of blockchain technology and make profit in this industry. According to a recent report, the global blockchain technology market size was valued at USD 3.67 billion in 2020. It is expected to expand at a compound annual growth rate (CAGR) of 82.4% from 2021 to 2028 [14]. In 2016, the Chinese blockchain technology market size was approximately 100 million RMB while in 2018, it rose to a billion RMB. It is predicted that the market size in 2022 will reach somewhere around a trillion RMB [31].

Circle is a finance related company that focuses on peer-to-peer transactions. It was founded by Jeremy Allaire and Sean Neville in October 2013. As one of the top peer-to-peer transaction companies around the world, Circle primarily depends on blockchain,

which is a distributed digital database that could be applied to many fields such as peer-to-peer transactions, supply chain and personal identification. Though Blockchain technology is the foundation of the company's operation, Circle itself has developed different types of products to further increase its transaction efficiency. Also, with the products it developed and its own business strategies, Circle has successfully become one of the most competitive blockchain related companies.

1.1 How Does Blockchain Technology Increase Transaction Efficiency by Solving the Trust Problem

Trust is an essential element in order to successfully complete a transaction. Nobody is willing to transact to anyone if they do not even trust the other side. Because of this, a third party like banks or government was always needed to supervise and verify the whole transacting process. Although the presence of the third party can close the trust gap in some degree, important data is still at the risk of being altered or deleted because it is centralized by the third party. So, even with a third party, the trust gap still exists due to the possibility that the process might be hacked and then fail.

However, on blockchain, "every record has a unique key that goes with it, every record is written and time-stamped, and every record is secured in cryptography" [5]. Therefore, it is impossible for the data of the interrelated records to be changed because in order to do that, every single node needs to be altered. Also, every user in the network possesses a copy of the ledger, which makes sure that the whole transacting process is trustworthy because if something goes wrong on this distributed ledger, the mistake can be easily detected as the wrong one does not match up with all the right ones.

1.2 How Does Blockchain Technology Increase Transaction Efficiency by Solving the Speed Problem

Transaction speed is a significant aspect to take into account for a company like Circle to accomplish its transaction process because peer-to-peer transactions "require speedy settlement, and mere seconds in delay could be extremely detrimental to a trade" [10].

However, as the traditional transaction process always required a middle man like banks or government, the efficiency of the transaction process was significantly reduced because of the time taken by the third party to settle things down. As John Colley puts it: "transactions sometimes take six months...because you are trying to account for every possibility that might go wrong and throw it up" [5]. Besides, with a third party, the trading process is also prone to potential human errors.

Blockchain technology can still make a difference and cope with the speed problem. This is because "documentation can be stored on the blockchain along with transaction details, eliminating the need to exchange paper. There's no need to reconcile multiple ledgers, so clearing and settlement can be much faster" [4].

1.3 How Does Blockchain Technology Increase Transaction Efficiency by Solving the Security Problem

Cybersecurity is one of the major problems for peer-to-peer transaction companies. Dickson claims that the possibility for cyberattacks to occur is higher than ever due

to our increasing dependence on digital technology [13]. There are certain kinds of cyberattacks that could pose harmful impact to companies like Circle. For example, Man in the middle attacks are one of the them. Man-in-the-middle attacks refers to a kind of attack in which attackers steal messages through replacement [2]. If this kind of attack happens while the company is transacting, important data and information might be stolen and the loss would be significant. Therefore, it is crucial to make sure that the whole process of transactions is secure for the transacting company.

In order to solve the problem of security, blockchain technology is implemented to help. On blockchain, information is distributed on a myriad of block units, and each block unit is linked to the other ones [13]. In this case, it is almost impossible for attackers to steal or change data because with the system of thousands of nodes possessing the same information, the attacking behavior could be easily discovered.

Blockchain technology can change the way data is accessed as well. Normally, the records on blockchain cannot be changed or hacked. This further reduces the possibility of unauthorized detrimental activities. By using private blockchain, access permissions can be set up and sensitive personal data can be anonymous.

2 Literature Review

2.1 Porter's Five Forces Model

The theoretical foundation of this research paper is Porter's Five Forces Model, which is a model introduced by Micheal E. Porter in the 1980s. There are five forces divided in the model: (1) Access to the market of new entrants, (2) Threat of substitutions, (3) Buyers' bargaining power, (4) Suppliers' bargaining power, and (5) Intensity of current market [32]. This review of literature is going to synthesize the studies done by others to provide a description and analysis of the each of the five forces.

Arons et al. (1999) studied the threats of new entrants and stated that the threats of entrance are the important structural components with an industry to prohibit the entrance of new comers. The authors also found that the major components of the threats of new entrants are scale economies, differentiation, capital requirements, switching cost, access to distribution channels, and cost disadvantages.

The intensity of current market depends on the pressure posed on the existing firms, so they would try to upgrade their market segment (Dagmar 2005). Indiatsy et al. (2014) claimed that price competition, like some sort of similar competitions, is imperative to the profitability in the entire market. In the banking industry, for example, a drop in price would result in a profit reduction for all banks while other competitions, like advertising, would only increase product differentiation.

The competition among rivalries in the industry is not the only threat firms face. Threat of substitutes is another indirect competitor to consider. As Riley (2012) claimed, identifying substitutions is a process of examine other products that might possess the same function or provide the same service as the industry's products. Zhukova (2021) further studied the competition of substitutes in the five forces model. He found that substitute products can pose threat from two aspects: (1) same quality with lower price (2) better quality with same price.

Bargaining power of buyers is another threat for the industry as buyers are able to force firms to lower the prices or provide services of high quality. Zhukova (2021) found that the effect of bargain power of buyers depends on the number of buyers a company possesses. Zhukova (2021) claimed that the smaller the number of buyers is, the easier it is for a company to charge higher prices.

Bargaining power of suppliers is another factor of the Porter's five forces model. Similar to bargaining power of buyers, suppliers can exert the bargaining power on buyers by raising the price or reducing the quality of the service. Arons et al. (1999) discovered that suppliers become powerful when they are more concentrated than the industry they sell to, when they find that a certain group of buyers are not important for them, or when the products they produce are important for the buyers.

2.2 Case Study Methodology

In the following part of this literature review, case study methodology is going to be discussed. First, a basic introduction about case study methodology is going to be provided, and then the paper is going to summarize several articles about how to do a case study.

Case study is a kind of study conducted to learn about different aspects of a certain object in order to find a pattern or draw a conclusion. Tellis (1997) studied case study methodology and traced the history of this study form. He stated that the earliest form of case study could be traced to France, and case study methodology in the United States can be associated with The University of Chicago Department of Sociology from the early 1900s.

However, even though sociology depended strongly on case study research, criticism toward it still existed. As Tellis discussed, some people regard case study considered case study research incapable of providing a generalizing conclusion because it only focused on one case. However, Tellis claimed that the sample size does not matter significantly as the purpose of a case study is building the parameter and the general application to all research [24–28]. When it comes to conduct a qualified case study research, different people presented different ideas. Zucker (2009) wrote that it is important to focus on the methods and analysis when doing a case study. Zucker (2009) divided the process of methods and analysis into three stages: describing experience, describe meaning, and focus of analysis. Baxter and Jack (2008) talked about determining which type of case study to conduct. There were different kinds of case study mentioned and analyzed. For example, exploratory case study refers to the circumstances in which the utilized method has no single set of outcomes [29]. However, descriptive case study describes phenomena that happen in real life [28]. Njie and Asmiran (2014) claimed that data collection is an aspect that can be significant when doing a case study because the craft and effectiveness of data collection determine the richness and depth of what will be eventually known. The author also noted the six major sources of data collection identified by Yin (1994); Stake (1995); Leedy and Ormrod (2005): Direct observation; Interview; Documents; Archival Records; Physical Artifacts and Participant observation.

3 Discussion

3.1 How Does Circle's Messaging Feature Improve Transaction Efficiency

Circle developed its own messaging feature for all the customers in the system. Circle claimed that its messaging feature provides context for payments, such as images that bring the relationship between the transacting sides closer [11] (Fig. 1).

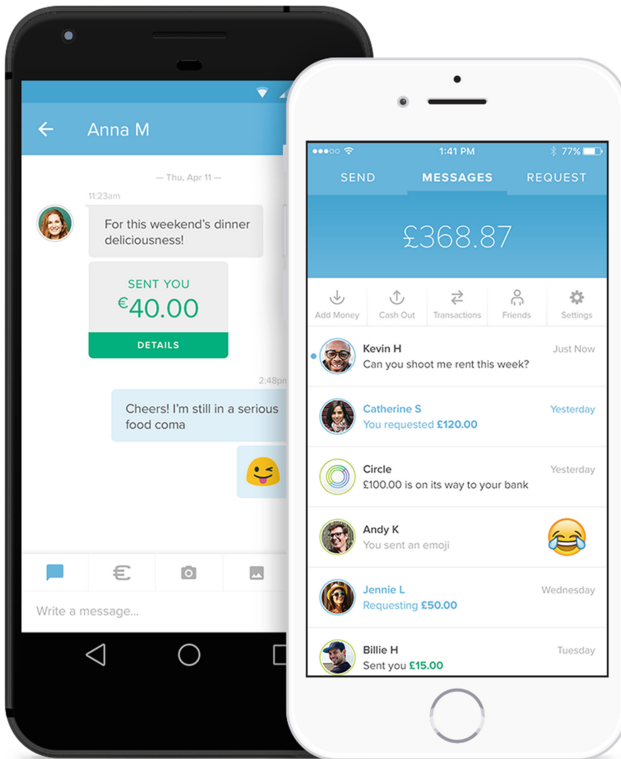


Fig. 1. Circle's messaging feature

This function further increases transaction efficiency on the foundation of blockchain technology in the following three ways.

First, Circle's messaging feature makes it easier to talk about and settle down transaction details because the two sides can directly connect with one another by sending a text message. This lowers the barrier of communication and improves transaction efficiency. If one side has a special kind of requirement for the transaction, the two sides are able to negotiate through this messaging feature and get into an agreement efficiently.

Second, Circle's messaging feature provides ways to flexibly deal with accidents. If certain process goes wrong during the transaction, the two sides can conveniently get into a negotiation and come up with the solution to the problem by directly reaching out to one another. This prevents problems from getting worse.

Third, Circle's messaging feature build closeness among people, and can therefore further solve the trust problem. Some people might still have doubt about transaction security even though they acknowledge the existence blockchain technology. However, with the messaging feature developed by Circle, they can easily and quickly make sure the other side is trustworthy by having a conversation.

3.2 How Does Circle's Product CENTRE Improve Transaction Efficiency

CENTRE is "a open-source project provided by Circle based on blockchain technology that provides transactions among global consumers" [7].

The first benefit of CENTRE is that it makes transactions among global customers possible. The first implementation of CENTRE is the partnership with Korea's Korbit and the Philippines' Coins.ph, which are two important roles in the digital currency market. The cooperation allows customers in the US or the UK to transact to customers in Korea or the Philippines in a secure, trustworthy and instant way through Blockchain technology. In this case, it is really convenient for Circle's users to complete international transactions [11]. This function increases the range in which transactions can be accomplished and improves transaction efficiency for customers with the requirement to complete global transactions.

The second benefit of Centre is its support for different currencies. Take the partnership with Korea's Korbit and the Philippines' Coins.ph as an example. A customer from the US or the UK can transact dollars or pounds directly to the other customer in Korea or Philippine through Centre without considering currency conversion. The result is that the currency received by the customer in Korea or Philippine would be Korean won or Philippine pesos. This functions reduces the time cost of global transactions, making the whole process more convenient and more efficient.

3.3 Circle's Competitive Business Strategy of Creating USD Coin

In September 2016, Circle and its open source project CENTRE introduced a new kind of cryptocurrency USD Coins, which are a sort of stablecoins pegged to US dollars. The USD Coin service tokenizes US dollars so that it can be used on blockchain, the distributed ledger. Bringing US dollars on the blockchain allows people to move them anywhere in the world within minutes and builds stability on cryptocurrencies. The introduction of USD Coins made Circle more competitive with other companies. As the co-founder and CEO of Circle Jeremy Allaire tweeted in August 2017, Circle was at that time the second largest crypto asset trader in the world and traded over one billion dollars per month.

One of the use cases of USD Coins is how another crypto trading company Grapefruit Trading used USD Coins. In order to freely move US dollars in a secure and trusted way, Grapefruit Trading chose USD Coins. Through the help of Circle Account and Circle's partner network CENTRE, Grapefruit Trading was able to "seamlessly mint and redeem USD Coins at any time" [10]. By operating on the various nodes of blockchain, Grapefruit Trading was able to make sure that their USD Coins were backed by US dollars and the every transaction process was secure and trustworthy.

USD Coins not only helped Grapefruit Trading improve its business strategies, but also gained Circle higher competence among a myriad of blockchain companies. In a blockchain company ranking provided by builtin.com, Circle is among the top nineteen blockchain companies all over the world [6].

4 Conclusion

As one of the top blockchain related companies that focus on peer-to-peer transactions, Circle has to make sure that its transacting processes are highly efficient. However, there are problems that need to be dealt with. Trust, speed, and security are three major problems Circle has to pay attention to. With the aid of blockchain technology, as well as its own developed products such as CENTRE, Circle is able to successfully solve the problems of trust, speed, and security and therefore improve its transaction efficiency.

Staying competitive among the increasing number of blockchain companies is another essential concern for the company. In this case, Circle developed its business strategies such as creating USD Coin that can retain the company's competitiveness among various blockchain companies.

After analyzing Circle's products and strategies that help retain the competitiveness, it is found that in order for finance related blockchain companies like Circle to survive, or even thrive, in the blockchain industry, they should focus on product innovation, such as Circle's messaging feature, CENTRE, and USD Coin. Innovation is able to deal with the force of substitute in the Porter's Five Forces Model and therefore take advantage of the bargaining powers of buyers & suppliers. When look back at Circle as an example, it can be found that if customers intent to trade with a crypto currency backed with US dollars and to be able to mint and redeem US dollars, Circle's USD Coin is the only option. Circle, therefore, can eliminate the bargaining power of buyers and increase its bargaining power as a supplier to reinforce its competitiveness in the growing industry.

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The Impact of COVID-19 on the US Economy and the Policy Response

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Abstract. Following the outbreak of COVID-19, the United States initially closed its economy to then reopen it at a time when the epidemics had not come under full control yet. The US Government issued a series of policies to stimulate economic recovery. However, the latest data show that the side effects of these measures have led the US economy to fall into a vicious circle of debt, inflation and supply chain issues, with implications in the short and medium run. This paper will first provide a baseline for the US economy after the trade war with China. It will then consider how the US economy has changed as a result of the COVID-19 outbreak and describe the developments following the vaccination campaign. The current economic performance of the US will then be considered along with any challenges associated with government policies. Finally, this paper sets out some targeted suggestions.

Keywords: China-US trade war · COVID-19 · Economic challenges · US government · Economic policy

1 Introduction

In this article, the author analyzes the performance of the US economy in practice. First, the author will consider the state of the US economy, current economic challenges and their causes, potential future problems, and the measures adopted by US government agencies. Second, the author will compare the economic performance of the United States after March 2018 and after March 2020 and will show that the US economy has been severely affected by the pandemic in the short term, which makes a return to pre-pandemic levels of economic activity difficult. Then, she will present the latest data (October 2021) on the US economy. Comparing these data with those from December 2020 shows that the US economy has begun to recover after the successful vaccine roll-out. Next, based on the latest economic data and trends, the author will identify and analyze two problems linked with the supply side. The author will then stress the importance of increasing the vaccination rate and of enhancing international trade cooperation. These will be justified with reference to the identified blockage points within the US economy. The entire article considers the policies that the US Government has adopted. In this context, alongside providing an account of the US economy over the period since 2018, the writer will provide some suggestions on potential future policy measures.

2 The US Economy After the China-US Trade War

In March 2018, the USTR office released a report stating that China is conducting unfair trade practices related to technology transfer, intellectual property, and innovation under Section 301 of the Trade Act of 1974 [1]. The US Government decided to retaliate with a series of tariffs. This event marked the official start of the China-US trade war. The list of goods hit by tariffs suggests that the US Government is mainly levying taxes on commodities and goods key to “Made in China 2025”, a national science and technology development policy of China.

2.1 Stable US Economic Performance

According to the data from the World Bank, the ratio of current account balance to US GDP in 2018 and in 2019 was -2.18% and -2.24% [2]. Besides, data from the US Census Bureau show that the range of the US CPI index is 8.59 [3], and the unemployment rate has a range of 0.9% [4]. These data show that after the trade war between China and the United States, the US economy was in a state of stable development.

2.2 FED’s Conventional Operations to Increase Market Liquidity

Accounting for the impact of global tensions on US economic outlook and for moderate inflationary pressures, the Federal Reserve decided to lower the target range for the federal funds rate by 25 basis points to a level between 2% and 2.25% [5]. However, uncertainty over the US economic outlook remained. After excluding food and energy prices, corporate fixed asset investment had been weak, and the US inflation rate and core inflation were still below the 2% average target. Moreover, this was the first interest rate cut by the Federal Reserve since the 2008 subprime mortgage crisis. Regarding the future direction of the federal funds rate, the Federal Reserve stated that it would continue to pay attention to the US economic situation and take appropriate actions to support the US economy’s expansion. On August 1st, 2019, two months earlier than previously planned, the Fed also ended its balance sheet reduction plan [5].

3 The Performance of the US Economy After COVID-19

The COVID-19 pandemic and its impact on the economy required extensive government intervention. Residents of the United States started to be vaccinated against COVID-19 at the end of December 2020. The author divides the performance of the US economy since the COVID-19 pandemic, into two time periods: a pre-vaccination period and a post-vaccination period.

3.1 The Pandemic Brings Real Economic Disaster

In July 2021 the National Bureau of Economic Research (NBER), a leading organization providing economic research and analyzing business cycles, updated its business cycle data. The economic recession that began in February 2020 had ended by April 2020 [6],

which made it the shortest US recession on record. On July 29th, Reuters reported that data released by the US Government in July showed that from the peak in the fourth quarter of 2019 to the second quarter of 2020, the US economy had shrunk by a record annualized rate of 19.2% [7]. Based on this, the recession due to COVID-19 is the worst on record.

It is difficult to overstate the unprecedented economic and social changes brought about by the COVID-19 pandemic. At the same time, while considering the recession and recovery associated with the pandemic, it is important to keep a broader perspective. The most direct economic impact from the pandemic on the US economy was that it was shut down after March 2020, with many economic activities and behaviors restricted. For example, Fig. 1 compares the latest economic recession cycle trend from the NBER (the period of economic recession is shaded) and the unemployment data from the U.S. Census Bureau. It can be concluded that during the recession, the unemployment rate in the United States increased by 10.4 percentage points in just one month to reach a record high of 14.8% [4]. The sharp increase in the unemployment was mainly linked to the shut-down of large swathes of the economy, as a result of restrictions aimed to limit the spread of the disease.

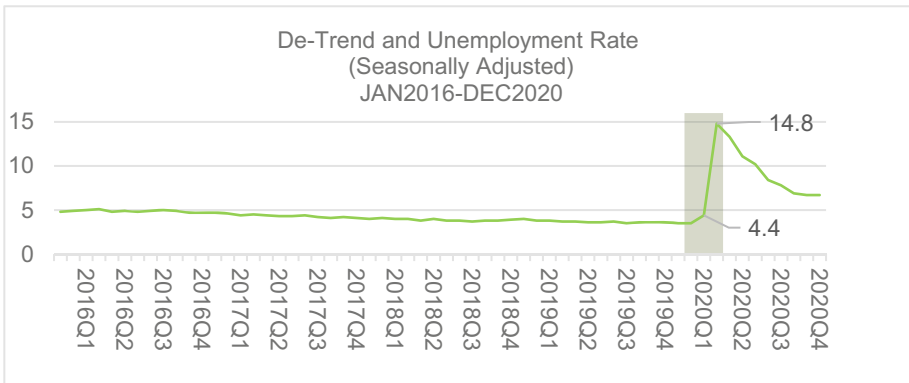


Fig. 1. De-trend and unemployment rate JAN 2016-DEC 2020 Source: US Census Bureau [4]

There are two main reasons for the mismatch between business cycle analysis and economic data: one is that the indicators that are often used to reflect economic performance are lagging indicators, which means that data become available after the events have happened; the other is that under a business cycle analysis, after the lowest point is reached, any increase in output will be identified as an expansion.

3.2 US Economic Performance After the Vaccine Roll-Out

Vaccines play a key role in industries that rely on interpersonal contact, such as the service industry and the travel industry. At the same time, vaccines also play a decisive role in the resumption of production in the manufacturing industry. The US Government has mobilized unprecedented financial resources, with an expansionary monetary and fiscal

policy. In layman's terms, it has invested a lot of money to deal with this problem. Since the pandemic, the US Government's series of economic stimulus policies accompanied by the continuing health crisis have caused the economy to temporarily fail to return to a state of healthy development.

The New York Times website used US vaccination information to create a vaccination rate map. According to the latest data from November 4th 2021, the United States vaccination rate (defined as the rate of those having received at least one dose) is 67%, and it is expected to reach the lowest line of herd immunity by December 9th. The full-vaccination rate has reached 58%, and it is expected that by September 2022, the vaccination rate for people over 5 years of age could reach 94%. At the same time, the Centre for Disease Control and Prevention (CDC) provides data on the number of doses administered. The latest seven-day average data from November 3rd shows more than 800,000 people received an additional dose of the vaccine [8]. This proves that the public's awareness of the prevention and control of COVID-19 has significantly increased. Therefore, increasing the vaccination rate is still the fundamental solution to bring the US economy on a stable growth path.

3.3 The CPI and Inflationary Risks

According to the latest data from the US Department of Labor, in September the adjusted CPI increased by 0.4%. Still, the annual growth data show that over the past twelve months the non-seasonally adjusted total CPI index was 5.4%. Among them, the food CPI index is 4.5%, the energy CPI index is 24.8%, and the total CPI excluding food and energy is 4.0% [9], far exceeding the Federal Reserve's well-anchored expectation of 2.0% for flexible average inflation. The hike in energy CPI is mostly linked with global supply chain problems, as economies across the world are recovering from the pandemic. According to data on all CPI items compiled by FRED, since the COVID-19 pandemic began, except for negative CPI growth in April 2020 (−0.7%), the index has constantly been positive [10]. Meanwhile, an interim report by the OECD in September 2021 pointed out that the OECD's expectation for overall inflation in the United States in 2021 is 3.6% [11].

4 Two Main Reasons for the Difficulty in Economic Recovery

Since November 2020, the inflation rate has been rising, mainly due to the reopening of the economy. The analysis of US economic performance will consider two markets, the commodity market and the currency market. The market for goods is currently facing greater consumer demand and supply chain constraints. While an expansionary monetary policy has been set off to stimulate economic recovery and support government spending.

4.1 Supply Chain Havoc

From a domestic perspective, the lower value of the US dollar on money markets makes it more expensive for US consumers to afford imported goods or goods with a high value of imported inputs. This is especially the case for daily necessities with relatively

inelastic demand, for which prices continue to rise. From an international perspective, as the world is becoming more and more integrated, the trade link with China has become increasingly important. Within this context the trade war between China and the US is still ongoing and has entered the next stage. This has worsened the current supply shortage for local companies caused by COVID-19, as they face higher costs for inputs. In addition to the increase in production costs, the rise in transportation costs is also one of the reasons for the soaring total prices of commodities. Based on the data from Statista, a German database company, the Global container freight rate has increased by 7.69 times between July 2019 and September 2021. The rate has grown exponentially since January 2021 [12].

Rising prices have led to increasing labor costs. Wage stickiness causes transportation company employees to either choose to give up their jobs or to re-negotiate wages. This is because they wish to off-set any falls in their real wages as a result of inflation. However, the possibility of successful bargaining in jobs where it is relatively easy to find substitute labor is very low, leading to labor shortages in the transportation industry. By increasing the promotion of vaccination and by increasing vaccination rates, the US Government should prioritize ensuring that local supply chain employees are vaccinated and reducing employee turnover due to havoc across the supply chain. This will reduce shortages and pressures on the market for goods.

4.2 Increase in Money Supply (M2)

Table 1 summarizes the economic relief bills approved by Congress since the start of the pandemic. After the outbreak, the US Congress passed six bills to put \$6,936.3 billion into the economy to stimulate both sides of demand and supply and vigorously promote the recovery of the US economy [13]. Among them, five economic bills were promulgated within the space of 10 months. Fiscal action was coupled with expansionary monetary action. The Federal Reserve provided \$4,907.5 billion to markets from March 2020 to September 2021 [14]. The number of US dollars circulating in the economy has increased significantly in a relatively short period. The adjustment functions of automatic market stabilization have been affected, resulting in unexpectedly high inflation that deviates from previous short-run expectations.

Table 1. COVID-19 economics stimulus bills Source: US today, US Congress [13, 15]

COVID-19 stimulus bills passed by congress			
Number	Name of act	Date	Brief information
1	Coronavirus Preparedness and Response Supplemental Appropriations Act, 2020	03/06/2020	It provided \$8.3 billion to fight the spread of COVID-19 in the United States by funding vaccine and test development

(continued)

Table 1. (continued)

COVID-19 stimulus bills passed by congress			
Number	Name of act	Date	Brief information
2	Families First Coronavirus Response Act	03/18/2020	The \$225 billion legislation provides funding for COVID-19 testing, paid sick leave, and food assistance
3	CARES Act	03/27/2020	The \$2.2 trillion bill includes \$1,200 in stimulus checks, increased unemployment benefits, the creation of a salary protection program, small business forgiveness loan program, and assistance to state, local governments, and businesses
4	Paycheck Protection Program and Health Care Enhancement Act	04/24/2020	This measure provided more funding for the Salary Protection Program and COVID-19 testing, a total of \$483 billion
5	Consolidated Appropriations Act, 2021	12/28/2020	The total expenditure of US\$920 billion (attached to the larger government appropriations bill) includes a \$600 stimulus check, updates to the wage protection plan, billions of dollars for vaccines. It provides a federal weekly unemployment benefit of US\$300
6	American Rescue Plan, 2021	03/11/2021	President Biden's first relief bill accounts for total expenditures of US\$1.9 trillion. The plan includes a \$1,400 stimulus check, funds for school reopening, and billions of dollars for vaccine distribution and development
7	Infrastructure Investment and Jobs Act, 2021	11/05/2021	A \$1.2 trillion infrastructure package and deliver \$550 billion of new federal investments in America's infrastructure over five years, a \$40 billion for bridge repair, replacement and rehabilitation included

5 Government Response to Current Economic Blockages

Regarding the current economic trajectory, the US Federal Government has mainly focused on two crises, one is from a mix of problem linked to inflation and debt, and the other is from the commodity supply chain.

5.1 Against Inflation and Debt Crises

The minutes of the latest FOMC meeting in November show that the Fed has started to shrink its balance sheet and plans to taper asset purchases up until mid-2022 [16].

Besides, in the FOMC meeting the Chairman of the Federal Reserve stated that the US Congress and the US Treasury Department are also making efforts towards vaccination and economic recover [17]. This move indicates that the Fed has realized the need to control the rising inflation rate, reduce the capital injection into market liquidity, reduce the monetization of the US fiscal deficit, and restore the ability of markets to self-regulate. In response to the rising inflation rate caused by the previous series of stimulus policies, the coordinated and joint control of approaches by different government departments will disperse pressure. Since March 2020 the Federal Reserve has purchased financial assets at a monthly rate of 120 billion US dollars [18]. Once the Federal Reserve stops buying, the US government will need to find more buyers of US debt to be able to finance current expansionary fiscal measures.

Assume that the Federal Reserve looked for profits and completed its balance sheet reduction or raised interest rates while pursuing interests and chose to sell US Treasury bonds. The US Treasury Department would then have to pay all the principal and interest. In a similar scenario, the debt dilemma in the US market will become even more apparent.

The White House published an article and gave a warning call on October the 6th mentioning that the United States has reached the debt ceiling on August 1st, 2021, and the Treasury Department will soon run out of cash and other resources to remain below the ceiling [18]. In response to the debt ceiling issue, the US Congress No. 171 on September the 30th showed that the Congressional Budget Office projects that US debt at its current pace will reach 202% of GDP by 2051. Congress agreed to temporarily expand government funding and provide emergency assistance through the *Extending Government Funding and Delivering Emergency Assistance Act*, which postpones the date of government funding to December the 3rd 2021 [19].

5.2 Dealing with Supply Chain Issues

On February the 24th, 2021, President Biden issued executive order no. 14017 “America’s Supply Chains”, which was published in the Federal Register on March 1st, 2021 (86 FR 11849-11854). EO 14017 focuses on the need for a flexible, diversified and secure supply chain to ensure the economic prosperity and national security for six critical economic sectors in the United States’ economy [20]. Moreover, the White House issued an announcement in June 2021 reporting that US government departments’ statistics show that US local companies faced two problems throughout the pandemic. One is that inventory is difficult to sell, and the other is a large-scale delay on the supply side [21]. This suggests that the White House has realized that it must clear the blockages in the supply chain to restore economic development.

6 Conclusion

Based on the analysis of this article, to accelerate the return to economic stability, we need to address the following three issues. First, the vaccination rate has not yet reached the lowest limit of herd immunity. The second challenge is linked to the national financial crisis caused by inflation and debt. Third, domestic supply chain problems in the United

States can be resolved by strengthening international trade, rather than engaging in trade wars.

A potential solution to the first problem is to increase the supply of free vaccines and frequency of virus detection tests. In particular, the US Government should prioritize ensuring that supply chain employees are vaccinated and improve employee benefits in key industries. This will reduce absence from work in key sectors and reduce staff turnover. Meanwhile, it should expand the infrastructures of specific hospitals and other medical facilities to fight against COVID-19. These infrastructures could then be used for future biochemical research to prevent the coming of the next pandemic. At this stage, vaccination remain the first choice to fight the COVID-19. Even though oral drugs are currently being developed, they are still undergoing clinical trials and there is at present not sufficient experimental data to prove their safety. In addition, drugs are mainly targeted at early infections with mild to moderate symptoms.

Regarding financial and debt issues, when the plan to reduce purchases is completed, the Federal Reserves could use other monetary tools such as raising the interest rates to combat inflation, if this was still a problem. Furthermore, the Treasury Department could discuss with Congress the fiscal debt ceiling more frequently, in order to avoid the risk of Government shut-down and lack of funding. The government deficit replenishment mainly comes from lump-sum taxation and one-time national debt issuance. In a counter-cyclical period of payments, the short-term and medium-term economic cycles of fiscal deficits will cause the dollar to depreciate. In contrast, in the long run, excessive government expenditure in the early period will mark a decrease in government expenditure later. Automatic economic stabilization will then be restored, and the inflation rate will return to its target value. Therefore, no matter how current economic policies affect the short term, these effects are only temporary. The plan for future economic development should be built based on the assumption that the impacts from COVID-19 cannot be fully recovered.

Moreover, the available solutions to the third problem are to strengthen trade cooperation with other countries and encourage foreign-funded enterprises to build factories. In particular, the US Government should pay more attention towards restricting entrepreneurs that deliberately let ports hoarding goods for high profits. This could be done by making use of a few future tax incentives to require the cooperation of these transport industry business owners. By exploiting the benefits from comparative advantage associated with international trade and lowering the tariffs on corresponding substitutes, trading can effectively alleviate the shortage of supply-side goods in the United States in the short term. As a next step, the US Government shall also consider the meaning of partnerships in international trade, developing and using IT ecological technology vigorously, stabilizing the domestic supply chain, and considering trade cooperation with other countries to achieve mutually beneficial win-win results as soon as possible.

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The Impact of COVID-19 on Chinese Stock Market in Two Outbreak Periods

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Abstract. The outbreak of the COVID-19 pandemic has had significant impacts on many aspects of society. The pandemic not only poses threat to public health but also causes emergence of the medical resources. From the information published by the media, we can suspect that COVID-19 also has negative impacts on the global economy when it is spreading. To figure out the impact of COVID-19 on China, this paper studies the influence on the Chinese stock market and stocks of different industries. Using data of share price in the two outbreak period of COVID-19, this work targets the different impacts during the two-period and in different industries. Analyzing the correlation between data from the stock market and the data of COVID-19 published by the National Health and Family Planning Commission of the People's Republic of China, this work concludes that the outbreak of pandemic has significant negative impacts in the initial outbreak period but do not have obvious impacts on the subsequent period. In addition, the impact on different industries is not the same due to the nonconformity of the nature of the industry.

Keywords: COVID-19 · Chinese stock market · Daily return

1 Introduction

Starting in January 2020, COVID-19 broke out in Wuhan and spread rapidly across China. On January 8, 2020, Wuhan announced the lock down of the city, and other parts of China also suspended work and schools to prevent the further spread of COVID-19. The delta variant was first discovered in India in May 2021. On May 21, 2021, the delta variant was first found in Guangdong Province, China. So far, such virus strains still exist in China and affect people's lives.

Affected by COVID-19, the Chinese stock market plummeted just after the opening of the first trading day after the 2020 Spring Festival. Shanghai Composite Index fell by 7.72%. Shenzhen Component Index fell by 8.45%. ChiNext Index fell by 6.85%.

1.1 Purpose

We want to observe the impact of the COVID-19 on the stock prices of different industries by studying the changes in the stock prices of some industries. Looking for the potential relationship between the COVID-19 and the stock market returns of some industries and hoping to find some solutions to similar situations by analyzing data.

1.2 Research Objective

We select four industries for our analysis, they are Car Manufacturing; Medical Manufacturing; Textile Industry; Banking Industry.

1.3 Contribution

Based on previous studies on the impact of COVID-19 on the financial industry, we refined the impact of COVID-19 on the stock financial market and took four specific industries as the entry point to establish a mathematical model using regression analysis to explore the impact of COVID-19 on the stock market in different periods.

2 Literature Review

The coronavirus (COVID-19) is named by WHO in January 2020, and it was first discovered in Wuhan, China. Now, COVID-19 is regarded as a global pandemic. "Patients with COVID-19 are often accompanied by fever, dry cough, and fatigue. Some patients will also lose taste, nausea, vomiting, diarrhea, and so on" [1]. Since this kind of virus was discovered for the first time, "people have not yet understood its etiology and source, so there is no specific drug to treat this kind of disease, and there is a lack of treatment experience for this kind of disease" [2]. According to the data from the World Health Organization (who), "as of August 9, 2020, COVID-19 has caused more than 19,824,060 confirmed infections and 729,910 deaths in 215 countries/regions, and the number continues to increase. Without preventive measures, the epidemic could infect 7 billion people worldwide and kill 40 million people." [3]. It is clear that COVID-19 has become one of the most important diseases in the world, and its rapidly increasing rate of diagnosis and mortality has also become a worldwide panic.

At present, all countries are fighting with the coronavirus. For example, in early 2020, China put forward the policy of home isolation. Since no effective drugs have been developed at present, and there is interpersonal communication, "the most effective prevention, and control method is to temporarily control social activities. This is the most original method and the most effective method so far" [4]. "COVID-19 poses a great threat to global financial stability and the economic activities nowadays are decreased." [5]. "According to the estimation of the United Nations International Labour Organization, about 25 million jobs would be lost because of COVID-19. Due to shutdown and other reasons, COVID-19 is causing huge losses to the global economy and financial markets, and stock markets." [6]. Therefore, it has become a hot topic to study the impact of COVID-19 on the economy. For example, what impact does the COVID-19 have on

the stock market, “because the stock market is regarded as a powerful tool for measuring the economy, and it can offer a different way to forecast the future of the company and the economy.” [2]. So far, according to a sample of 77 countries, “compared with the increase of death cases, the response of the stock market to confirmed cases is more obvious.” [7].

As a barometer of the economy, the stock market has also been greatly impacted. Many scholars have proved that COVID-19 has a great negative impact on the stock market, and “it has caused an unprecedented impact on the current economy of China and even the whole world. Because of COVID-19, global financial market risks increase.” [8]. “On February 3, 2020, China’s stock market opened on the first day after the long Spring Festival holiday, at a time when the epidemic was at its worst, and the Shanghai index rose or fell by - 7.7%.” [9]. The COVID-19 has undoubtedly had a profound impact on the current Chinese economy. The revenue of retail catering, accommodation and tourism, transportation, culture and entertainment, and other industries fell sharply. “Manufacturing, real estate, construction, and other industries are slow to resume production due to the limited flow of people and logistics. Remote offices, online education, online medical treatment, fresh logistics, and other technology companies have sprung up. The coronavirus has brought different challenges and opportunities to various industries in China.” [10].

Some researchers have confirmed that COVID-19’s explosion will increase the volatility of the Chinese stock market. Xiang, Q. et al. used the GARCH model confirmed that after the influence of COVID-19 on the Chinese stock market, “it will take several months or even longer for the Chinese stock market to return to a normal level.” [11]. Chen Lin, et al. used the panel data fixed effect model and made a conclusion that “the impact of the epidemic on different industries and different types of stock markets is different.” [12]. Taking Shenwan Pharmaceutical Biological index as an example, based on the event analysis method, it is concluded that “the COVID-19 has a short-term significant impact on the stock return of China’s pharmaceutical listed companies.” [13]. All these studies show that COVID-19 has a great impact on the stock prices and trading volume of different industries in China.

COVID-19 has had a huge impact on the manufacturing industry. As workers were required to be isolated at home, COVID-19 had caused a serious consequence, that is, “the production line and supply chain were forced to be interrupted.” [14]. Nowadays, the global value chain is facing two challenges, one is the influence of COVID-19, and the other one is Global trade disputes. “At the beginning of the outbreak, China’s commodity exports fell sharply, and the value chain was broken. The global production network was paralyzed.” [15]. According to the data of the China Automobile Industry Association, in the first quarter of 2020, car sales decreased by 42%. However, for the medical industry, things got different. “With the emergence of the epidemic, the demand for products related to epidemic treatment, such as CT, ultrasound, ventilator, and ECMO, has increased.” [16]. Therefore, “the Chinese government has proposed to expand the production scale of the medical industry to meet its own and export needs.” [17]. “As a public health emergency, epidemic events have driven the overall improvement of the A-share market in the medical industry.” [18]. Many of China’s medical industry and medical e-commerce platforms, such as “Ali health, saw their share prices soar after

the outbreak of the epidemic. Although there were fluctuations, they showed a positive upward trend as a whole.” [19]. COVID-19 also has a certain impact on the banking industry. The epidemic has caused instability in the global market, and the banking industry is no exception. “Bank stocks suffered a sharp fall in March 2020. However, banks can still provide customers with digital services to ensure that they can operate during the epidemic period.” [20].

The corona-virus pneumonia is now under control in China, although there are still small-scale outbreaks, such as the effects of delta variants. According to the current index dependence of various industries in China, although it is still higher than that in the calm period after the epidemic, “the dependence structure has been similar to that in the calm period. This also shows that the Chinese people’s production has returned to the state before the outbreak.” [21]. However, as the main culprit of COVID-19 now, delta mutation will also have an impact on China’s economic market and the stock market. The mutant strain reduced the protective power of the vaccine, and the delta variant has the characteristics of rapid diffusion. As a result, “this round of epidemic will expand the volatility of the US dollar index and put the RMB at risk of devaluation in the second half of the year. At the same time, it has a certain impact on some industries, such as tourism.” [22].

3 Method and Discussion

3.1 Method

Step 1. This work selects two critical time points of the COVID-19 as cut-off points.

Period 1: From January 23rd 2020 to April 4th 2020. (January 23rd 2020 lock down of Wuhan. April 4th 2020 lift the lock down of Wuhan).

Period 2: From May 24th 2021 to August 13th 2021. (May 24th 2021 first discovery of delta virus. August 13th, 2021 up to now).

Step 2. This work selects daily yield of four industries according to the classification of China Securities Regulatory Commission as dependent viable.

Car Manufacturing; Medical Manufacturing; Textile Industry; Banking Industry.

Step 3. This paper was conducted based on Wind data base to collect the data of stock price and then calculate the daily yield using Wind and Excel. We calculate daily yield for each stock in each sector. Then, we calculated daily yield for the industry by weighted average Daily yield of industry.

Step 4. After obtaining the daily yield of each industry, this work made eight tables representing the fluctuation of daily yield of four industries in two different periods.

3.2 Data and Discussion

For this section, we will introduce the data selection and initial processing and the model construction. In addition, we will also post the final result of our data.

3.2.1 Data Selection and Initial Processing

To calculate the dependent viable, we select stock price of four industry exclude the ST stocks according to the classification of China Securities Regulatory Commission, which includes car manufacturing (153 samples), medical manufacturing (85 samples), textile industry (26 samples), banking industry (42 samples). Apart from the specific stock, we also collect the data of the Hushen 300 Index to observe the whole market. This paper obtained data form Wind database and processing the data in Excel using following formula.

$$\text{Daily Return} = (\text{Opening Price of Day } t - \text{Closing Price of Day } t-1) / \text{Closing Price of Day } t-1$$

Formulate Daily Return

(1)

For the calculation of daily return of each stock, this paper average the daily return according for each industry and the market index. The following charts describe the trend of the daily return in different period. Figure 1 shows daily return of car manufacturing industry, medical manufacturing industry, textile industry industry, banking industry industry and the Hushen 300 Index in Period 1.

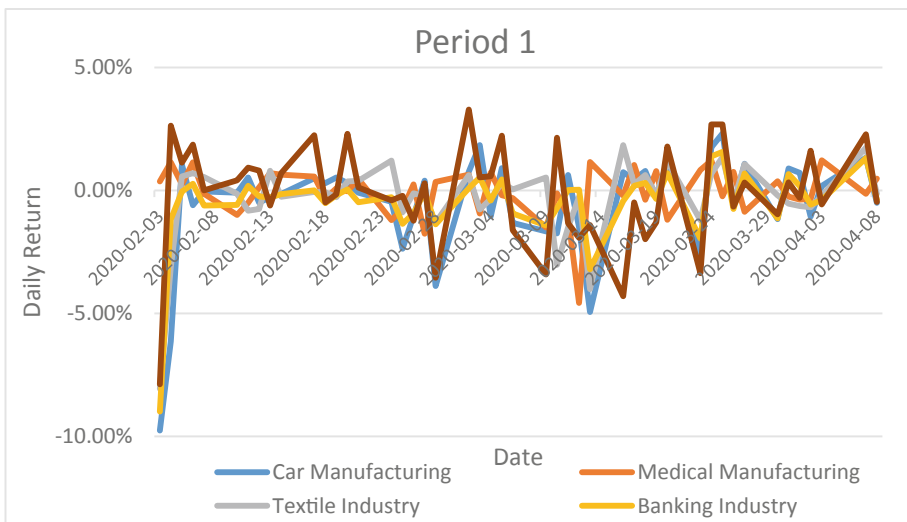


Fig. 1. Period 1 Car Manufacturing, medical manufacturing, textile industry industry, banking industry industry and the Hushen 300 Index in Period 1.

Figure 2 shows daily return of car manufacturing industry, medical manufacturing industry, textile industry industry, banking industry industry and the Hushen 300 Index in Period 2.

For the quantification of COVID-19, this paper selected different measurement for each period. During period 1, this work calculated the growth rate of confirmed cases and the growth rate of death as independent viable for the reason that the number of

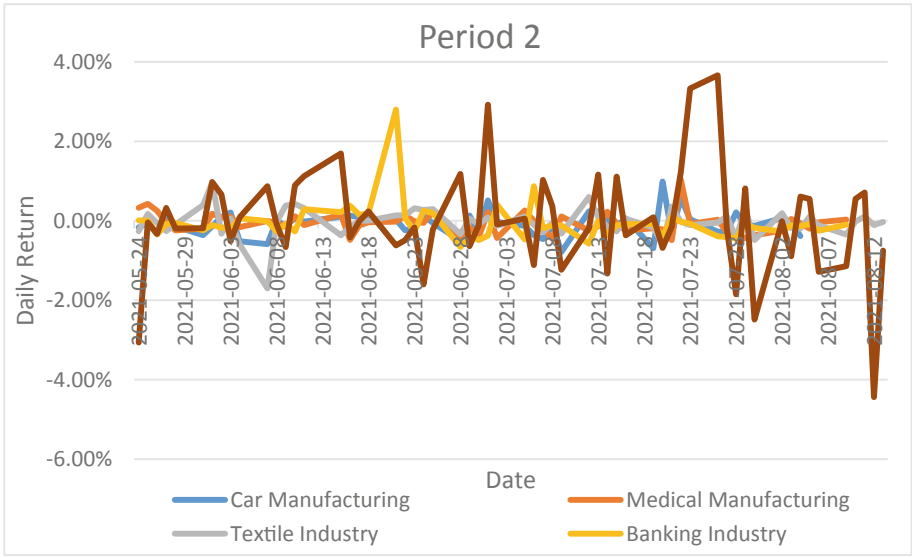


Fig. 2. Period 2 Car Manufacturing, medical manufacturing, textile industry industry, banking industry industry and the Hushen 300 Index in Period 2.

death is existing and increasing at that time. In period 2, this work calculate the growth rate of confirmed cases and the growth rate of vaccination (dose) as dependent viable for the reason that the growth of death is basically zero.

Growth rate of confirmed cases

$$= \text{Number of confirmed cases in day } t - \text{Number of confirmed cases in day } (t-1) / \text{Number of confirmed cases in day } (t-1) \quad (2)$$

Formulate Growth rate of confirmed cases

Growth rate of death

$$= \text{Number of death in day } t - \text{Number of death in day } (t-1) / \text{Number of death in day } (t-1)$$

Formulate Growth rate of death

(3)

Growth vaccination rates

$$= \text{Number of vaccination in day } t - \text{Number of vaccination in day } (t-1) / \text{Number of vaccination in day } (t-1) \quad (4)$$

Formulate Growth vaccination rates

In the days when stock market is not open such as weekends and holiday, this paper did average of the growth rate of those days. And Fig. 3 and Fig. 4 describe the situation

of COVID-19 based on our method of quantification. Figure 3 shows growth rate of confirmed cases and growth rate of death in Period 1. Figure 4 shows growth rate of confirmed cases and growth rate of vaccination in Period 2.

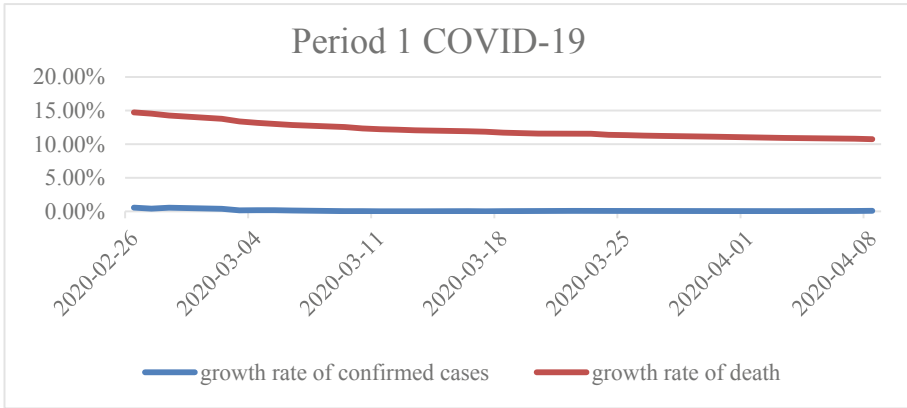


Fig. 3. Period 1 COVID-19

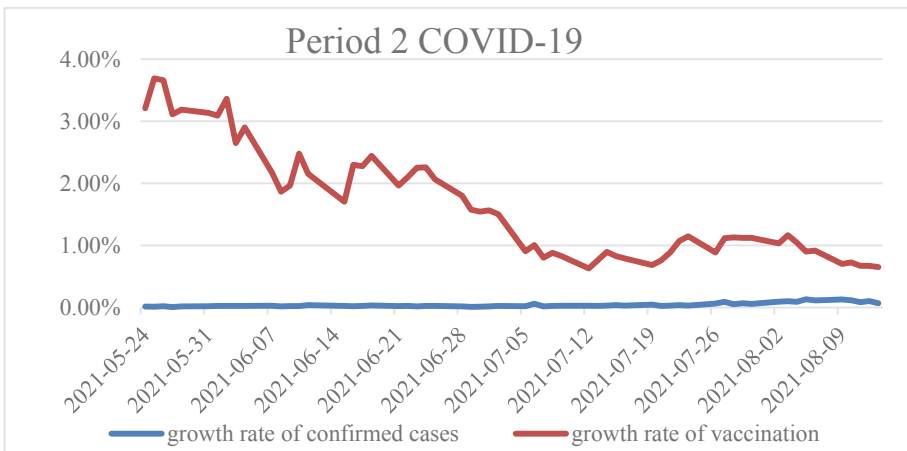


Fig. 4. Period 2 COVID-19

Model Construction. We used the regression-based methodology and built the quadratic equation of one unknown as our model. The equation of our model is formulating 5.

$$Daily\ return = a_1 \times growth\ rate + a_2 \times growth\ rate^2 + C + \theta \tag{5}$$

Formulate Model of daily return

Based on formulate 5 and the data we collected, we did a regression using the data processing software Stata to verify our assumption. In addition, we check the significance

of each independent viable and to find the impact of COVID-19 to the stock market and each different industry.

Final Result. The final result of regression for period 1 and period 2 are in Table 1, 2, 3 and 4.

Table 1. Period 1 growth rate of confirmed cases

	Car manufacturing	Medical manufacturing	Textile industry	Banking industry	Hushen 300 index
Growth rate of confirmed cases	-0.142 (0.0942)	0.113** (0.0487)	-0.0767 (0.0725)	-0.0713 (0.0674)	0.144 (0.0962)
Growth rate of confirmed cases_sq	0.147 (0.249)	-0.344** (0.129)	0.0367 (0.192)	0.0193 (0.178)	-0.561** (0.254)
_cons	-0.000840 (0.00330)	-0.00226 (0.00170)	-0.000369 (0.00254)	-0.00170 (0.00236)	-0.00161 (0.00337)
<i>N</i>	48	48	48	48	48
<i>R</i> ²	0.173	0.145	0.147	0.170	0.159
<i>AIC</i>	-238.0	-301.3	-263.1	-270.1	-236.0

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, (Table 1 shows result of growth rate of confirmed cases in period 1.)

In period 1 growth rate of confirmed cases had positive effect to the return of medical manufacturing industry and the square of it had negative effect. The square of growth rate of confirmed cases had positive effect to Hushen 300 Index. And its effect to other industry is not significant.

The daily return of medical industry decreased with the increase of growth rate of confirmed cases and then increase substantially. The daily return of stock market in China basically decreases with the outbreak of COVID-19.

In period 1, the growth rate of death had negative impact to car manufacturing, textile and banking industry and also the whole market. And its square had positive effect to the industry and market mentioned above. Its effect to the medical manufacturing industry is not significant.

With the increase of growth rate of death, the market and the selected industry exclude the medical manufacturing industry decreased substantially.

For period 2, our paper can conclude that neither of the growth rate of confirmed cases and the grow rate of vaccination had significant effect to the selected industry and market.

Table 2. Period 1 growth rate of confirmed cases

	Car manufacturing	Medical manufacturing	Textile industry	Banking industry	Hushen 300 index
Growth rate of death	-0.0235*** (0.00393)	0.00231 (0.00248)	-0.0187*** (0.00286)	-0.0202*** (0.00227)	-0.0150*** (0.00470)
Growth rate of death_sq	0.000904*** (0.000155)	-0.000131 (0.0000980)	0.000726*** (0.000113)	0.000780*** (0.0000894)	0.000533*** (0.000185)
_cons	0.00183 (0.00263)	-0.00132 (0.00166)	0.00234 (0.00191)	0.00153 (0.00151)	0.00355 (0.00314)
N	48	48	48	48	48
R2	0.444	0.143	0.487	0.638	0.225
AIC	-257.0	-301.3	-287.5	-310.0	-240.0

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, (Table 2 shows result of growth rate of confirmed cases in period 2.)

Table 3. Period 2 growth rate of confirmed cases

	Car manufacturing	Medical manufacturing	Textile industry	Banking industry	Hushen 300 index
Growth rate of confirmed cases	-488.1 (479.7)	-4.967 (4.771)	-1.480 (6.837)	241.1 (239.0)	8.340 (24.72)
Growth rate of confirmed cases_sq	310991.8 (359004.9)	1982.6 (3571.0)	777.8 (5117.6)	-154777.0 (178863.2)	-11432.4 (18499.1)
_cons	0.152 (0.112)	0.00102 (0.00111)	-0.000000698 (0.00159)	-0.0757 (0.0556)	-0.000497 (0.00575)
N	59	59	59	59	59
R2	0.024	0.092	0.002	0.023	0.033
AIC	10.34	-533.7	-491.2	-71.87	-339.6

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, (Table 3 shows result of growth rate of confirmed cases in period 2.)

Table 4. Period 2 growth rate of growth of vaccination rate

	Car manufacturing	Medical manufacturing	Textile industry	Banking industry	Hushen 300 index
Growth rate of vaccination	-10.54 (18.60)	0.0205 (0.193)	0.000468 (0.271)	5.787 (9.266)	0.960 (0.988)
Growth rate of vaccination_sq	436.0 (464.4)	1.257 (4.815)	0.822 (6.758)	-228.9 (231.4)	-24.71 (24.68)
_cons	0.0536 (0.153)	-0.00130 (0.00159)	-0.000703 (0.00223)	-0.0323 (0.0763)	-0.00735 (0.00814)
N	59	59	59	59	59
R2	0.068	0.058	0.007	0.067	0.018
AIC	7.619	-531.5	-491.5	-74.60	-338.7

Standard errors in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, (Table 4 shows result of growth rate of confirmed cases in period 2.)

Analysis of the Results. During the first period of the COVID-19 outbreak in China (during the Wuhan lockdown), the study found that the increase in confirmed cases during this period had a significantly positive impact on the returns of medical manufacturing stocks. This may be due to the explosive demand for medical devices at the beginning of the epidemic. The increase in the number of confirmed cases is further encourage the situation, as it means that personal protective equipment like face mask has become a necessity for front-line workers in hospitals and the logistics industry.

As for the relationship between the death rate and various industries, it is found that the increase of death cases had extra significant negative impact on car manufacturing, textile industry, banking industry and even the whole market. All the data mentioned above are significant at the extent of $p < 0.01$. Connected to the situation that Chinese government halted most factory operations in the early days of the outbreak, investors of common industrial generally took a pessimistic view. On the other hand, as the development of the epidemic is faced great uncertainties, small or medium size banks may suffer unexpected cash pressure, which makes the banking stocks fluctuate greatly, which also reflects the sensitivity of consumers to the increase in the number of dead cases.

As for the second period, the results of the regression analysis showed no significant relationship between the stock market performance of each industry and the COVID-19 pandemic. However, since the second period is in the middle of May 2021, more than 400 million doses of COVID-19 vaccine have been administered in China, and in the following days it has have been growing rapidly to over 1.5 billion. Which means a strong prevention occurred in China. In this case, we make a further inference. With the improve of prevention on COVID-19, investors are likely to become more optimistic. Because the experience of the epidemic in 2020 tells investors that there is a high possibility that the epidemic will be brought under control in the short term. When this situation reflected in

the stock market, increase in the number of confirmed cases may not have a significant negative impact on the stock market.

4 Conclusion and Suggestion

4.1 Research Conclusions

Based on the daily returns of the stock market, this paper uses regression analysis to build a model, try to find the potential relationship between COVID-19 and the stock market returns of some industries.

The results show that there are significant differences in the impact of the epidemic on different industries during the period of Wuhan lockdown. It has a positive impact on the medical production industry, while it has a significant negative impact on car manufacturing, textile industry, banking industry and SCI 300 index. In the second period when the Delta Variant of COVID-19 began to spread in China, there was no significant relationship between the epidemic and the stock market. It is further speculated that this may be due to the strong epidemic prevention.

In brief, this paper did a periodic study of the impact of COVID-19 on the stock market, and further explores the reason of significant differences in specific time period. This could provide the basis for further research into the link between stock markets and black swan event.

4.2 Suggestion

As an unexpected event, impact of COVID-19 on financial markets is characteristic. However, there is always some similarity in different events, crises always bring opportunities. According to the analysis, we put three suggestions that might be helpful in the face of a similar situation.

First, pay attention to changes in consumer psychology. We found that for different industries, an increase in deaths had a bigger negative impact on the stock market than an increase in the number of confirmed cases. This may indicate that consumers will feel the danger of COVID-19 more acutely when they face the increasing death number. When the number of deaths increases dramatically, industries should be more alert to the shock to the share market from changes in consumer psychology.

Second, the pandemic may present potential opportunities for some industries. By adjusting production strategy in time, the enterprise may not suffer losses, and may even have the possibility of expansion. For example, the epidemic in the first period had a positive effect on the medical manufacturing industry. If the masks production line is introduced at this time, there is a good chance to bring additional income to the company. In fact, BYD, one of the largest auto enterprises in China, quickly introduced a mask production line at the beginning of the epidemic and made a profit over ¥4.2 billion by 2020, which allowed the company to recoup losses from a decline in its auto business (Gao, F., 2021).

Third, epidemic prevention is needed. Public's sensitivity to the COVID-19 may have been reduced due to the prevention measures. It can also boost investor confidence which

effectively reduced the unnecessary stock market decline. From a business perspective, strong protection prevents further epidemic, which eliminates the possibility of more extreme measures such as city lockdowns that could cause severe losses from factory shutdown.

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CiteSpace-Based Analysis on the Research Progress of Agricultural Insurance in China

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Abstract. By using CiteSpace visualization software, this paper comprehensively reviews and sorts out the development context of agricultural insurance based on the literature of relevant agricultural insurance subject areas in the CNKI database from 2007 to 2021, and conveniently draws the knowledge graph from the number of articles, researchers, research institutions, high-frequency keywords, emergent words and so on, and carries out biblio-metric analysis on it. The research results show that there is still a certain gap in the research of agricultural insurance in our country, which needs the country and society to promote its development together.

Keywords: Agricultural insurance · CiteSpace · Biblio-metric method

1 Introduction

Agricultural insurance refers to the insurance activities in which an insurance company undertakes to compensate the insured for property losses caused by agreed natural disasters, accidents, epidemics or diseases in the agricultural production process according to the agricultural insurance contract. Since the central government implemented the agricultural insurance premium subsidy policy in 2007, China's agricultural insurance work has gradually developed and achieved positive results. In 2020, China's agricultural insurance premium income amounted to 81.49 billion yuan, representing a year-on-year increase of 21.2%, accounting for 1.80% of the total premium income. China has become the country with the largest agricultural insurance premium in the world. It can be seen that agricultural insurance has developed very rapidly. Therefore, it is necessary to conduct an in-depth analysis on the hot spots in the field of agricultural insurance research in recent years and the evolution trend [1].

In the research on the development of agricultural insurance, knowledge graph can be used to construct the information included in the insurance industry, the latitude of coverage and other contents, such as insurance products, product prices, insurance coverage, validity period and so on, thus greatly improving the efficiency of sorting out and obtaining information [2]. From the knowledge graph itself, it is essentially a large-scale semantic network. The entire network consists of countless nodes and connections between nodes. Each node represents an entity in the real world, and the connections between two nodes represent the relationship between different entities,

generally in the form of SPO. An entity can not only make a physical object, such as a computer, a guitar, a football, a bicycle, etc., but also a collection of concepts, such as place names, names, gender, occupation, etc. Connections between nodes can represent rich relationships, such as including relationships, precedence relationships, causal relationships, etc. Entities and relationships between entities in the atlas are often represented by triplets. In addition, it can also give entities various attributes, which is a very prominent knowledge representation capability of the knowledge graph. As one of the important branches of visualization technology, knowledge graph can visually display the relationships between entities in a graphical way. From the advantages of visualization technology, firstly, data visualization is a very clear way of communication, which enables researchers to understand and process their information faster. Secondly, data visualization is to discuss the results in a constructive way. Using visual tools to report can enable researchers to use some short graphics to reflect complex information, avoiding presenting readers with overly detailed and tedious data.

Since the emergence of visualization technology in bibliometrics, a number of valuable scientific tools have emerged, such as CiteSpace [3], BibExcel [4], HistCite [5], etc. Among them, CiteSpace is an excellent software for mapping scientific knowledge developed by the Chen Chao-US team of Drexel University in the United States. It mainly uses the co-citation analysis theory and path-finding network algorithm to measure the literature in specific fields and explore the key path for the evolution of discipline fields. In addition to the functions of mutation subject detection, social network analysis, diachronic analysis and geospatial analysis, the software also has the advantages of good stability and good visualization effect. With its powerful function, good stability and visualization effect, it has become one of the more commonly used software in visualization. It is also frequently used in analysis of developments in the insurance sector.

Based on this, this paper uses 955 Chinese documents included in the CNKI data frame as the data source and bibliometrics as the theoretical guidance, uses CiteSpace, an information visualization software, to generate the knowledge graph of agricultural insurance research, and performs visual analysis on agricultural insurance through a number of functions, such as time analysis, cooperation network analysis between authors and institutions, keyword co-occurrence and clustering graph analysis, and sudden subject knowledge graph analysis.

2 Literature Review

Knowledge Graph, which is called knowledge domain visualization or knowledge domain mapping map in the library and information industry, is a series of various graphs showing the relationship between the development process and structure of knowledge. It describes knowledge resources and their carriers with visualization technology, and excavates, analyzes, constructs, draws and displays knowledge and their interrelations. It combines the theories and methods of applied mathematics, graphics, information visualization technology, information science and other disciplines with metrological citation analysis, co-occurrence analysis and other methods, and uses visual atlas to vividly display the core structure, development history, frontier fields and overall knowledge

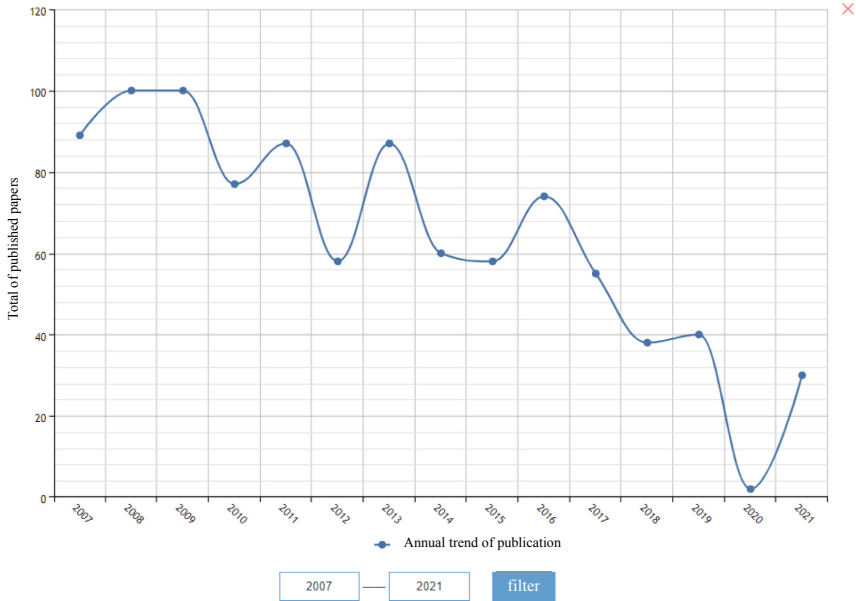


Fig. 1. Time analysis of dispatch volume

structure of the disciplines to achieve the purpose of multi-disciplinary integration of modern theory. It can provide practical and valuable reference for discipline research [6].

From the perspective of the insurance industry, the paper [7] puts forward a guiding method on how to establish a knowledge graph applicable to the insurance industry, and further discusses the application prospect of the knowledge graph in the reinsurance industry on this basis. From the perspective of the insurance industry, this paper [8] thinks about how to build a knowledge graph that is truly applicable to the insurance field, so as to establish the relationship between knowledge points in the insurance industry, and on this basis to explore the application prospect of the knowledge graph in the insurance industry, to provide resource support for the development of China's insurance industry. The paper [9] introduces the basic concepts and related services of the knowledge graph. The demand, opportunity and challenge of applying knowledge graph in insurance industry are summarized. At the same time, on this basis, a set of artificial intelligence construction schemes for the insurance industry is proposed, which takes knowledge graph as the core, automatic knowledge extraction as the construction target and application as the landing point. As well as the time zone analysis, it is found that the quantitative analysis of China's long-term care insurance system is less, and at the same time it lacks innovation and cooperation.

The paper [2] takes 852 Chinese documents included in CNKI database as the data source and bibliometrics as the theoretical guidance, and uses CiteSpace, an information visualization software, to generate the knowledge graph of engineering insurance research, in order to provide some reference for the research theory and practice in the field of engineering insurance. The paper [10] comprehensively reviews and sorts out



Fig. 2. Knowledge graph of high-frequency keywords in agricultural insurance

the development context of long-term care insurance by using CiteSpace visualization software to take the literatures in the relevant subject areas of long-term care insurance in the CNKI database from 2000 to 2020 as samples, and draws the knowledge graph from the aspects of the number of published articles, researchers, research institutions, etc. and performs biblio-metric analysis on the literatures. The paper [11] uses the visual analysis software CiteSpace to perform biblio-metric analysis on 797 documents of CSSCI and core journals from 1999 to 2019, which are intercepted from the HowNet database. Through co-occurrence of key words, time zone view and emergent map, the knowledge graph of the long-term care research of the elderly in China is constructed to show the research hotspots, evolution paths and research trends of the long-term care research of the elderly in China in the past 20 years. The paper [10] uses CiteSpace software to make a visual analysis of the research on China’s long-term care insurance system, and makes a visual analysis of the long-term care insurance system through the research progress, research subjects, fund sources, co-occurrence of key words and thematic clustering.

Table 1. High-frequency keywords in agricultural insurance.

Serial number	Keyword	Age	Frequency of occurrence
1	Agricultural insurance	2007	744
2	Premium subsidy	2007	58
3	Financial subsidy	2007	51
4	Agricultural risk	2007	26
5	Counter-measure	2007	17
6	Reinsurance	2007	17
7	Enlightenment	2011	15
8	Question	2008	15
9	Policy-related	2007	14
10	Premium income	2007	13
11	Peasants' income	2007	13
12	America	2012	13
13	Ethical risk	2008	13
14	Influencing factor	2009	13
15	Farmer	2009	12
16	Agriculture	2007	11
17	Rural revitalization	2018	10
18	Targeted poverty alleviation	2017	10
19	Catastrophe risk	2010	10
20	Rural finance	2009	10

3 Data Sources and Research Methods

3.1 Data Sources

See Table 2.

Table 2. Number and year of papers published by authors.

Serial number	Author	Age	Number of posts issued
1	Zhang Zurong	2007	21
2	Guang Guozhu	2007	15
3	Zhang Wei	2011	13
4	Huang Yingjun	2009	11

(continued)

Table 2. (continued)

Serial number	Author	Age	Number of posts issued
5	Ye Minghua	2012	10
6	Feng Wenli	2007	10
7	Huang Ying	2015	8
8	Zhang Qiao	2013	7
9	Tao Jianping	2015	7
10	Zhu Junsheng	2007	6
11	Chen Shengwei	2019	6
12	He Xiaowei	2014	6
13	Zheng Jun	2015	6
14	Zhao Yuanfeng	2012	6
15	Jia Jinrong	2009	6
16	Pan Yonghui	2008	6
17	Yu Yang	2009	5
18	Luo Xiangming	2011	5
19	Li Qinying	2007	5
20	Zhu Zhongkun	2015	5

3.2 Research Methods

Biblio-metric analysis is one of the main methods in current literature research. Bibliometrics is a scientific method that uses a certain amount of documents as analysis samples and uses mathematical and statistical methods to quantitatively analyze knowledge carriers including documents. However, CiteSpace is easy to operate and has a good visualization effect. Therefore, this paper uses the visualization software CiteSpace5.5R2 to perform quantitative analysis visualization and knowledge mapping on 938 journals in the field of agricultural insurance published in China since 2007, which are included by CNKI, so as to realize the research progress analysis of agricultural insurance in China.

4 Analysis of Visualization Research Results Based on CiteSpace

4.1 Analysis of the Number of Documents Issued

Figure 1 shows the number of periodicals issued each year from 2007 to 2021. It can be found that in general, the number of agricultural insurance-related articles has shown a downward trend since 2007, and the annual number of articles is within 100. It can be seen that the number of articles published in relevant journals can be divided into four stages (Table 3).

Table 3.

Serial number	Organization	Age	Number of posts issued
1	School of Economics and Management, China Agricultural University	2008	17
2	School of Economics and Management, Huazhong Agriculture University	2007	12
3	College of Insurance, Southwest University of Finance and Economics	2009	11
4	School of Economics and Management, Northeast Agricultural University	2009	11
5	Institute of Agricultural Economy and Development, Chinese Academy of Agricultural Sciences	2007	10
6	College of economics and management	2012	9
7	Institute of Agricultural Information, Chinese Academy of Agricultural Sciences	2008	9
8	School of Agriculture and Rural Development, Renmin University of China	2016	8
9	School of Economics and Management, Northwest Agriculture and Forestry University of Science and Technology	2009	8
10	Institute of Insurance, Guangdong Institute of Finance	2011	8
11	National Economic Research Center of Guangdong University of Finance and Economics	2014	7
12	School of Finance, Central South University of Finance and Economics and Law	2009	7
13	School of Economics and Business Administration, Chongqing University	2009	7
14	Zhongnan University of Economics and Law	2008	6
15	School of Finance and Statistics, East China Normal University	2012	6
16	School of Finance, Anhui Finance and Economics University	2015	6
17	School of Finance, Nankai University	2017	6
18	Peking University School of Economics	2007	5
19	School of Finance, Nanjing Agricultural University	2015	5
20	School of Economics, Hunan Agricultural University	2009	5

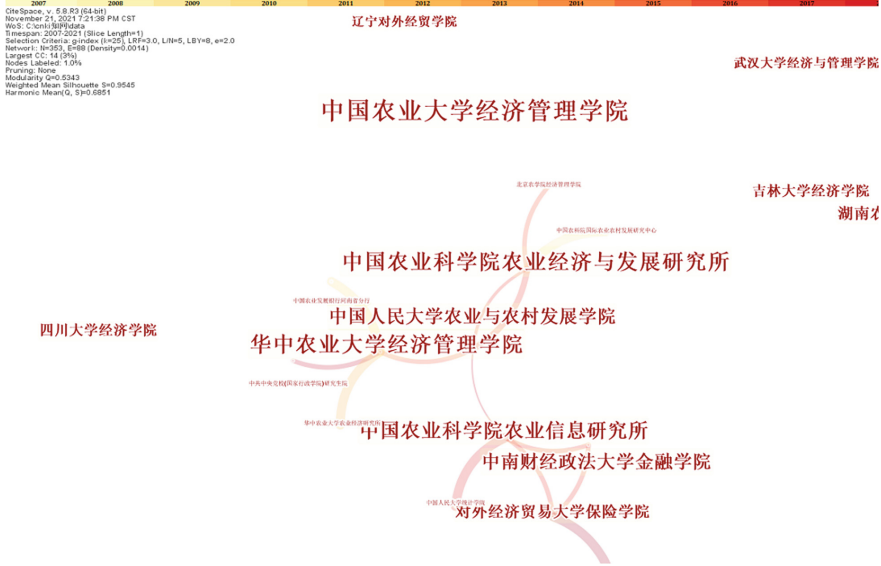


Fig. 3. Analysis of knowledge graph of relevant institutions

The first stage is from 2007 to 2009. The number of articles published in this stage is the highest, with an average of 100 articles in 2007 and 2008. The country has started to encourage the development of agricultural insurance, which can indicate that the research on agricultural insurance at this stage has a high degree of attention. The second stage is from 2008 to 2016. The number of relevant articles published is less than that of the first stage, and shows a significant fluctuation trend, indicating that the research on agricultural insurance is declining and the research on agricultural insurance has entered a slow development stage. The third stage is from 2016 to 2020. The number of articles published in this stage generally showed a sharp downward trend, especially the number of articles published in 2020 was basically zero, indicating that the research on agricultural insurance may enter a bottleneck after a period of time. The state or relevant institutions should launch relevant policies to promote the research on agricultural development.

4.2 Analysis of the Keywords Co-occurrence Map

The key words are the focus of the analysis of the whole article and the summary of the article. In this paper, CiteSpace is used to draw a knowledge graph of the keywords provided by the sample. According to the frequency and centrality of keywords, we can get the research hotspots and future development trends in this field.

First, the co-occurrence analysis of the key word agricultural insurance is performed, with the time set to 2007-2021, #Years Per Slice set to 1, and Node Types set to key word, and then the operation is started, as shown in Fig. 2, where the number of nodes is 500, the number of connections is 1019, and the density is 0.0082. Although the density of the atlas is higher than that of the organization, it is still relatively dispersed. In the atlas given by CiteSpace, the size of the circle where the word is located is directly proportional

Top 13 Keywords with the Strongest Citation Bursts

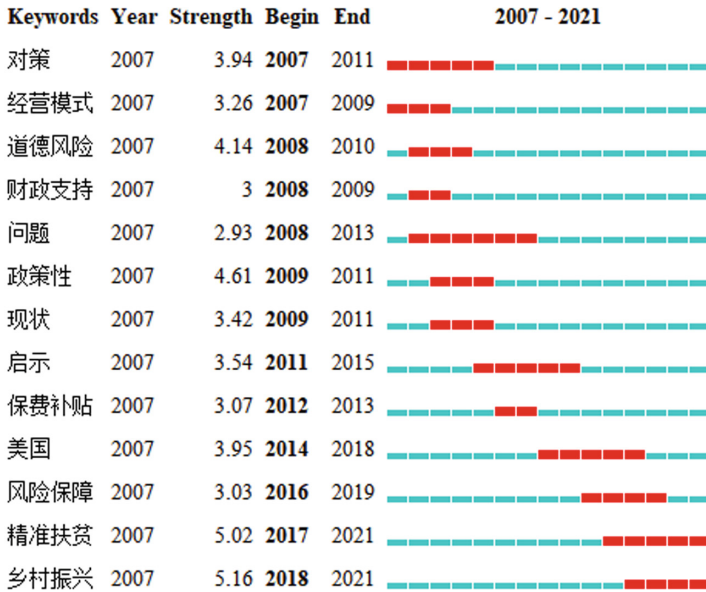


Fig. 4. Keyword emergence.

to the number of times it appears. The more links between each keyword, the closer the relationship between them. The key words “agricultural insurance” appeared 744 times, “premium subsidy” appeared 58 times, “financial subsidy” appeared 51 times and “agricultural risk” appeared 26 times, indicating that the key words such as “premium subsidy”, “financial subsidy” and “agricultural risk” are closely related to the central word “agricultural insurance”.

The Q value of the network map is 0.5343, which indicates that the structure of the map is reasonable and can represent the research topic of agricultural insurance. Table 1 lists the frequency and centrality of some keywords. Generally speaking, the higher the frequency of a word, the higher the centrality of the key word. There is a positive correlation between the two. It can be seen that the centrality of “agricultural insurance” is the highest, at 1.67, while the centrality of key words such as “premium subsidy” and “financial subsidy” is only 0.03 or less, indicating that the research on this aspect is still relatively scattered and no core research point has been formed.

4.3 Analysis of the Authors and Research Institutions

The analysis of authors and research institutions has a positive effect on the organization and guidance of scientific research activities. CiteSpace is used to analyze authors and research institutions respectively in the retrieval results, and the information of the main authors and institutions is obtained by setting “Node Types = Author/Institution, Top50, Time Slicing = 1”.

Among them, from the researchers' point of view, Zhang Zurong ranked first, with a total of 23 articles. Followed by Guang Guozhu with 15 articles. Secondly, Zhang Wei posted 13 articles. From the perspective of research institutions, the majority of domestic research on agricultural insurance is carried out in universities. Among them, China Agricultural University has the largest number of papers published, followed by Huazhong Agricultural University and Southwestern University of Finance and Economics. As can be seen from Fig. 3, the map has 353 nodes, but only 88 links, and the map density is only 0.0014, which indicates that the research institutions are also scattered and have few links.

4.4 Analysis of the Knowledge Map of Sudden Themes

The CiteSpace software is used to extract the burst words from the research object. According to Fig. 4, compared with the traditional high-frequency word analysis, the burst topic detection based on the keyword co-occurrence topic timeline is helpful to grasp the frontier of subject development. The figure shows the time period in which the start time and the end time of the distribution of sudden topics constitute a sudden, indicating that the co-occurrence words become a research hotspot in this time period. The greater the intensity, the greater the sudden occurrence of the co-occurrence words.

5 Conclusion

This paper makes full use of CiteSpace software to make a visual analysis of the relevant documents of CNKI. Through the analysis of the number of articles published, co-occurrence of key words, emergence of key words and analysis of authors and institutions, the following conclusions are drawn. First, the research on agricultural insurance in China still needs to be strengthened, which requires the joint efforts of the state and society. Secondly, in the academic circle, the research on agricultural insurance is mainly concentrated in universities, and the research from the government and society is less. At present, although the research on agricultural insurance has achieved certain results, there is still much room for development. Future research can combine theory with practice and combine national and social forces to promote the development of agricultural insurance.

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Risk and Regulation of Shadow Banking in China: Analysis from WMP and P2P

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Abstract. In China, shadow banking used to effectively help commercial banks resolve bad debts, but the underlying risks accordingly evolved into systematic risks, and it aroused the government's concern and action. This paper discusses two typical examples of shadow banking in China, bank-issued wealth management products and P2P lending platforms, to illustrate various risks and then present government regulatory responses to these risks. We conclude that firm commitment should be one of the major factors facilitating the growth of China shadow banking. Based on the research on the regulatory response of bank wealth management products and P2P, we believe that immediate and effective supervision is necessary to avoid systematic risks and correctly guide the development of shadow banking.

Keywords: Shadow banking · Wealth management products · Peer-to-Peer lending · Systematic risks · Regulatory responses

1 Introduction

“Shadow banks are financial intermediaries that conduct maturity, credit and liquidity transformation without explicit access to central bank liquidity or public sector credit guarantees,” [1] Pozsar defined it in a shadow banking report. The most prominent feature of Chinese shadow banking is that it is an extension of commercial banks. Undeniably, shadow banking can contribute to economic growth. They have built a bridge between subprime borrowers and surplus funds in the market and acted as a critical role in the financing of small and medium-sized enterprises (SMEs). However, Chinese shadow banking evolved into tools mainly for regulation arbitrage, to bypass the supervision of commercial banks [2].

China's shadow banking has snowballed since 2008. Based on the “China Shadow Banking Report”, China Banking and Insurance Regulatory Commission (CBIRC) identifies the Chinese shadow banking system as belonging to two categories, broad and narrow shadow banking. The report also discloses the market size of Chinese shadow banking. China's broad shadow banking scale was 84.80 trillion Yuan, accounting for

86% of GDP in 2019 and equivalent to 29% of total banking assets in the same period. At the end of 2019, the scale of shadow banking in the narrow sense was 39.14 trillion Yuan, accounting for 46.2% of the shadow banking in the broad sense, down 11.87 trillion Yuan from the historical peak (51 trillion Yuan) [2].

In this paper, we will analyze the risks and regulatory responses, using bank-issued wealth management products and P2P as examples.

2 Wealth Management Product

2.1 Features

China bank principal-floating wealth management products (WMPs (According to the definition of shadow banking in China Shadow Banking Report by the CBIRC, only bank principal-floating wealth management product is included in the shadow banking system; In addition, the new regulations of China's asset management require that bank wealth management products no longer promise to guarantee principal. In this paper, we refer to the principle-floating wealth management product with WMP).) are short-maturity off-balance-sheet substitutes for deposits because of “no regulatory ceiling on the WMP returns”, and they are used to meet the required loan-to-deposit ratio (LDR) [3]. Furthermore, WMPs are also identified as substitutes for loans because it lends money to ultimate borrowers riskier than loan customers [2]. Bisio argues that to meet the required deposit reserve ratio, “China commercial banks use WMPs to establish contractual arrangements that convert the loans into investments in non-bank financial institution (NBFI) financial products backed by loans” [4]. In this mechanism, banks move their risks and loans off their balance sheets, and they sell WMPs to households or institutional investors, so it seems that investors should bear the credit risks of WMPs. However, there is usually a firm commitment (After the expiration of the financial product, the product manager must repay the principal and expected income to the investors. When the underlying assets of the financial product are at risk or the product itself does not have sufficient cash value, the product manager will undertake loss by himself or herself and advance the financial product with the product manager's own funds.) or “implicit guarantee” that the bank customer manager would verbally promise the investor to receive the expected return of WMPs, in China. Moreover, investors would “expect banks to cover losses to avoid damage in reputation (partly because banks have covered the losses in the past)” [5]. In addition, bank WMPs usually have a higher average yield than that of China 10Y Government Bond [6]. Thus, the bank WMPs could be treated as “de facto deposit substitutes” [5], and bank WMP is one of the major financial products for Chinese households.

2.2 Risk Analysis

Figure 1 illustrates the cash flows of the funding invested in the bank-issued wealth management products. The risks buried within each process can be demonstrated in the following perspectives.

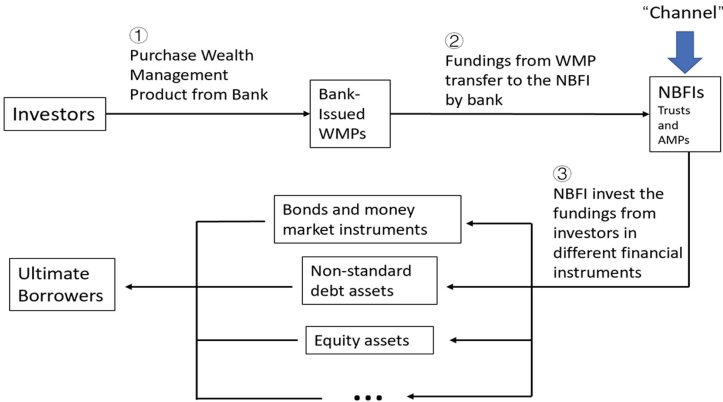


Fig. 1. The cash flow of investment funding

Firstly, the major risk is information asymmetry. To reduce unnecessary troubles when explaining details to the investors, especially those aged investors, banks generally choose to disclose information about the Investment direction without a specific investment target. This will result in the consequences that investors have no idea about the products behind the WMPs and the risks related to the investments. Combined with the firm commitment promised by the bank and the higher returns than deposits, it will further weaken the concern of investors about the underlying assets behind the products and neglect the significance of the risks. For investors who lack professional knowledge and understanding about the financial markets, their risk awareness is more likely to degenerate, and the risks of these WMPs exceed their abilities to deal with investment default.

Secondly, the potential risk that corresponds with the action of transferring the funding from WMPs to the NBFIs by the bank is the maturity mismatch. The bank generally sets the short maturities for two purposes. One reason may tie to the preference of investors for short-term investment products which provide more liquidity for them. Another reason for setting short maturity is to provide an overestimated deposit balance with the intention to meet LDR required by the CBIRC at the quarter-end [3]. However, some of the financial instruments invested by the NBFIs such as the bonds and non-standard debt assets are long-term. This may cause the problem of maturity mismatch where the source of funds is short-term, and the underlying assets invested using these funding are long-term. Luo et al.’s findings state that there is a positive correlation between “non-performing loans ratio and WMP maturity mismatch” [7]. This further enhances the consequences of maturity mismatch that it is more likely to result in a higher default risk with more non-performing loans.

Third, there are multi-layers of NBFIs in the structure of bank WMPs (nesting). For example, if the bank invests some funds of its WMP into the asset management product (AMP) of securities companies, the AMP’s capital could flow into other kinds of financial products of NBFIs, and through multi-layers of NBFIs, the capital can even be back to the original WMP (capital idling). The capital idling increases the cost of real economy financing, and the capital is circulating through the financial system.

Accordingly, the degree of leverage increases [8]. In addition, multiple layers of NBFIs add to the difficulty of regulating WMPs, and it increases the fragility of the banking system.

Fourth, ultimate borrowers of bank WMPs might be riskier. In other words, these borrowers “would not normally be financed through the prudentially regulated banking system” [5]. In that case, ultimate borrowers might have default risks or even cause rollover risks of the bank that issued WMPs. As Joel Bowman indicated, multi-layers of NBFIs made lending to riskier borrowers easier. Since the beginning of the China 4 trillion Yuan stimulus plan, the fierce interbank deposit competition made small- and medium-sized banks (SMBs) rely more on WMPs to do regulation arbitrage, even though the ultimate borrowers are riskier [3]. In addition, ultimate borrowers might cause rollover risks for banks. That could be also traced back to the stimulus plan (Acharya et al.) It is because the original bank loans in the stimulus period enter the real estate or the infrastructure, which “takes years before cash inflows can cover the initial costs” [3]. Thus, banks have to roll over these original loans by refinancing these ultimate borrowers with WMPs, or borrowers would default.

2.3 Regulatory Response

A series of measures such as the New Assets Management Regulation have been imposed on the market in order to prevent the unhealthy development of WMPs and deal with the risks mentioned above. First, banks are forced to break the firm commitment, mainly through changing the valuation of WMPs. WMPs are required to be valued on a net asset value basis, rather than on an amortized cost basis. In that case, WMPs would be similar to open-end funds that disclose net asset value regularly, so banks can’t do “implicit guarantee” or firm commitment that based on expected return in the past. This signifies that the investors are not protected from financial losses anymore. In addition, investors are urged to concern the risks presented in WMPs and learn more about the underlying assets of WMPs because their principal is not guaranteed. Thus, it also mitigates the situation of information asymmetry.

Secondly, the new regulation prohibits channel and nested investments. It only allows the WMPs from the banks to invest into one layer of external financial instruments or AMPs. This prevents the occurrence of funds returning to financial institutions, and it effectively alleviates the investment risk caused by the idling of funds in different financial products. This will also manage the problem of multi-level nesting bypassing the supervision through long chains and resulting in a more transparent process of the cash flows.

3 P2P

3.1 Features

P2P (peer-to-peer) lending is the online platform that matches lenders and borrowers. It is part of **narrow shadow banking** in China. Major borrowers are individuals and SMEs, which have trouble borrowing money from commercial banks. Private lending

changed from offline to online through the utilization of the Internet is the most primitive operation mode of P2P online lending platforms and it is the prototype of Chinese P2P online lending. The original P2P lending platform is an information intermediary, it only implements functions such as information matching, tool support, and services. However, the entire P2P industry in China started to act as a combination of information and credit intermediary after Hongling Investment company started “safety promise” as firm commitment. When the P2P platform acts as a credit intermediary, the P2P platform can directly use the money from lenders to operate investments without informing investors.

3.2 Risk Analysis

The default rate of Chinese P2P lending platforms was 87.2% based on data in 2019, which demonstrated high risks in P2P mode in China [9]. These risks had even spawned several Ponzi scheme platforms. Meanwhile, high returns indicate high risks. For instance, in 2015, there were 260 P2P platforms that had an average return rate of 20%, some of which had even higher return rates [10].

The leading cause of credit risk comes from information asymmetry. Pokorná and Sponer argued that information asymmetry is a credit risk for lenders since investors cannot distinguish a good platform [11]. While Shao and Bo believed that “there is information asymmetry between borrowers and platforms as well” [12]. Most P2P borrowers are those whom banks consider being unable to repay loans on time. However, either platforms or investors do not have access to credit ratings, they cannot discriminate borrowers’ repayment ability. Once borrowers cannot repay their loans, investors and platforms will face the risk of default.

Funding pools are essential to the P2P model in China, but maturity mismatches and liquidity risks will ensue. Cash flows into funding pools are always short-term, while cash flows out are long-term. This means that one large amount of debt divides into multiple investment products, corresponding to different investors with different maturities and amounts. Once the borrowers cannot repay their loans and interest payment, it will cause a shortage of capital. Zhang and Gao mentioned, “maturity mismatch can cause great damage to lenders, and even evolve into a platform credibility crisis” [13]. Meanwhile, liquidity risks will follow. In addition, liquidity risks will occur when P2P companies cannot afford the firm commitment because of the large percentage of bad debt.

The operational model of P2P in China gradually causes the high leverage ratio in two perspectives. Firstly, to provide a high rate of return to the investors, a higher interest rate charged to risky borrowers is required, which often pushes borrowers into default since they do not meet the prerequisite of borrowing from the commercial bank. Secondly, the risk buries within the current model that involves both the guaranteed company and the promise from the P2P platform that it will repay the principal and interest regularly to investors when borrowers default utilizing the sufficient risk reserves. The P2P lending will face a high platform leverage ratio when the actual platform business volume exceeds the amount it can do within its capabilities. The platform will accept more projects than it can afford to match the investors’ high required rate of return. In contrast, the borrowers’ high default risk will increase the probability of the platform paying the compensation to the investors. This causes the risk reserves may not be able to cover all the compensation,

and the platform will eventually collapse. For example, Hongling Investment company still had 16.1 billion Yuan unpaid to investors after its exit from the P2P market [14].

The lack of regulations and series information asymmetry present those P2P lenders and P2P platforms face high uncertainties when making investment decisions. High uncertainty may lead to borrowers' and platforms' moral hazard problems, especially fraudulent P2P lending cases. Zhu examined that firm commitment introduces more moral hazard problems and raises default rates [15]. The reason is that more investors are attracted by firm commitment, while these inexperienced investors often lack their own assessment of borrowers.

3.3 Regulatory Response

China once had the world's largest P2P market, with 5,000 platforms at its peak. Bloomberg considered that "China's P2P industry is one of the riskiest and least-regulated slices of the nation's sprawling shadow-banking system" [16]. Chinese authorities started to make rules for internet financing, including P2P lending platforms, in 2016. As a result, in January 2021, CBIRC announced the number of P2P platforms reduced to 0.

The core ideas of all P2P regulatory policies are legalization, transparency, and standardization. The Chinese government has clarified the role of P2P institutions only as information intermediaries, not credit intermediaries. It is notable that in August 2018, the CBIRC asked China's four largest shadow banks to assist in resolving the risk of P2P. Starting from the beginning of 2019, the Chinese government started the clearance process for P2P lending platforms. In addition, the Internet Financial Risk Political Group notified P2P institutions to access the credit system, the ongoing crackdown on malicious debt evasion related to P2P lenders that have withdrawn from operations and the increased disciplinary efforts against defaulters in the online lending sector.

4 Conclusion

From the analysis of WMPs and P2P, it can be concluded that the lack of regulation of shadow banking is harmful. By comparison, the firm commitment is a common issue in WMPs and P2P, whether the institution guarantees the principal or the return. Unfortunately, the firm commitment leads to the reality that returns of WMPs or P2P might not precisely reflect the underlying risks of these financial products, so it disrupts the order of the Chinese financial market. Accordingly, they are under stronger supervision of China government to curb the brutal growth of shadow banking. In the future, regulators need to introduce regulation as early as possible when new financial products emerge in the market, the failure of P2P in China has illustrated this problem. Also, investors need to consider carefully when they come across financial products with complex structures. Regulatory policies for shadow banking need to continue to be improved, as China's shadow banking will exist along with the Chinese financial system. Chinese authorities believe that shadow banking under strict regulation is a way to promote economic growth, reduce risk and deal with bad debt.

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Quantitative Research About Chinese Financial Market

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Abstract. The main idea of the research is to find a reliable and profitable trading model and strategy of the Chinese stock market from a different perspective. First, most quantitative trading nowadays is operated by quantitative factors, consisting of volume, historical price, correlation with other assets. However, this research mainly focuses on the regularity of the market. To find the law of the market, this paper study the intrinsic characteristics behind it, such as how money runs in the market (This is based on the author's experience in several financial institutes). Then, this paper focuses the research based on a regularity the author already found. The method is kind of based on relative strength. However, the relative strength here is different from the Relative Strength Index (RSI). It is a way to combine the Candlestick chart with the Up/Down ratio of stocks (Up/Down ratio means the percentage of increase and decrease for a typical day). By back testing the model, it is workable to define whether effective or not and meet the final goal.

Keywords: Strategy · Chinese stock market · Relative strength · Up/Down ratio

1 Introduction

This research is mainly focused on the trading model of the Chinese stock market. Chinese stock market is a market in which short selling is almost banned. The China Securities Regulatory Commission (CSRC) only allows a limited number of stocks to be sold short [1]. Only a limited share can be bought to short sell. Thus, it is easy to see that for these huge public offerings of funds with hundreds of billion Yuan, and it is implausible for them to pursue profit with short selling. The only way left is to buy for investment and hold these “blue chip” stocks. This research primarily pays attention to speculation instead of investment. These funds choose these “blue chip” stocks to invest and grow up with the firm is due to their large market value. From some perspective, stocks with higher weighted LeaderRank algorithm scores generally have more long-term investment value; and the so-called views, “too big to fail” and “too connected to fail”, are further confirmed [2]. Secondly, until the end of last year, all the stocks had a limited up/down ratio every day, which is 10%. Now all the stocks in the ChiNext increase to at most 20% up/down ratio every day while the Main Board stays the same. This is different from the US market and would be a key point when considering building up the model. There are also many market indexes. The one that would be primarily considered

in this research is the Shanghai Securities Composite Index (SSEC). SSEC is the index of the whole market consisting of almost all the stocks in the market. Therefore, this index directly reflects the circumstance of the whole market.

In this paper, using a model to speculate is the ultimate purpose. To meet the requirement, it is essential to do several processes. The first one is to choose the stock-picking pool. The second one is finding a profitable method in the long term and using the historical data to back test the result. In this part, exploring a different way of using the method and testing them are also indispensable. The last one is to use the model in real daily life and check the feasibility.

2 Experiment Design

2.1 Stock Picking Pool

There are more than 3000 stocks in the Chinese stock market. These codes of stocks begin with ‘SH’ means that these stocks are on Shanghai Stock Exchange. Also, for these begin with ‘SZ’ means that these stocks are in Shenzhen Stock Exchange. All these stocks constitute the Shanghai Securities Composite Index (SSEC).

It is impossible to use all of them as the picking pool since some may consider it risky. These stocks are marked with “ST” in the front and definitely would not take into account. Besides, a large proportion of stocks are construed as overvalued and undeserved to invest in. Now, the stocks left are worth to invest and much less risky. However, in the background introduction about the Chinese market, we have discussed that the only way for these significant funds to profit is to buy these “blue chip” stocks. Based on others thought, finding that the trading activities of institutional investors can positively predict future stock returns help this paper to hold the direction [3].

The question now comes to be what is the definition of “blue chip” stocks. In this research, we would explain them as worth to invest and large market value. We would choose them as the stock-picking pool. There are indeed many valuable stocks. However, their size is not large enough when considering by these significantly large hedge funds. Even some small Private funds would invest in them, and the whole market cannot build a joint force to increase their price. Also, some of these firms are even be manipulated by some illegal money. This thinking is based on the author’s experience in the funds.

All in all, in this research, the stock-picking pool is stocks with a market value more significant than 50 billion yuan and be considered worth investing. There are about 200 stocks due to the variation of the market every day. Besides, it also consists of some firms with a market size larger than 20 billion yuan, but with massive growth value admitted by these huge funds. The total amount is about 250 stocks.

After building up the stock-picking pool, the model now has about 250 stocks. Choosing what to speculate about every day becomes an intricate question—in this research, reiterating the authors’ view that all the increase of stock must come with the money purchase. To judge whether to use a massive amount of money to buy a stock requires several quantitative factors.

2.2 Stock Picking Method

After building up the stock-picking pool, the model now has about 250 stocks. Choosing what to speculate about every day becomes an intricate question—in this research, reiterating the authors' view that all the increase of stock must come with the money purchase. To judge whether to use a massive amount of money to buy a stock requires several quantitative factors.

1. The first one is to pick all the stocks in the stock-picking pool that is active. The corresponding factor used is the volume of stocks. For any stock in the method shows that its volume of the nearest three days is larger than the 125-day average volume, this method would sift them out and make the new picking pool for that day. If a stock shows a peculiarity like that means that money is continuously inflowing in that stock. Thus, the stock is active.
2. The second factor is the strong/weak indicator. In this research, this paper defines this indicator that for a day of a given stock, it shows the S(Strong) if that stock's up/down ratio is larger than the up/down ratio of the Shanghai Securities Composite Index (SSEC). Also, it shows W(weak) if the up/down ratio of the stock is smaller than the up/down ratio of the Shanghai Securities Composite Index (SSEC). Like the first indicator, the method checks the nearest three days of a given stock by strong/weak indicator. In this research, this paper primarily concerns about the situation of three S(strong) since consecutive purchasing means that it is strong. Besides, there would also be other combinations of this factor. It will be checked in the paper later.
3. The third one is the trend about a stock. This is the most subjective factor. In this research, the trend is defined as comparing a given day's price with the average price of the nearest 30 days of that day. Its price that day is larger than the average. This method would define the trend to be positive and sift it out.

2.3 Experiment Process

In this research, the historical data of all stocks in the picking pool and the Shanghai Securities Composite Index (SSEC) are obtained from the website 'www.baostock.com.' This research downloads all the data from 2018.1.1 to 2021.5.30. There are names, codes, price, up/down ratio, and volume of all the stocks in the picking pool every day. After getting these data, this paper use Python to process them based on the method discussed before. There are several functions in python which process the requirement. The code will then use the input and check the stock corresponded every day. Then, every day, this work would use some percent of the money to buy all the stocks and sell them the next day. It is possible to calculate the percentage of gain or loss every day and put them in a table in excel. Later, this work uses the table to calculate the total percentage of gain or loss for the three and half years and draw them as a graph to compare with the index trend (SSEC). All in all, the final step is to check whether it is a profitable model and more thought about how to improve.

2.4 Introducing the Data and Tool

In this research, the model use python to program all the method and justify all the historical data. “www.baostock.com” is an open-source website where people can download the data about the Chinese stock market they need. The table below is the code of part of the stocks temporarily used for this research project.

Table 1. Some of the stocks used

SH	SZ
SH603993	SZ000625
SH601899	SZ000301
SH601857	SZ000166
SH600584	SZ000157
SH600309	SZ000338
SH600011	SZ000776

In the Table 1, code of stocks begin with ‘SH’ means that these stocks are in Shanghai Stock Exchange. Also, for these begin with ‘SZ’ means that these stocks are in Shenzhen Stock Exchange.

3 Experiment

3.1 Technology Innovation Orientation and Enterprise Competitive Advantage

Following the process in the section - Experiment design, write the code in python for every function in the model. By setting all the requirements for the volume, this paper start to check the strong/weak indicator. In this research, define this indicator that for a day of a given stock, and it shows the S(firm) if that stock’s up/down ratio is larger than the up/down ratio of the Shanghai Securities Composite Index (SSEC). The method chooses all stocks to be traded on any day that satisfies the consecutive three Strong(S), meaning that the up/down ratio of stocks ought to be larger than the up/down ratio of the Shanghai Securities Composite Index (SSEC) in three consecutive days since the data is too large. Then, this work picks several random days to show the output of the program.

For example, in 2-2-2018, the methos output data below.

Table 2. Stock picking on 2018.2.2

2018/2/2	Up/Down ratio (%)	Up/Down ratio next day (%)
SH.601998	0.54	9.70
SH.601628	1.61	1.43
SH.601336	1.30	1.87

(continued)

Table 2. (continued)

2018/2/2	Up/Down ratio (%)	Up/Down ratio next day (%)
SH.601318	0.70	-0.39
SH.601229	2.34	2.53
SZ.002493	0.83	-1.45
SZ.002032	0.64	0.11

In the Table 2, it is easy to see that there are seven stocks sifted in 2018-2-2. The second list is the up/down ratio of that stocks in 2018-2-2. It is helpful to check that whether the model sifts stocks correctly. The third list is the up/down ratio of the next trading day (2018-2-5) which is the gain of loss of individual stocks. In the real world, the model would buy all these stocks near the market close time in 2018-2-2 and sell them on the next trading day. For data from 2018-1-1 to 2021-5-31, the program outputs a file like this.

The next step is to calculate the cumulative gain/loss from 2018-1-1 to 2020-5-30. Since it is workable to calculate the gain or loss every day, the python program also outputs another file which consists of net present value (NPV) every day. For example, in 2018-1-1, the net present value is 1.0000.

For instance, the table below is a random part of the whole file.

Table 3. Change of net present value

Date	Increase in net present values (%)	Net present value
2019/3/19	-0.47	0.8893
2019/3/20	-0.43	0.8855
2019/3/21	1.43	0.8981
2019/3/22	-1.89	0.8812
2019/4/1	-0.43	0.8773
2019/4/2	1.84	0.8936
2019/4/3	-0.23	0.8916
2019/4/4	3.05	0.9188
2019/4/8	-0.89	0.9107
2019/4/9	1.58	0.9250

In the Table 3, the final net present value in 2021-5-29 (2021-5-30 is weekend) is 0.8391 which is not a good value. The model loss about 16% in about three and half years.

3.2 Adjusting

The first guess fails, and the model is not profitable and effective. Then this paper changed the method to buy stocks the day when there are four consecutive Strong(S). Later the model put the condition on the index that the model only trades when the index is above the 5-day average line because this means the whole market in the short term is benign. The result becomes much better than the net present value is 1.5115. The total return is about 51% in three and half years. It is much better than before.

The picture below is the line chart of Net Present Value every day.

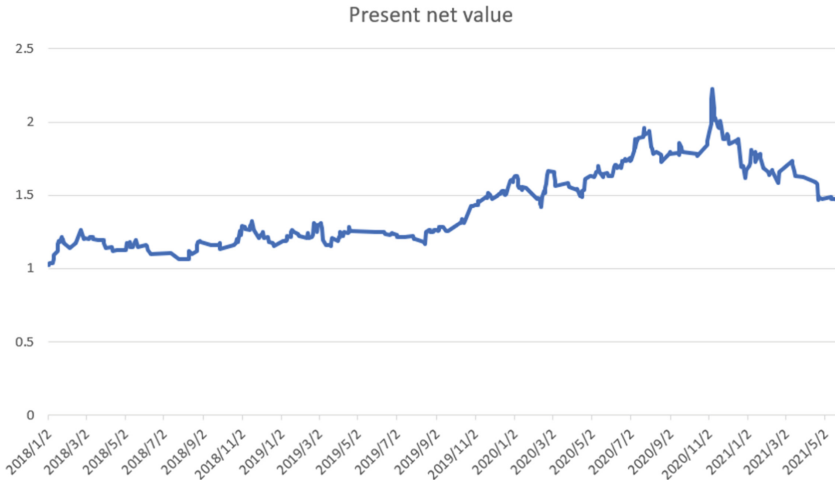


Fig. 1. Net present value

The picture below is the trend of the Shanghai Securities Composite Index (SSEC) from 2018-1-1 to 2021.5.31.

When comparing the two figures (Fig. 1 and Fig. 2), it is easy to see that the index goes back to about 3500 in the three and half year, while the profit yield curve almost continuously goes up. The speculation model outperforms the index. However, the profit is still too small to be called speculation. It is better to think in other ways to improve the method.

3.3 Improvement

Choosing the consecutive strong or weak indicator gives the possibility to speculate. The reason behind this is that the conditions on volume, consecutive strong indicators, and a trend define the stock to be noticed and pursued by these huge public offerings of funds. Based on this thought, this paper changed the consecutive strong or weak indicators, such as three strong and a weak after. Then, this work starts to change the program in python to add more conditions to it.

Figure 3 is the line chart of Net Present Value based on the new condition.



Fig. 2. Shanghai Securities Composite Index (SSEC)

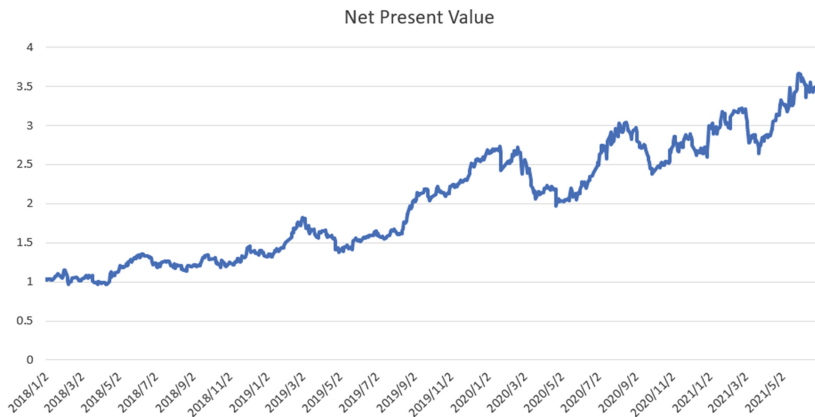


Fig. 3. Net present value

The result of the net present value at 2021-5-31 is about 3.513, which means that if you put \$ 10,000 in the model and started to speculate at 2018.1.1, you would get about \$ 35,130 at the maturity.

Besides, the curve trend in the picture manifests that the speculation is successful and has no very large retracement. This paper also tries other conditions such as four consecutive strong and a weak after. All the results show that the three consecutive and weak have the best profit rate. Thus, it is an efficient and profitable model.

3.4 Hypothesis

In this case, net present value is calculated by buying the close stock price of a day and selling the close stock price the next day. In real daily life, it happens that in many cases,

a stock would rush up and fall back in that day. Also, it might first fall and rise. Thus, instead of using only the close price, using the average price between the highest price and the close price could give an incredible profit of more than 5000%.

Besides, using hedging is another very important part. Other research reveals the important implications for effective hedging and diversification strategies, asset pricing and risk management [4]. In this work, to make the volatility of the profit curve small, it is workable to buy the short put option on CSI 300 index, or other index. Because most of the day, the stocks chosen by the model would be much strong than the index.

4 Conclusion

In this research, this paper explores a thought about speculation in the Chinese market. The model then uses the thought and quantify all the thoughts into separate conditions. These conditions corresponding to the code program in python build up a whole model and make the thought real. Using the worst condition of buying and selling, the model runs about 350% of profit in about three and a half years. In these three years, the Chinese Index-Shanghai Securities Composite Index (SSEC)-first fell and then rose to about the same point. However, in this model, the rise and fall of the index do not influence the profit yield curve so much. The only extreme situation of the index could lead to retracement. This is caused by the stock-picking method since all the stocks traded every day is not only risk-less but strong as well.

The final goal is reached, but there are more improvements can be made. For example, in the real world, buying a stock at a close price is almost the same as buying that stock 5–10 min before the market closes. Nevertheless, the selling point of that stock the next day can be more detailed. Using statistics to calculate the percentage of the next days' expected profit is possible instead of just using the close price. Also, after the implement of hedging, the profit would not be affected so much, but the volatility in the net profit curve would become smaller. This makes this model much more reliable to be the basement of a fund.

This model is a kind of subjective quantitative model. If people do not follow the model to buy all the stocks sifted, they pick some to buy in the picking pool based on the cognition might make a better situation. For future improvement, it is better to use the historical data with machine learning, such as neural network, to find the distribution of the percentage of profit the next day. Some argument reveals the profitability of portfolio optimization and validate the intraday stock price prediction using MLP [5]. With the distribution, it is more efficient to sell at a higher price with the largest probability.

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Sino-U.S. Trade War: Winner and Loser—What Does the Stock Market Say?

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Abstract. This paper focuses on how China and the U.S. economies were affected by the trade war through various influential indices. The stock price fluctuations could be well explained by connecting with impactful events that happened during the trade war period. Hence, it showed the trade war between China and the U.S. has done no good for China, and for the U.S. the gain is greater than the damage. The purpose of this paper is to show the trade war from a unique perspective, also to conclude the winner and the loser of the Sino-U.S. trade war through this unique perspective.

Keywords: Influential indices · Fluctuations · The Sino-U.S. trade war · Impactful events

1 Introduction

The U.S. and China - Trump, Biden, and Xi. The U.S. and China are now the two largest economic entities in the world, thus, the Sino-U.S. trade war has enormous influence on the global economy. The result of the 2016 and 2020 U.S. elections also brought many uncertainties. As the change of the U.S. president will have a huge impact on the economic relationship between the two countries, whether Biden's presidency will ease or aggravate the trade issues with China fostered by the policies of President Trump.

Since President Trump took office in 2016, the economic relations between China and the U.S. have undergone major shifts. Various trade negotiations between China and the U.S. have been intermittent to retaliate against each other's benefits. For instance, on August 23, 2019, China announced tariffs of 75 billion U.S. dollars on U.S. goods, then Trump responded by imposing over 250 billion dollars of tariffs on Chinese goods. How has the trade war affected both China and the U.S., especially with the stock market value?

The purpose of this research is to figure out whether two countries' actions toward Sino-U.S. trade had influences on their respective stock indices. We will look at the major events that happened during the Sino-U.S. trade war and see how these events affect the indices of both countries and the global market.

2 Literature Review

In order to find out the impact of Sino-U.S. trade on the U.S., authors invented a method for the impact of policy announcements on investment rates [1]. By estimating the impact of forecast announcements in China and the U.S. on total returns, the decision-making stock market would have lower capital. So, it will cut the investment rate [1].

In the multi-year trade war between China and the U.S., the U.S. economy has suffered much. After the signing of the first phase of the U.S.-China agreement, it had a negative effect on the U.S. economy, and it did not solve the previous trade war issue. A study by Moody's Analytics showed that due to the trade war, there was a loss of nearly 300,000 jobs and an estimated 0.3% drop in real GDP [2]. After President Trump took office, he prioritized the trade agreement he signed which will allow China to advance its own interests abroad. Another research from the Federal Reserve Bank of New York and Columbia University found U.S. companies lost at least \$1.7 trillion in the trade war. And because the U.S. imposed tariffs on goods imported from China, their stock prices have also fallen [2].

Regarding the escalation of trade disputes between the world's two largest economies, the U.S. tariffs on Chinese products and the number of products are constantly occurring. In order to help investors better understand the impact of the trade war, the author made four assumptions, namely U.S. Inflation, Corporate profits, Federal revenues, and China GDP [3]. An import tariff is a type of sales tax. For consumers, sales tax will increase the consumer cost, so this is good news for consumers because some of the prices to consumers in the U.S. and China were not in this calculation [3]. The impact may be absorbed in the form of a decline in company profits. The trade war also brought negative impacts on China's currency and many emerging market currencies. The devaluation of the RMB and dragging down other currencies is likely to harm the profits of U.S. companies. However, compared with the scale of corporate profits, the impact of tariffs is relatively small, so this is because the U.S. stock market will not be greatly affected. The trade war is also beneficial because imposing tariffs will increase the revenue of the federal government.

By having all the other inequalities, China can offset some negative effects by devaluing the RMB. However, due to high debt levels in China, slower growth will lead to business failures and defaults, which in turn will cause more failures and defaults [3]. The Sino-U.S. trade war may reduce the profit margins of companies in both countries.

3 Data

For our data, we chose Standard and Poor's 500 (S&P 500) to describe the U.S. stock market, Shanghai Securities Exchange Index (SSEI) to describe the China stock market, and Dow Jones Global Index (W1DOW or DJGI) for the global market. The reason that we chose SSEI and S&P 500 as the representative of the U.S. and China stock market is that these two indices are the two mainly used and widely known indices in both China and the U.S. We were also interested in how the Sino-U.S. trade war impacted the global stock market after reading the report of "*The Investment Cost of the U.S. - China Trade War*" done by Mary Amiti.

For the data processing, we first found the three indices on yahoo finance and downloaded the historical data of the three indices for the past 3 years. Next, we found some announcements and actions done by both China and the U.S. during the trade war, and separated them into anti-trade (negative) and pro-trade (positive) events. We then matched those events with the dates on the historical indices data and calculated the index volatility from the day before the announcements and actions up to 5 days later ($t - 1$ to $t + 5$). In order to further our analysis, we plotted the indices' volatility on several scatter plots.

The following is a brief summary of our results from the data (see Table 1 and Table 2). As we can see, during the pro-trade events, the WIDOW had the highest mean growth of 0.56%, followed by the 0.42% of S&P. However, compared to the other two indices, SSEI had a slight negative mean growth of 0.03% during the pro-trade events. During the anti-trade events, SSEI bore the most impact, having an average of 0.91% decline. However, compared to SSEI, S&P and WIDOW were bearing much less.

Table 1. Trade war positive events (pro-trade) [4–6]

	SSEI $t - 1$ to $t + 5$	S&P $t - 1$ to $t + 5$	WIDOW $t - 1$ to $t + 5$
Mean	-0.03%	0.42%	0.56%
Standard deviation	2.50%	3.04%	2.43%
Maximum	3.70%	3.24%	2.80%
Minimum	-4.47%	-8.83%	-6.64%
Median	0.41%	1.18%	1.56%

Table 2. Trade war negative events (anti-trade) [4–6]

	SSEI $t - 1$ to $t + 5$	S&P $t - 1$ to $t + 5$	WIDOW $t - 1$ to $t + 5$
Mean	-0.91%	-0.31%	-0.11%
Standard deviation	2.62%	1.30%	1.17%
Maximum	3.56%	2.36%	1.80%
Minimum	-6.07%	-2.60%	-2.13%
Median	-0.10%	-0.10%	-0.23%

4 Analysis

As we can see from Fig. 1, during the anti-trade events shown in the article “*The Investment Cost of the U.S. - China Trade War*”, the SSEI had much greater volatility compared to the U.S. and the world, showing that the Chinese market is more fragile and easily impacted through the anti-trade events, no matter the U.S. targeting on China or vice versa. At the same time, the U.S. market showed much less volatility that stuck with the range between 2.5% and -2.5%. However, the DJGI (WIDOW) showed volatility less than both China and the US, with a more diversified stock collection, the impact that the trade war posted between the U.S. and China brought did not pose any serious impacts on the global economy, in fact, only both parties involved in the trade war, which is the U.S. and China, bear most damage from the trade war.

Another interesting point for Fig. 1 is that the data shown in the article did not overlap with any other three indices and showed great differences on certain events. For example, during the event around Sep 17, 2018, the data in the article stated that the global stock had a mild increase, however, SSEI had a sharp rise and S&P was flat. A similar result happened during the event around Jun 15, 2018, where the SSEI had a slump, and the S&P also had a decrease. However, the data in the article stated the global stock had only fallen slightly. The reason for the differentiation is that the author only looked at the global returns instead of focusing the returns specifically for the U.S. and China. Also, the data tended to lean more toward the performance of the U.S. stock market, as shown on the graph, the green triangle was always much closer to the red triangle except for the first day and the last day.

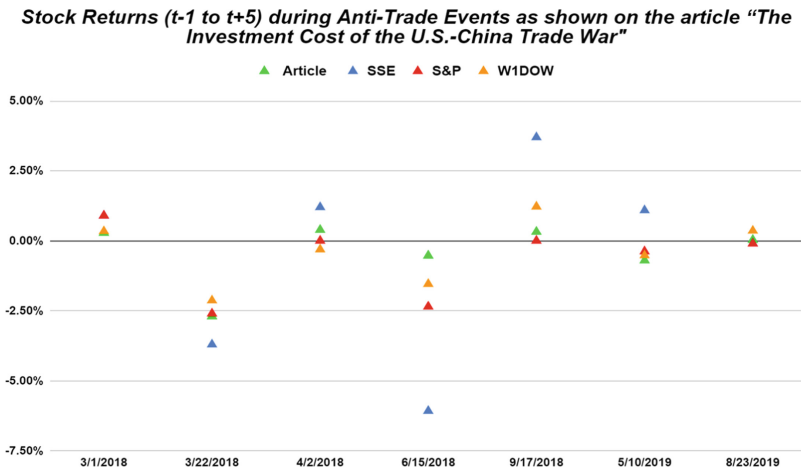


Fig. 1. Stock returns during anti-trade events showed on Mary Amiti’s paper [4–6]

However, as we found more events related to the U.S. and China trade war, we can see some special trends (see Fig. 2 and Fig. 3). On 7/14/2020, to meet import quotas set by the World Trade Organization (WTO), China booked a record deal of corn from the US, such an event should bring the SSEI up. However, SSEI went down around 4% immediately while the S&P 500 raised around 3.24%, out-performance than the global market (the DJGI increased by 2.80%). The reason that such a scenario happened is possibly due to the investing community thinking such as a victory of the U.S. and a loss of China. We can also see similar phenomenons on 6/4/2018 and 1/15/2020 where the U.S. and China had the first trade talk and the signing of the phase one trade deal.

What we can see from the anti-trade events is that in most cases China either outperformed the U.S. by a lot, or did much worse than the U.S. The anti-trade events also seemed like to be mostly negative toward the U.S., while mostly positive for China. Under such circumstances, it is possible to say that China is being cheated in Sino-U.S. trade, however, there were also several cases where China suffered major losses. The U.S., however, did not seem to have much to lose, maybe due to its larger economic volume than China where China sees Sino-U.S. trade more important than the U.S. The U.S. is also able to enjoy a more diverse trading with other nations than China, while China does not have a diverse trading with other nations and the Sino-U.S. trade war might even affect China's trade with other nations. Based on the data, it is certain to conclude that it is more important for China to maintain a good trading relationship with the U.S. than the opposite.

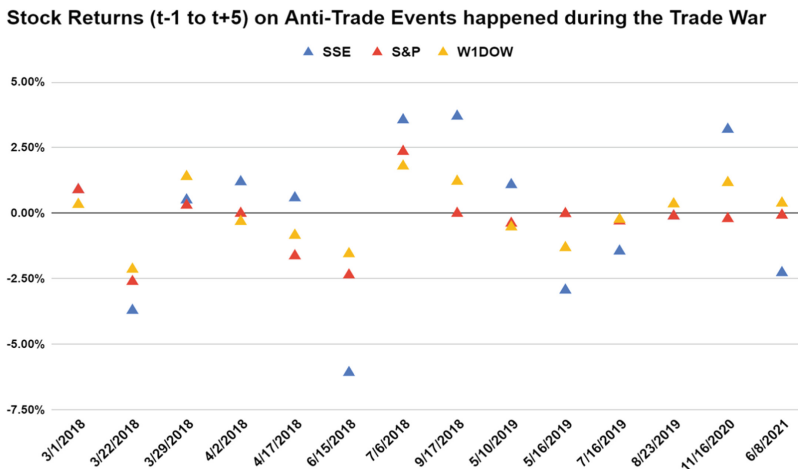


Fig. 2. Index volatility on anti-trade events that happened during the trade war [4–6]

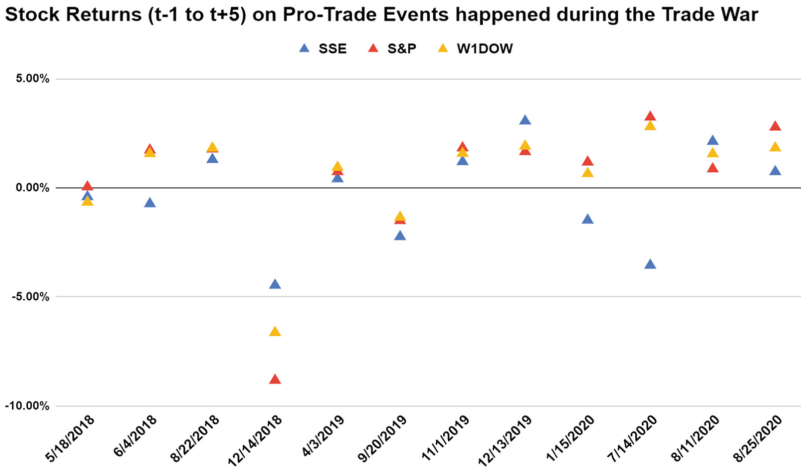


Fig. 3. Index volatility on pro-trade events that happened during the trade war [4–6]

5 Conclusion

In conclusion, as the data and analysis showed, the trade war between China and the U.S. has done no good for China, no matter if there are good turnarounds for China. At the same time, the U.S. has a bigger gain than loss, so that might conclude the reason why U.S. wanted to start a trade war against China. The trade war also poses a much greater disruption to China and U.S. economy compared to the World.

However, there is still the possibility that the sources we found are biased. For example, the author of the article “The Investment Cost of the U.S. - China Trade War” used more general data which did not show the specific changes of stock market in the U.S. and China. In the analysis section, we can see that the data is more leaning toward the U.S. stock market performance. It is relatively reasonable since we used Google as a platform to find all the sources needed for the paper, and because most western countries use google, different perspectives might cause bias toward China.

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How Shadow Banking Affect Chinese Monetary Policy

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Abstract. The research problem of the paper is how shadow banking system affects macro-economy in China and how monetary policy should be used. This paper conducts the research on five aspects: price levels, economic growth, money supply, liquidity and transmission to discuss the effects of shadow banks on monetary policy. Our conclusion is that shadow banking has both positive and negative sides. At the end, we give the suggestions that monetary innovation using Internet and big data, hierarchical management of shadow banking and supporting small and medium-sized enterprises financing could be helpful to alleviate the negative effects of shadowing banking.

Keywords: Shadow banking · Monetary policy · Price levels · Economic growth · Liquidity

1 Introduction

Outside of the traditional banking system, shadow banking refers to a variety of financial intermediary services. It typically employs non-bank financial firms as carriers to change credit, liquidity, and maturity of financial assets, as well as other risk variables, in a “quasi-bank” function. Shadow banking is unregulated, with hidden hazards and the potential for cross-contagion. It is regarded as one of the “culprits” of the financial crisis of 2008. The importance of improving shadow banking supervision has been generally recognized by the international community, and it is now the focus of the third edition of the Basel Agreement reform. It has also become a top priority for the Financial Stability Board.

Shadow banking has four distinct characteristics. To begin, non-bank financial institutions are the broadest definition of shadow banking. If financial institutions other than traditional banks engage in comparable activities, they may be classified as shadow banking. The second function is to transform the risk characteristics of financial assets.

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The International Monetary Fund and the Financial Stability Board have both proposed that paying attention to shadow banking has the goal of revealing the causes of its hazards. The deterioration of credit and liquidity conditions is at the foundation of financial asset risk, and financial intermediaries frequently play the role of risk factor conversion and finally become risk bearers. As a result, shadow banking should be seen as a topic having credit, liquidity, and maturity conversion functions, which has also served as the foundation for the Financial Stability Board's subsequent establishment of a shadow banking monitoring framework. Third, it represents a significant hidden hazard of systemic risks. On the one hand, shadow banks perform the functions of traditional bank credit intermediates and take on traditional bank risks. On the other hand, because shadow banking primarily provides financing to entities that are not covered by traditional banks, these entities have poor credit ratings, a high default probability, and a high default loss rate, and the majority of their operations are cross-market and cross-industry, with little transparency. Easily become a systemic danger source. Fourth, it is decoupled from the prudential, behavioral, and rescue systems. Negative externalities are prevalent in the financial business. Regulatory agencies in a number of nations have developed sophisticated prudential and behavioral supervisory frameworks, and they all use the franchise license access model. Shadow banking is frequently not supervised at all or just to a limited extent, and thus is not covered by the external rescue guarantee system. It can only rely on self-rescue once there are serious threats. However, due to a severe lack of capital and reserve reserves, its potential to self-recover is limited.

The financial market in China has become increasingly sound and perfect as the Chinese financial system continues to change. Shadow banking has grown in size and importance, having a significant impact on the social economy and finance, particularly monetary policy. In recent years, shadow banking has emerged as an innovative business model in China's financial industry, meeting the funding demands that traditional financial institutions are unable to provide. Shadow banking, as a powerful complement to the financial market, plays a critical role in the financial world. The growth of shadow banking has already had a significant impact on the macro economy, and the magnitude of that impact cannot be ignored.

2 Overview of Chinese Shadow Banking Development

In China, shadow banking is nothing new. Non-bank financial institutions including trust firms and insurance businesses began to emerge in the 1980s. The "Interim Measures for the Administration of Securities Investment Funds" were promulgated in October 1997, and securities investment funds exploded in popularity. Commercial banks have been providing wealth management services in succession since 2002. During this time, individual institutions primarily evolved around their own business scope, product limits were generally defined, and shadow banking's overall scale was not vast. Following the financial crisis of 2008, shadow banking has begun a period of tremendous expansion. Monetary policy has switched from tightening to moderate relaxation in response to the impact of the international financial crisis, and the stringent constraints on financial institutions' credit scale have been lifted. New RMB loans surged by 9.6 trillion yuan in 2009, with M2 and M1 increasing by 27.7% and 32.4%, respectively, the highest levels since

the 1990s. However, monetary policies have begun to tighten in response to the rapid rise in real estate prices and the accumulation of risks from local government financing platforms. Simultaneously, the overall amount and structure of credit loans from financial institutions have been strengthened, and loan growth and investment directions have been carefully limited. Banks have transferred a substantial amount of assets off the balance sheet to avoid macro-control and supervision in this setting. As a result, a slew of new cross-market and cross-industry shadow banks have emerged. The “bank-trust collaboration” industry of bank wealth management and trust businesses, in particular, has grown rapidly. Banks purchase trust plans from trust firms with wealth management funds, and the trust plans are subsequently invested in the real estate industry and local government financing platforms as trust loans. The “bank-trust cooperation” business grew from 1.4 trillion yuan at the start of the year to 2.08 trillion yuan in the first half of 2010.

Bank wealth management investment in non-standard assets accounted for 27.49 percent of all wealth management assets in 2013. The “Notice on Regulating the Investment Operation of Commercial Banks’ Wealth Management Business,” released by the regulatory body, established a proportional limit on banks’ wealth management investment in non-standard assets. New cooperation techniques such as interbank tripartite repurchase, interbank specific-purpose carrier investment, and trust beneficiary rights have emerged as the focus of shadow banking has shifted to on-balance sheet interbank operations. Investment in inter-industry specific-purpose vehicles increased from 3.6 trillion yuan in 2012 to 23.05 trillion yuan in 2016. Assets purchased under resale agreements continued to climb, peaking at 10.5 trillion yuan in mid-2014, a new high. From 6.98 trillion yuan at the end of 2012 to 17.46 trillion yuan at the end of 2016, the size of fund trusts grew dramatically. In addition, new business models have evolved, such as Internet financial products, online lending, and peer-to-peer loans. The third-party Internet payment market in my nation has grown from 16 trillion yuan in 2013 to 143 trillion yuan in 2017, according to market figures. Yu’eobao launched in June 2013 and has net assets of 1.58 trillion yuan at the end of 2017.

3 Shadow Banking Effects on China’s Main Goal of Monetary Policy

Basically, the objectives of monetary policy are to facilitate economic growth, maintain price stability, increase employment rate and pursue balance of payments. Different implementations are all serving to realize these main goals. As for the China case, “the Law of the People’s Bank of China explicitly stipulates that the ultimate goal of China’s monetary policy is to maintain currency stability and thereby facilitating economic growth”. Thus, in the next sections, this paper focuses on how shadow banking in China influences both prices and economic growth.

3.1 The Impact of Shadow Banking on Price Levels

The use of monetary policy had led to the development of shadow banking in China, particularly in 2008 when the Chinese government injected RMB 4 trillion into the

economy and reduced interest to stimulate growth and cope with the financial crisis [1]. However, to cushion the economy from overheating, tightening monetary policy in 2010 [1]. This move enabled exponential growth of shadow's banking system in China as entities that were unable to access credit from formal channels could access financing from trust companies cooperating with some financial institutions. The net effect weakened the efficacy of monetary policy as shadow banks and commercial banks react in opposite ways to monetary policy [1].

China's shadow banking tends to affect how monetary policy authorities monitor prices. The central banks embrace a contractionary monetary policy to decrease the money in circulation. They also tend to increase the interest rates, affecting exports, consumption, and investment. Under the tight monetary policy, economic growth also tends to decline [2]. In shadow banking, enterprises that can hardly access credit from formal financial channels such as banks can access shadow banks as new funding channels. For example, the real estate industry in China was able to raise a large amount of money by issuing a large number of shadow banking products using trust companies despite the People's Bank of China imposing tight regulation on the real estate market by tightening of loans to real estate market in the country. The use of shadow banking to raise funds has led to China's real estate industry [2]. However, the achievements of the real estate industry tend to weaken the effect of state regulations. The existence of shadow banking in China and its role in the national economy implies that companies with limited access to funds, especially from banks and other formal sources of funds, can now use shadow banks as an alternative to meet their financing needs. The effect is that shadow banks offset the impact of tight monetary policies imposed by monetary policy authorities [2].

When central banks embrace an expansionary monetary policy, the interest rate tends to fall, money supply rises, and consumption, exports, and investment increase. Formal sources of funds such as banks tend to affect shadow banking by lowering or slowing the regulated growth of shadow banks [2]. This is evident from China's determination to regulate internet finance in recent times. One of its effects has led to a decline in shadow banking where the trust loans and entrusted loans are registering a falling growth rate, including a negative growth rate. Internet finance is an example of how an expansionary monetary policy causes a contraction of shadow banking hence reducing price increases. This concludes that shadow banking tends to have an opposite effect on price levels to policies taken by monetary policy authorities [2].

3.2 How Shadow Banking Affect Economic growth

Shadow banking tends to counter the effectiveness of monetary policy in the regulation of economic growth. The tightening of the monetary policy by the People's Bank of China, particularly in the real estate sector, led to a decline in the supply of money due to a rise in interest rates [2]. This led to the slowing of economic growth due to shrinking consumption, investment, and exports. However, these effects were short-term as shadow banking through trust companies could offset the impact of monetary policy. Formal financial channels tend to have a crowding-out effect on shadow banking, as evidenced by the shrinking of the scale of shadow banking in China following the regulation of internet finance [2]. Shadow banking has a similar effect on the price level and economic

growth concerning monetary policy. The impact of shadow banking on economic growth and price level tends to counter or reduce the effect of policies implemented by monetary policy authorities [2].

In conclusion, the shadow banking system affects the effectiveness of monetary policy in regulating economic growth and price levels of the economy. The tightening of monetary policy to control prices and economic growth is rendered less effective by shadow banking. Enterprises that are unable to access financing may access the needed fund. In regulating the real estate market in China, the People's Bank of China used a tight monetary policy to limit borrowing in this market. However, the real estate market could use trust companies to produce many shadow banking products that made it possible for them to raise needed financing leading to rapid industrial development.

3.3 The Impact on Credit Supply and Money Supply

As pointed out by a paper [3], in China's monetary policy, credit supply is actually making a great difference. Meanwhile, with the appearance of shadow banking, there is a new form of credit creation within the system, which poses a challenge towards the effectiveness of the monetary policy monitored by the People's Bank of China. To be more specific, shadow banking often puts forward a series of securitization products that bring spare private money into playing. These amounts of money are not distinctly supervised by the central bank, but increase the overall money supply in the market. According to Wang [4], "results show that the credit scale of commercial banks in 2010 was influenced by the activities of shadow banking and that the amount of credit supply exceeded the limit regulated by the central bank. This consequently affected the regulation and implementation of the central bank on monetary policy".

The Impact on Liquidity. To control the money supply, the People's Bank of China can always at least do something like setting a reserve ratio. What the central bank cannot perform is to manage the liquidity well. Shadow banking elevates the velocity of money during securitization. In a market where money flows extremely quickly, the effectiveness of controlling the money supply diminishes sharply. Moreover, the reserve requirement for the commercial banks does not meet up the expectations of the central bank. Conversely, it pushes people to deposit less in the banks. In these cases, people do not choose to keep money at home. Instead, they turn to shadow banking for a higher return. The reason is simple. It is true that commercial banks are involved in fewer loans with a higher reserve ratio. This means the expected return rates for the depositors decrease as well since now banks earn less. However, shadow banking does not have to follow the reserve requirements, and it can offer people more attractive return numbers. Therefore, the liquidity of money surges, and becomes more difficult for the central bank to control. According to Li [5], "the central bank increased its ratio of reserve requirement 12 times during the period from January of 2010 to June of 2011, but the consequences of these implementations were not optimistic".

The Transmission of Monetary Policy. Shadow banking weakens the transmission of monetary policy. CBOC implements tightening monetary policy through commercial bank which decrease money supply and increase interest rate. But shadowing banks

which are out of CBOC's control, can provide lower interest rate to make loans, which obviously against the aim of CBOC. Furthermore, in order to satisfying the requirement of absorbing savings, commercial banks have to further increase their deposit interest rate, competing with shadow banks, which not only increase traditional banks' funding costs but also reducing the value of their net worth. Both effects increases the pressure on commercial banks cost. Overall, the increase of loan from shadowing banks offset the decrease of the fund from commercial banks, which weaken the effectiveness of monetary policy.

Also, Shadow banking affects the process of goods by adding non-marketed goods to the list of assets. More so, high deposits and huge withdrawals result in the insolvency of the available assets. The diverse impacts of shadow banking such as the efficient balance between international revenue and cost also have a direct impact on the Chinese banking system. Most notably, shadow marketing contributes to fluctuations in the economic sector [2]. The lack of control by the monetary policy affects inflation, economic growth, availability and supply of money, as well as assets. As a result, the financial system of China operates through instabilities, which in turn, contributes to the country's financial crisis.

Advice on Monetary Policy

Strengthening Monetary Innovation and Regulation: To improve the effectiveness of monetary policy, COBC could try to consider including social financing institutions such as shadow banks in the monetary policy targeting system. In addition, COBC needs to continuously innovate monetary instruments and improve the system of structural monetary policy tools. However, to prevent financial moral hazard, the government should draw on international experience to revise the scope and rules of central bank collateral to prevent the misuse of new monetary instruments [6].

In addition, considering that shadow banks such as entrusted loans are hidden to a certain extent, the effectiveness of monetary policy is determined by whether or not accurate and timely data on the financing of the whole society can be obtained, and the relevant departments can combine modern technologies such as the Internet and big data to obtain more accurate loan data and accurately monitor the effectiveness of monetary policy.

Focus on Small and Medium-Sized Enterprises (SMEs) Financing: As the majority of loans in China's financial market go to large corporations, SMEs often have difficulty in raising finance. In contrast, social financing institutions such as shadow banks provide financial support for SMEs. Growing shadow banks will further lower the lending threshold, making the risk of default higher for enterprises, which in turn will undermine the entire financial market. This is why commercial banks controlled by the CBOC should start paying attention to the financing woes of SMEs, not only to curb the brutal growth of shadow banking, but also because SMEs play a rather important role in the national economy as a whole: providing employment, driving technological innovation and boosting economic growth.

Conduct Hierarchical Management of Shadow Banking. Shadow banking can be divided into three categories: shadow banking within the traditional commercial banking system

such as entrusted lending, shadow banking arising from non-banking financial institutions such as trust wealth management and insurance, and shadow banking outside financial institutions such as private lending and internet lending. The risks of these three types of shadow banking are different from each other. The first two are less risky, while the last category seriously affects the stability of financial markets due to the lack of necessary regulators and regulations. For shadow banks within commercial banks and financial institutions, their lending operations need to be strictly regulated. The flow of funds and channels need to be clear and transparent. For private lending and internet lending, government agencies need to step up regulation [7], outlaw unscrupulous lending platforms and regulate qualified lending platforms, grasping market risks and giving full play to the positive role of internet finance

Accelerate the Process of Interest Rate Marketisation. In western countries, the objective of monetary policy is not only money but also money market interest rates. The money supply affects the price level and interest rates stimulate economic growth by influencing investment. In China, however, monetary policy cannot significantly influence the level of interest rates due to the low degree of marketisation of interest rates [8]. When measuring money liquidity, the interest rate in the lending market is a more accurate indicator than the money supply. Money supplied by the central bank to commercial banks may not be released into the lending market in a timely manner. It is therefore difficult for central banks to gauge how effective the credit expansion has been, especially combined with the influence of unregulated shadow banking. By promoting interest rate marketisation, the central bank can directly observe the cost of financing in the real economy and financial markets through market interest rates.

4 Conclusion

Shadow banking may have given businesses and individuals additional access to finance. However, in relation to monetary policy, shadow banking is detrimental to its effectiveness. The subprime loans provided by shadow banks are prone to cause turbulence in lending markets, which may counter the effect of economic growth from monetary policy. In addition, the financial flows involved in shadow banking are often difficult to monitor, make it more difficult for central banks to regulate prices level. Shadow banks often compete with commercial banks regulated by the central bank. They expand credit when central banks want to recycle money, weakening the central bank's control over monetary liquidity. To alleviate the negative effect of shadow banks, central banks should stick to interest rate marketisation for gaining insights of lending market.

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Public Rental Housing Status Quo in Beijing and Impacts on Middle to Low-Income Group's Consumption and Talent Introduction

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Abstract. Aiming at protecting and enhancing the quality of life of mid-lower income groups, China gradually implements the construction of public rental housing projects across the country. This paper takes Beijing as an example to analyse the potential impact of public rental housing on the city by constructing charts, which cover three aspects. The main findings are the creation of a large number of public rental housing units can attract an influx of high-quality talent, yet it is also found that while public rental housing can alleviate the pressure on the property expenditure of this group of people to a certain extent, it does not have a significant impact on their consumption expenditure due to the uncertainty of their future income. Finally, some suggestion on the construction and management of public rental housing are raised to improve the existing policy.

Keywords: Public rental housing · Consumption expenditure · Talent introduction

1 Introduction

Development of public rental housing is in the background of increasing net inflow of population who are confronted with rising pressure on housing since housing is their top consideration. Different from ordinary commercial houses, public rental houses are a housing resource with intention to solve housing difficulties for some groups. Public rental houses are not available for all but feature basic requirement. Public rental houses provided and subsidised by local government are a basic welfare for moderate- and low-income citizens. Public rental houses are not owned by individuals but owned by government or public institutions. Public rental houses are rent to newly employed and unemployed workers, immigrant workers, disabled and retired people at discount below the market price.

Research on public rental housing status quo is of great importance because housing security is placed at the top of the agenda for social people's livelihood in the capital of China, Beijing with continuous net inflow of population. With appeal of three-children

per family policy, Beijing is the pioneer in China to carry out public rental housing policy to encourage families to have more children. Public rental housing is conducive to improving living standard for multiple-children families and turning down cost of housing. Under the background of increasing net inflows of immigrant workers and advocacy of three-children policy, public rental housing is expected to enter the peak of development. This report is intended to examine public rental housing status quo in Beijing, following what previous literature has done. In addition, the gap that previous research paper does not address, namely, impacts of public rental housing on moderate-to-lower income group in Beijing will be covered in this report. Theoretically, support of public rental housing can stimulate consumption when housing compression effect is weakened. I propose that for moderate-to-low-income group, consumption stimulus effect might be weaker than expected due to long-term planning for savings.

2 Literature Review

The questions that have interested people include ‘What is the trend of public rental housing in Beijing including those in construction in completion in recent five years’, ‘What is the distribution of public rental housing resources across districts in Beijing’, and ‘What are the inner links of public rental housing supply and mid-lower income group’s disposable income and consumption’. The three questions can fill in the gap with previous research results, connection of public rental housing to mid-lower income group’s consumption in Beijing is seldom solved in existing literature sources and it is important to fill in the gap to provide reasonable suggestions on policy makers.

Promotion of government subsidised housing including public rental housing can play positive role in stabilising domestic demand and consumption and improving income structure in medium and long term [1]. Alleviation of real estate inventory pressure can be realised by boosting effective social demand. Security housing plays an indispensable role in digestion of real estate property inventory and improvement in rational consumption [2]. Housing plays a more effective role in boosting consumption than project construction and on the condition that strong expectation on declining housing price, demand for government subsidised housing is of increasing importance [1]. Increases in effective supply and demand for government subsidised houses enable decrease in social demand for commercial houses.

Scaling up investment in government subsidised housing inevitably squeezes demand for commercial housing, on the condition of excessively high price of housing relative to disposable income for mid-lower income group, compression effect can be more obvious [3]. When cost of housing takes up less portion of their income, mid-lower income group can have greater flexibility allocate disposable income between consumption of other goods and services, and savings [3]. There is clearer tendency towards savings when disposable income of the group decreases, when disposable income rises, tendency of consumption of other goods and services is stronger [4]. Increase in supply of government subsidised houses plays a limited role in boosting effective consumption for mid-lower income group [4]. Chairman of SOHO China claimed that if a family member went unemployed or was in danger of unemployment, he or she might be frustrated to consume nor purchase of house, he might be careful in eating out [5].

Public rental housing is conducive to encourage people to rent before they buy and lead rational housing consumption [6]. Public rental housing policy reduces economic pressure on housing, thereby leaving enough space for consumption and savings [7]. In China, the consciousness of savings is deeply rooted, those who live in government subsidised houses feature stronger propensity to savings, thus, impact of public rental housing on stimulus of consumption is limited [8]. The real motive of government subsidised housing lies in stabilisation of overheating housing price and the most effective solution to boost consumption is to raise disposable income [1]. Even expense on housing takes decreasing portion of disposable income, savings can take the incremental portion of disposable income, while change in disposable income moves in opposite direction to change in consumption in Beijing within the recent three years since 2018 to 2020 [8]. Since the scale of disposable income is weakened by inflation and soaring prices, even when housing expense takes decreasing portion of disposable income, stimulus of consumption has been proved to stay below expectation [9].

3 Strategy

Since all types of government subsidised houses are provided to residents with housing difficulties and the target group largely coincide with mid-lower income group, it is appropriate to analyse inner links between supply of public rental houses and impact on consumption. To tackle with the three research questions previously identified in the section of literature review, the strategy is to examine the trend in supply of public rental houses in the recent five years, the trend of disposable income and consumption and explain for the finding from social psychology and Keynesian economics. The section of formal analysis can be divided into two parts, one is to examine status quo of public rental houses in Beijing in recent five years, and the other one is to analyse the links between supply of public rental houses and consumption for the group.

This research paper is typical secondary research. Secondary data concerning sales price of commercial houses, the number of public rental houses in construction, the number of completed public rental houses, the number of planning public rental houses, disposable income and consumption for the mid-lower income group is available in National Bureau of Statistics official website and Beijing Municipal Commission of Housing and Urban-Rural Development official website. No primary data is involved in this research paper. The data will be presented in bar chart and line graph. As for the part of explanation for connection between supply of public rental houses and mid-lower income group's consumption, economic concepts are used for explanation.

Previous researches focus on description of public rental houses supply and demand in previous years and summary of government subsidised housing policy, without check of the inner link between supply of public rental houses and the target group's savings and consumption. To fill in the blank, the second part of explanation will be done in qualitative discussion since details of consumption for the middle-to-income group is not available in open sources but details of consumption for all. The methodology for this research topic is not a brand new one but a mature methodology. The same with the previous researches, the research context is still in Beijing, the capital city of China with the largest and continuous inflows of immigrants whose main concern is to solve the problem of housing. Focus on Beijing is the miniature of the big picture in China.

4 Results

4.1 Public Rental Housing Status Quo in Beijing

Government support of public rental housing is in the context of sudden dramatic rise in average sales price of commercial housing and stabilisation of housing price is the top priority in improvement in people's livelihood along with stabilisation of price. The average sales price of commercial housing in Beijing soared from ¥38,433/sq.m in 2019 to ¥49,999/sq.m in 2020 by 30%, after witnessing moderate increase in sales price of commercial housing in previous three years from 2016 to 2018, as Fig. 1 depicts [10]. In comparison of Fig. 1 and 2, supply of public rental houses marked by those completed, seems to increase together with soaring price of commercial house. In recent two years from 2019 to 2020 when commercial housing price went up dramatically, planned publicly houses decrease to the lowest level within recent four years, while publicly houses in competition peaked at 90,000 sets in Beijing [10]. The previously planned public rental houses will be turned to completed publicly houses in late years, therefore supply of publicly houses can be briefly marked by the completed public rental houses.

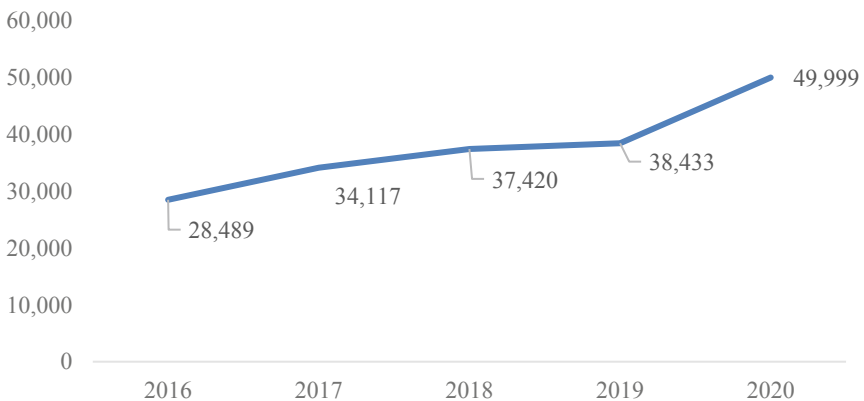


Fig. 1. The average sales price of commercial housing in Beijing from 2017 to 2020 in Chinese Yuan (CNY) not based on purchasing power parity [11]

As Fig. 3 shows that the resources of public rental housing resources are unevenly distributed across districts. In 2020, resources of public rental houses in construction in Beijing are intensively distributed in three districts, namely, Fengtai District, Tongzhou District and Daxing District, followed by Chaoyang District, Haidian District and Changping District. Concentrated distribution on the three districts is primarily owed to availability of land resources, convenience for commuting, consumption and entertainment. While, few public rental houses are available in those densely populated areas where business and educational resources are agglomerated there, especially Xicheng and Dongcheng Districts, because of limited land resources. Development of public rental houses aims to alleviate housing pressure in downtown and foster population aggregation in new

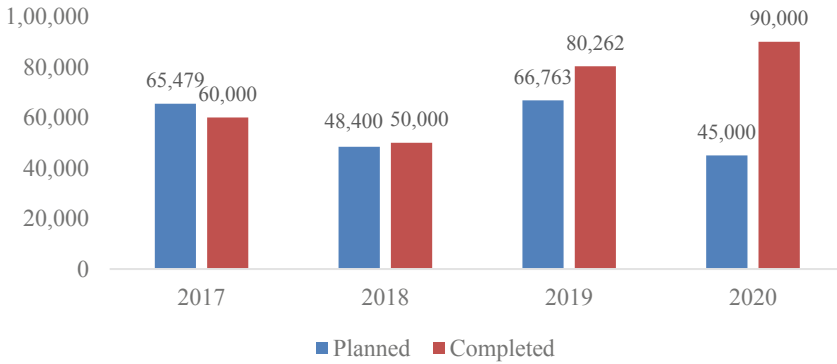


Fig. 2. The number of planned and completed public rental houses in Beijing from 2017 to 2020 in sets [12]

areas. Increases in public rental housing resources in Fengtai, Tongzhou and Daxing are expected to moderately boost consumption due to availability of commercial resources.

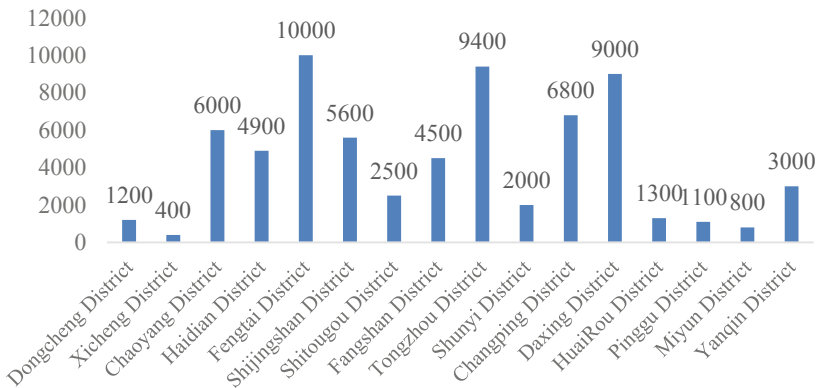


Fig. 3. Distribution of public rental houses in construction across districts in Beijing in 2020 (sets) [13]

4.2 Impacts of Public Rental Housing on Consumption for Mid-Lower Income People in Beijing

It is found that supply of public rental houses moves in moderately opposite direction to consumption for mid-lower income group in Beijing. The fact is inconsistent to what the general public expects naturally. To interpret the fact, mid-lower income group have greater propensity to savings than propensity of consumption. This fact is in line with Keynesianism when disposable income increases, only a small portion of disposable income is used in consumption, while the relatively higher proportion of disposable income is used in savings, the rule of decreasing propensity of consumption exists [14]. Decreasing propensity of consumption explains for the finding that increase in supply

of public rental houses does not help boost consumption relative to disposable income, the mid-lower income group would rather save for future. Mid-lower income group save for expense in rigid demand in the future.

Supply of public rental houses in Beijing decreased from 2017 to 2018 and increased dramatically in 2019, as Fig. 2 shows. Public rental houses are provided to mid-lower income people. As Fig. 4 depicts, the ratio of consumption to disposable income per capita for mid-lower income people in Beijing went up from 55.69% in 2017 to 57.7% in 2018 and decreased slightly to 57.15% in 2018 [10]. Theoretically, if supply of public rental houses increases, the portion of expense on housing to disposable income decreases, thus, the ratio of consumption to disposable income per capita should increase. However, as Fig. 4 shows, from 2018 to 2019 when mid-lower income group are provided with sudden increase in completed public rental houses, the ratio of consumption to disposable income for mid-lower income group in Beijing even dropped by over half a percentage point [10]. The fact is inconsistent to what the general public expects naturally. To interpret the fact, mid-lower income group have greater propensity to save than propensity to consume.

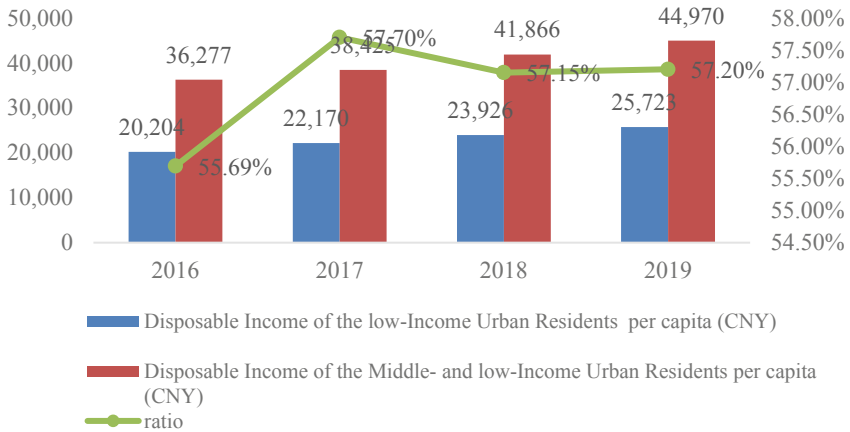


Fig. 4. Mid-lower income group's disposable income and consumption per capita and the ratio of consumption to disposable income in Beijing from 2016 to 2019 [15]

In short, increase in supply of public rental houses does not stimulate consumption in relative terms to disposable income, even though, consumption in rigid demand by the mid-lower income group increases in absolute terms. When increase in disposable income can be largely offset by price inflation, increase in supply of public rental houses leaves greater room for people to consume and save, for mid-lower income group, they would rather save for rigid consumption in the future rather than consuming right now. Mid-lower income group feature greater portion of rigid demand than the other groups. Since they are disadvantaged in workplace, they do not earn much at present, it is uncertain whether they can earn more in the future or not, thus, they feature greater propensity to save than the other groups.

5 Extension

Though mid-lower income group haven't increased their consumption according to the supply of public rental house as great as expected, there is no reason to believe that public rental housing can't benefit the society to a large extent. This work illustrates the importance of public rental housing from the perspective of the influx of people.

Migrant population play an important role in cities' sustainable development and prosperity, they also become the prominent feature of China's urbanization and economic globalization at the age. However, at the same time, the influx of people towards large cities poses challenges to the long-term and stable development of a city in the future because most of the migrants have difficulties affording houses whether it's renting or buying. Being as the capital of China, Beijing attracts people from all over the country with its city management, more employment opportunities, and better economic development. However, Beijing has unaffordable housing prices and strict requirements for purchasing house, which make Beijing be less attractive for the talents.

In 2016, the permanent population of Beijing was 21.729 million, among them, the permanent migrant population was 8.075 million, accounting for 37.2% of the permanent population. For migrants, their living conditions are related to their future development and social stability; some of these migrants are unable to rent or buy houses in the market due to low income or lack of savings and accumulation, and some of them are unable to rent or buy houses in the market due to their unfixed working location. Thus, forming a new housing difficulty group in the city. From the perspective of family unit, there is a relatively large group earns even less than 5000 RMB a month, it can only afford a low-quality life for a family live in Beijing. The average rent in Beijing is some 100 RMB/m²/month. High rents account for most of their wages. They don't have enough money to improve their quality of life, or to provide their children with better education, let alone to enjoy a trip on vacation. This makes living in Beijing a very anxious thing, so more and more young people are escaping from Beijing. Moreover, when people worry too much about where to live, they can't put their whole heart on working, which make them less efficient.

Housing construction requires huge amounts of investments and long time period. It is not an easy thing for the government to build public housing in the case of public transportation, medical system, and many other essential things call for money, either. But, considering the benefits public housing leads, especially for attracting more talents and stabilizing people's lives, such investments are worthwhile.

6 Policy Recommendations

6.1 Improve the Public Rental Housing Application System to Provide Efficient Services to Those Who Really Need Help

In terms of market demand, public rental housing has emerged to meet the needs of most migrant workers and fresh graduates. The application and approval process of public rental housing should be improved, for example, the application form can be appropriately set up with questions on residence preferences to further understand the housing needs of applicants and improve housing satisfaction; secondly, the speed of

vetting should be accelerated to provide housing security for compliant applicants as soon as possible. Finally, the establishment of a credit system in the field of housing security should be promoted to guide applicants to attach importance to their personal credit, and provide a 'green channel' for those with good credit, while penalties should be applied in the opposite direction.

6.2 Provide a Variety of Public Rental Housing to Better Meet Aspirations

The provision of public rental housing can be considered from a number of perspectives, specifically from both the demand and supply sides. From a demand perspective, households undoubtedly want comfortable accommodation, so having people of a comparable standard of lifestyle and type of work living in one community can go some way to improving community cohesion; from a supply perspective, the per capita income of migrants varies greatly, and it would be beneficial to migrants and community managers if the government could provide public rental housing of different sizes, in different locations and at different prices, depending on income levels. The benefits to migrants and to community managers would be considerable. Specifically, firstly, this could help immigrants to maximize their participation in the public rental market due to the diversity of housing types and prices on offer. In addition, community managers will be able to equip the neighborhood with amenities appropriate to the income level of the tenant and choose how to manage community health, for example. It would therefore make more sense to offer different public rental housing based on quality, size and location and to charge applicants different prices.

6.3 Enhance Management of Facilities in and Around the Community to Strengthen and Improve Safety and Security

Daniel Hartley [16] found that the closure and demolition of high-rise public housing in Chicago were associated with a net reduction in violent crime, but they had a smaller impact on property crime. In order to reduce crime in public housing communities, government staff should conduct regular psychological counselling and security efforts. Secondly, due consideration should be given to the construction of the external environment of public rental housing, such as the geographical location of transportation, living services and health care institutions, to protect the daily work life of the residents. In fact, the 14th Five-Year Plan for Economic and Social Development of the People's Republic of China states that public rental housing projects need to be piloted in different cities with the aim of providing more public rental housing, optimizing the vetting mechanism and increasing financial and taxation support as a way to allow for healthier and longer-term urban development.

7 Conclusion

In brief conclusion, government support of public rental housing is in the context of sudden dramatic rise in average sales price of commercial housing and stabilisation of housing price is the top priority in improvement in people's livelihood along with

stabilisation of price. Supply of public rental houses in Beijing witnessed a rising trend in recent five years despite of sudden decrease from 2017 to 2018. It is found that supply of public rental houses moves in moderately opposite direction to consumption for mid-lower income group in Beijing. The fact is inconsistent to what the general public expects naturally. To interpret the fact, mid-lower income group have greater propensity to save than propensity of consume. Mid-lower income group do not earn much, and they are uncertain about earnings in the future, thus, they would rather save for future. When expense on housing takes less portion of their disposable income, they would rather save for future rather than consume right now. Thereby, consumption for mid-lower income group increases in absolute value, while has remained almost unchanged in relative sense to disposable income. From the perspective of population migration and the introduction of talents, public rental housing plays an influential function. Beijing issued a relevant policy in July 2018 to provide housing protection for talents migrating into the city. Firstly, the planning of talent residences is district-led; secondly, public rental housing is not affected by market prices and does not leave any investment space for this type of property. The introduction of this provision has attracted a large number of talented people to move into Beijing. Previously, however, the majority of the migrant population in Beijing did not have the ability to rent or buy a market price property, and many young people who could afford it chose to leave the city due to life pressures, which led to a loss in the number of talented people in Beijing. Therefore, building investment in public housing is a wise choice, both from the perspective of attracting talent and from the perspective of the city's future development.

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Research on China's PVC (Polyvinyl Chloride) Futures

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Abstract. This research paper examines the historical trend and potential factors that led to the change in the price of China's PVC futures since it was listed. Based on the industry chain of PVC, the PVC price mainly depends on the cost of upper stream product calcium carbide and the performance of downstream industries. It is demonstrated that the soaring price of calcium carbide and unexpectedly well performance of downstream industries have caused the PVC price in China to rise in 2021. More specifically, it is found that the most recent environmental policy, influences of COVID-19, and imports and exports are affecting the PVC price to different extents. Although the real estate started to perform weakly, since the fundamentals of PVC are unlikely to change in the short run, without a dramatic change in the macroeconomic environment, it is better to do more rather than short selling.

Keywords: China PVC futures · Arbitrage opportunity · COVID-19 · Real estate

1 Introduction

1.1 The Background of PVC Futures

In futures market terminology, PVC refers to Polyvinyl Chloride, a polymer that has a wide array of industrial uses including in construction, agriculture, daily life, electricity, public utilities, etc. [1]. China is today the world's largest PVC resin producer and consumer [2]. By the end of 2019 there were 73 PVC resin producers in China of which three had an annual production capacity of one million tons or more [3]. Due to China's rich coal resources but limited oil storage level, the calcium carbide method (a product of coal decomposition) accounts for about 80% of the total production capacity of PVC [4]. Figure 1 below is referred to as the industry chain of PVC in China.

Since the beginning of 2021, as a result of the gradually recovering economy, the prices of bulk commodities such as cement, metals, and chemicals have all risen sharply. Take plastics as an example, up to September, compared with the same period last year, the price of almost all sorts of plastics has increased by about 20% to 30%. Among them, the price of PVC has skyrocketed since February and reached a historically high price in the past ten years recently. This work will examine the underlying causes of this dramatic increase in price and compare it with the historical performance of the PVC future market.

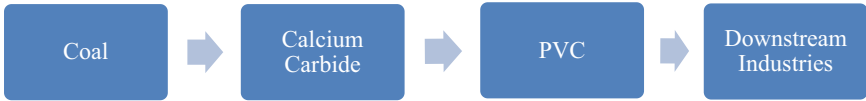


Fig. 1. PVC industry chain in China

1.2 PVC Contract

The PVC futures contract is a standardized contract designed by the Dalian Commodity Exchange Market for the purpose of PVC futures trading. The contract specifies precise requirements for the commodity, as shown in Table 1. On the contract maturity date, the futures price will equal the spot price of the commodity.

The presence of symmetrical-and-opposite risk allows for risk-sharing via futures contracts as the total profit of any futures trading is zero. However, compared to directly purchasing the actual asset at a specific point in time, agreeing upon a long-term fixed-price supply contract could diminish risks for both producers and suppliers.

Table 1. DCE PVC futures contract [5]

DCE PVC futures		
Exchange	Dalian Commodity Exchange	
Settlement	Physically delivered	
Contract Size	5 tons/lot	
Pricing Unit	5 yuan (RMB)	
Tick Value	5 yuan (RMB)	
Contract Months	Monthly contracts (12 contracts in a year)	
Last Trading Day	10th Trading Day of the Delivery Month	
Note: This contract is electronic ONLY -- no open outcry		
	No Open Outcry	Electronic
Trading Hours	N/A	9:00-11:30 a.m. 1:30-3:00 p.m.
Ticker Symbol	N/A	V
Price Limits	N/A	4% of Last Settlement Price

1.3 The Features of PVC Futures

Regional Distribution. Due to the large differences in the degree of economic development, resource endowments, and market conditions in various regions, the production of the PVC industry in various regions is not balanced. At present, relying on abundant resources and energy advantages, the northwestern region is recognized as a low-cost area for the calcium carbide process of producing PVC and has a certain leading position in the hierarchy of China's PVC industry.

Seasonality. Other than the clear dependence on the price of upstream raw materials, the PVC price is also closely related to the real-estate industry, one of PVC's largest downstream consumers, and seasonal variations.

From the standpoint of the downstream industry chain of PVC futures, more than 80% of the downstream products of PVC are used in the construction and real-estate industry. Therefore, the future development and seasonality of the domestic real-estate market is pivotal to the demand for PVC. From Fig. 2, as the real-estate work resumption rate gradually increases from March to June, the price of PVC also rises due to demand and supply relations. July to August is the common off-peak season for real estate; therefore, as the continuous hot weather discourages PVC production and building construction, the price PVC price is normally pushed to the highest point in a year because few factories are willing to and need to produce during this time. After September, the demand for PVC recovers a bit but experiences a huge decline till November since the weather turns cold in the northwestern region and workers begin to recess during the Spring Festival.

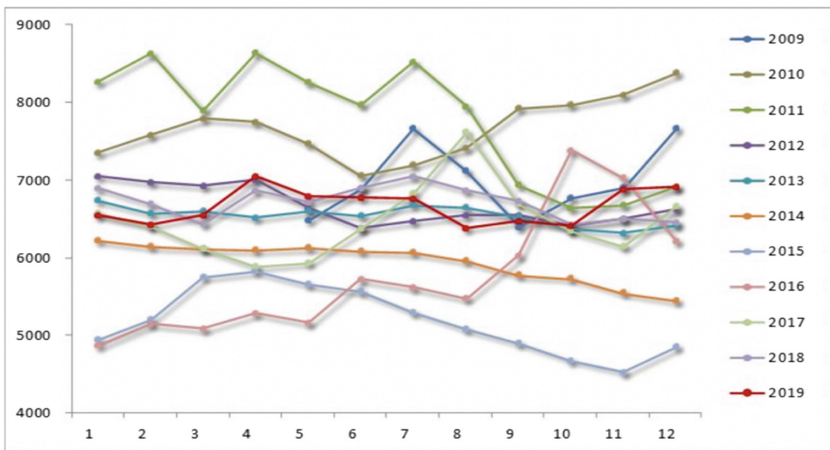


Fig. 2. PVC seasonal variations. Yuan/Ton vs. Time Source: Wind Terminal

Correlation with Crude Oil Futures. Figure 3 below shows that the price curve of PVC and crude oil are roughly of the same trend, but there are apparent differences in the level of rising and fall. In the past six months, the trend of PVC price is obviously behaving stronger than that of crude oil. The price of crude oil relative to PVC fluctuates more dramatically, and the ratio of the highest price to the lowest price of crude oil is 4.12 times while that of PVC is 1.91 times. The price of PVC fluctuates between 6000–7600 most of the time. Only when the price of oil is significantly lower than US\$50, the price of PVC will shortly drop to between 4500–5500.

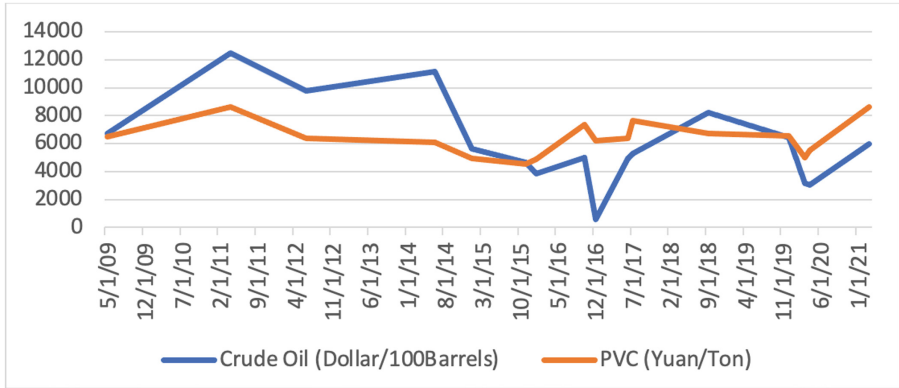


Fig. 3. Relationship between price of crude oil and PVC Source: Snowball Terminal

2 The Price Performance of PVC

2.1 The Historical Performance of PVC

On May 25, 2009, PVC futures were officially listed and traded on the Dalian Commodity Exchange. Since then, its price fluctuated sharply as the terminal demand deliver a significantly higher pressure on the PVC futures prices than expected, as shown in Fig. 4. Meanwhile, the global economy was gradually recovering after the economic crisis, and the Fed implemented a quantitative easing policy [6]. The price of raw calcium carbide rose significantly along with ever other bulk commodities, and the cost of PVC production skyrocketed. Promoted by multiple factors, PVC futures prices hit 9,650, a historically high point in the past ten years.

Starting around 2011, the government had started to regulate and control the real-estate industry, which led to a substantial reduction in PVC market downstream demand. At the same time, the European debt crisis continued to spread out and bulk commodities prices in general, began to fall. In particular, the international crude oil prices fell rapidly, which had a huge impact on PVC futures prices. PVC futures prices plunged sharply in September 2011 and fell back to near the low point since listing.

In the next four years, the overall performance of China's PVC was weak and the price continued to decline. Due to the sluggish performance of the real-estate industry, PVC futures prices hit the bottom all the way, hitting a new low since listing in late November 2015 at 4405 yuan/ton, falling below the production cost line of the enterprises.

In 2016, the domestic bulk commodity market generally recovered. PVC futures prices gradually stopped falling and stabilized, stepping out of historical lows. The recovering domestic real-estate industry also improved the PVC demand expectations. The sharp rise in coal prices and environmental protection policies enacted pushed the price of calcium carbide up significantly, restoring the supply and demand equilibrium. The profitability of the industry improved significantly such that PVC futures prices have soared all the way, breaking through the 8000 yuan/ton mark in mid-November 2016, and continued to fluctuate at a high level for the next four years.

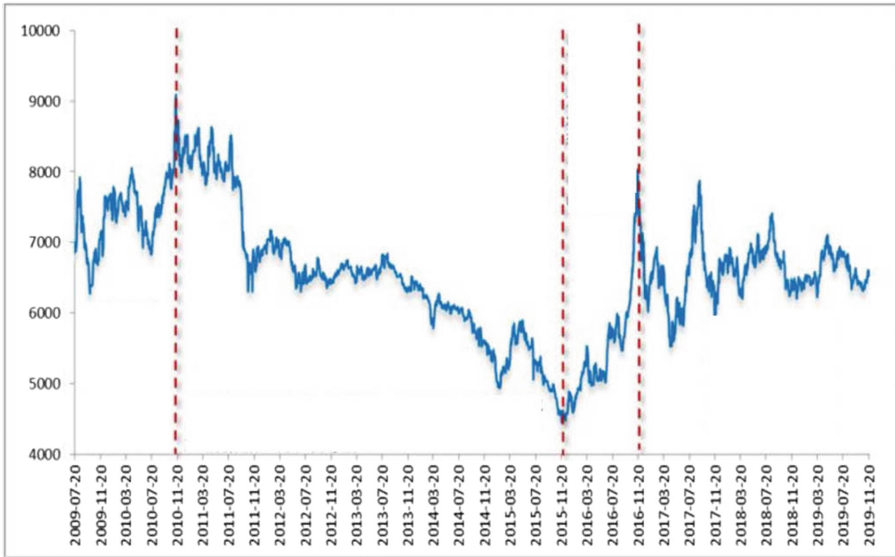


Fig. 4. Historical performance of PVC. Yuan/Ton vs. Time Source: Wind Terminal

2.2 The Current Performance of PVC

Supply Side. As the industry chain of PVC in China displayed above, it is clear that the price of upstream products, coal and calcium carbide, have a direct and huge impact on the PVC price. In China, almost 80% of calcium carbide production comes from the northwestern region, the exact region on which the most recent “Carbon Neutrality Policy” and “Limitations on Electricity Usage” has been imposed in February 2021. Under the influence of these two environmental policies that were aimed to cut the annual energy consumption, the production capacity of calcium carbide was greatly affected, pushing the calcium carbide price up sharply in the short term and greatly increasing the cost of PVC during its resumption season, as shown in Fig. 6. Since the upstream calcium carbide is a large local electricity consumer, and its supply and demand were quite tight, there has been growing concern with the supply side of PVC due to shortage of raw materials since the “dual control policy” would eliminate a large number of suppliers with low productivity. As a result, as shown in Fig. 5, a lot of funds have rushed to do more PVC, continuously pushing the PVC price up, but the overall price is still within the range of fluctuations in previous years.

Demand Side. However, the impact of the cold wave in the United States during the Spring Festival has made the price difference between domestic and foreign markets even more significant. A large amount of export demand was built up onto the supply constraints and cost support, making the PVC market after the Spring Festival even more promising. During the Spring Festival, the cold wave in the United States led to the shutdown of large-scale domestic installations in the United States, triggering a significant tightening of international PVC. Many manufacturers have announced that the installation would not be restarted until June at the earliest. At present, the United States,



Fig. 5. Q1 2011 PVC2105 contract trend chart. Yuan/ton Source: NANHUA FUTURES

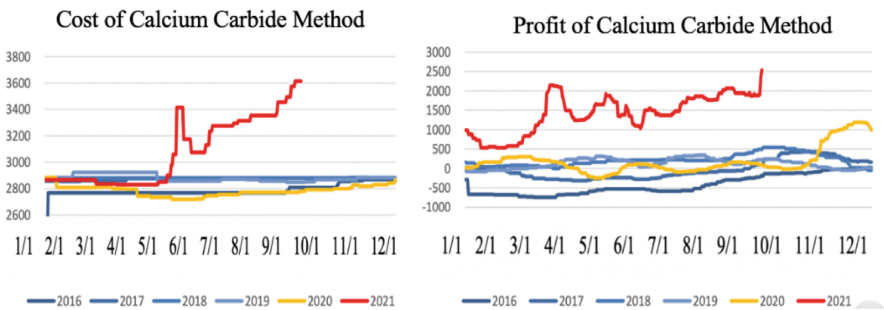


Fig. 6. Domestic cost and profit of calcium carbide Source: NANHUA FUTURES

which was still in a midst of full economic recovery, was in the post-real estate cycle, a time where the growth rate of real estate sales scale began to slow down and reached a maximum, rendering a relatively high PVC demand. Given the trend shown in Fig. 7, it is foreseeable that even if the US installation is restarted somewhere between June and July, there is a great possibility that the supply will be directed to and limited to the surrounding scarce regions. Consequently, this supply gap in the short run experienced by the United States and several European countries may still need to be filled by Chinese exports, which demonstrates the fall in PVC imports and the rise in PVC exports in 2021. Therefore, PVC, a product with insufficient production capacity, was experiencing a dual-drive of “supply shock” and “export support”, which together explicitly pushed the price up all the way up to 9,300 yuan/ton in the 2105 contract.

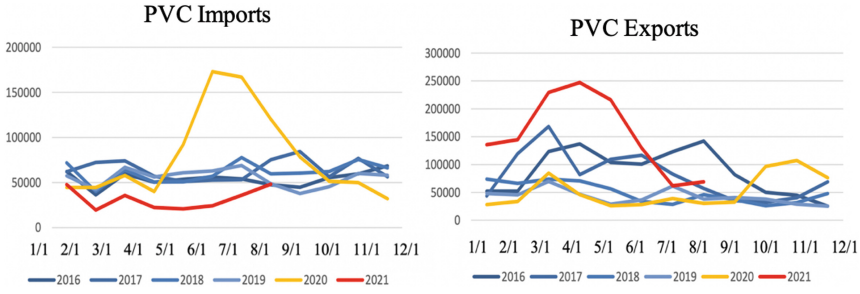


Fig. 7. Domestic cost and profit of calcium carbide Source: NANHUA FUTURES

System Risk. As discussed above, at the post-real estate stage, the downstream related industrial chain of real estate has experienced a fairly profitable period of time, one of the main reasons attributable to the soaring price of PVC, along with the surge in demand for other construction raw materials in infrastructure construction after the pandemic.

From the perspective of the real-estate data, due to the impact of the pandemic last year, the new construction rate in February fell 44.9% year-on-year, while the cumulative increase till February this year was 64.3% year-on-year, basically coming back to a 90% level of what appeared in 2019.⁵ However, this trend changed starting September. In the first half of the year, the scale of commercial housing sales once hit a five-year high. However, with the continuous tightening of control policies, the overall market began to decline, and it is likely to continue declining in the short term, based on Fig. 8. According to past practices, September and October are the traditional peak sales seasons for the real estate industry. However, based on the performance of the property market in many cities this year, September 2021 is not so “profitable” anymore. CRIC data shows that the 39th week of transaction data including the Mid-Autumn Festival holiday that has just passed has seen a sharp decline year-on-year, among which hot cities such as Shanghai, Nanjing, Ningbo, Suzhou, and Shaoxing have fallen by more than 50% year-on-year.

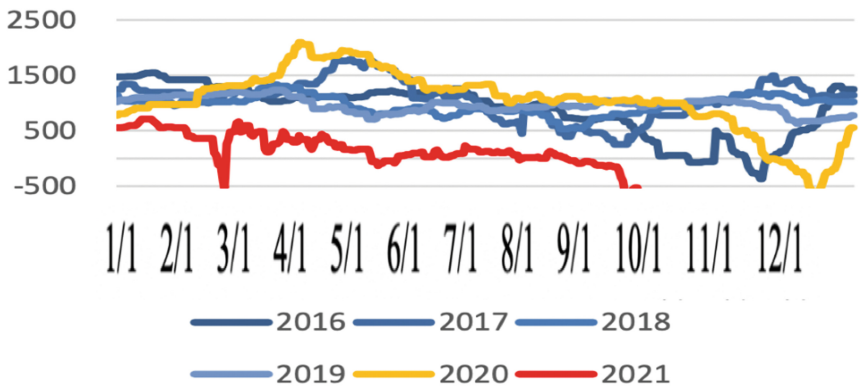


Fig. 8. Profit of PVC construction materials. Yuan/Ton vs. Time Source: NANHUA FUTURES

3 Investment Behavior in PVC Futures Market

3.1 Arbitrage Opportunity

Calendar Spread Arbitrage. The spot price of a futures is the time-varying price that hedgers and speculators concern about. In general,

$$Spot Price * (1 + Cost of Carrying) = Arbitrage - Free Futures Price$$

Therefore, based on the seasonality of PVC, a common arbitrage opportunity is to purchase PVC in the summer or winter and sell them in spring and autumn, given the fact that the cost of carrying PVC is quite low. Investors should focus on the contract ending in May and September because the operating rate of PVC downstream industries fluctuates seasonally and regularly. Inventories begin to accumulate in the winter, and the turning points appear in the spring next year and right after summer ends. In the time of inventory reduction, near-month contracts are more profitable and suitable for positive sets. This is so-called Calendar Spread Arbitrage. From Fig. 9, in 2017, it is evident that the price difference between the 09 contracts and 01 contracts is significant. Therefore, there is a great arbitrage opportunity to enter the long position in January and enter the short position in September.

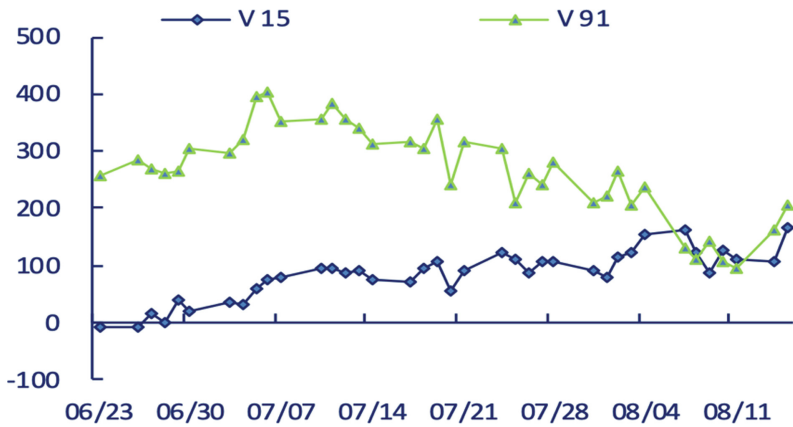


Fig. 9. Calendar spread price difference in 2017 Source: Wind Terminal

Cross-Product Arbitrage. Another common type of arbitrage opportunity in the futures market is cross-product arbitrage. It is common for investors to hold in position for closely related products, and cross-commodity arbitrage works when there is either a certain substitution effect or a good correlation between the two products. The substitution effect between LLDPE (non-toxic PVC) and PVC is not obvious, because LLDPE is mainly used to produce agricultural film and packaging film, while the main purpose of PVC is to produce building materials. However, both being the downstream products of crude oil, the correlation between them is actually very high. Therefore,

when the price of LLDPE rises, the price of PVC must rise accordingly. However, the rate of increase is not the exactly same, where there is always a certain range of price differences between the prices of the two products. If the price between the two products deviates from the normal value, there is always a tendency to return to the normal value. For example, take the price difference between LLDPE and PVC is 500 yuan/ton, if the price difference between LLDPE and PVC is 1000 yuan for a certain period of time, then the price difference deviates from the usual value of 500 yuan, and there is an arbitrage opportunity. Since the price difference tends to return to 500 yuan, selling LLDPE and buying PVC is an arbitrage opportunity. When the price difference between LLDPE and PVC falls back to 500 yuan, the profit of arbitrage is 500 yuan/ton. For example, consider the L-V price difference in 2017 in Fig. 10 below. A potential arbitrage opportunity is to do more in PVC and short sell LLDPE at 6/19 and around 7/20.

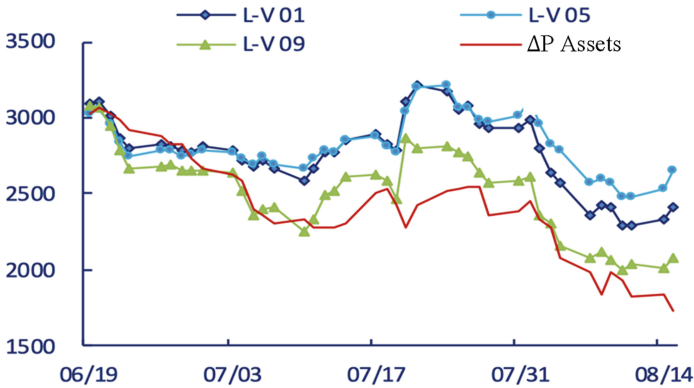


Fig. 10. L-V price difference in 2017 Source: Wind Terminal

3.2 Major Participants

Aside from the factors mentioned above, the futures price can be indirectly influenced by major participants in the futures trading market. Both the hedgers and speculators have an impact on the market. A speculator uses a futures contract to profit from movements in futures prices, and a hedger to protect against price movement. Speculators usually wish to enter a long position when they anticipate the futures price to rise, and hedgers wish to protect their revenue against price fluctuations by entering a short position and selling the contracts. In this year specifically, considering the complex circumstance, there is no clear optimal strategy to follow. From the perspective of the timing of the trading strategy, I believe that October to November is still the rhythm of buying on dips, because the first dual control is still continuing, and likely to further spread in northwestern regions. The important thing is that Xinjiang’s dual control has not yet landed. Therefore, speculators can expect the price to still be somehow rigid. Besides, September and October are still the peak season for PVC futures. At this time, it is difficult to see an extensive shutdown among the downstream industries. After December, considering the particularly poor condition in the downstream this year, it is expected that an extensive downstream

shutdown is likely to occur in advance. Therefore, it might be promising for hedgers to short sell in the fourth quarter.

4 Conclusion

Based on the current situation, assuming the macroeconomic environment does not change dramatically, with the consideration of the short-term PVC supply and demand gap, the persistence of the “dual control” policy, and the minimal possibility of a short-term return to the United States, the PVC price in China is still likely to rise slowly, or at least not falling. This is because of the difficulty of alleviating these core contradictions in the short run. However, the fact that the real estate demand might continue to fall entering winter seems to be the biggest risk for investors at present. But the rigidity of the demand side (the terminal real estate has a strong bargaining power for products, but it is unlikely to delay construction due to the high PVC price) still ensures the long-term stability of its price. Indeed, the most apparent restraint is that the PVC price has gone up too quickly in the short run so that certain resistance has appeared amongst the downstream. However, it is evident that the optimal strategy so far is still to do more PVC. It is foreseeable that as long as investors keep a close eye on the price adjustment of downstream products (for instance, the significant decline in October) and if there is a chance for price to be transmitted, there is still room for the price of PVC to rise continuously. In other words, apart from the high price of PVC, doing more is the most likely optimal strategy.

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The Effect of Pinduoduo's Current Marketing on Customer Retention

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Abstract. With the rapid development of e-commerce, many e-commerce platforms emerge endlessly. In order to stand out from the crowd, every platform is looking for its own “unrepeatable success”. In China, Pinduoduo is one of them. Different from the traditional e-commerce model, Pinduoduo is a social e-commerce platform. With its low-price group shopping model, rich game-like shopping experience and a partnership with WeChat, China’s largest social networking platform, Pinduoduo stands out in an online shopping industry crowded with giants and is growing fast. This paper mainly studies whether the existing marketing model of Pinduoduo is positive for customer retention through a questionnaire survey and relevant data about Pinduoduo. Finally, according to the conclusions, to give some relevant suggestions for Pinduoduo’s sustainable development.

Keywords: E-commerce platform · Pinduoduo · Customer retention · Marketing · Questionnaire

1 Introduction

1.1 Background

In the past several years, social e-commerce has been rapidly developing in China and is now playing an important role in the e-commerce market [1]. This encourages more competition among e-commerce platforms. The most significant bottleneck for traditional e-commerce right now is the high cost of customer acquisition [2]. The maturation of social media growth in recent years has presented a viable answer, allowing e-commerce to establish a platform based on social networking [3].

Yahoo! coined the term “social commerce” in November 2005 [4] to describe a set of online collaborative shopping tools such as shared shopping lists, user ratings, and other user-generated content-sharing of online product information and advice.

Pinduoduo, a social e-commerce representative in China, is the fastest-growing e-commerce start-up in Chinese history, having reached a gross merchandise value of \$15 billion only two years after its launch, a milestone that incumbents Alibaba and JD.com

took ten and five years, respectively [5]. Officially, Pinduoduo entered the US capital market in 2018 with a \$19 issue price and a \$24 billion market capitalization.

Pinduoduo is a third-party mobile e-commerce platform that includes a merchant check-in feature. It focuses on the C2B (Customer to Business) group mode, which is people-oriented and sharing-driven. Pinduoduo incorporates entertainment and sharing concepts into e-commerce operations: After forming a shopping group with friends, family, and neighbors, users initiate invitations and purchase high-quality goods at a lower price. Pinduoduo can run all the way thanks to this social “group” mode based on the Wechat ecosystem [6].

1.2 Related Literature

Previous scholars analyzed the development stage of social e-commerce platforms. The platform's stabilization is divided into two stages: spread and evolution [4]. The first stage is about providing incentives for customers. For multi-sided platforms like Pinduoduo, the providers must employ a variety of strategies to attract users on both the supply and demand sides [7]. For this stage, Pinduoduo's twist lies in its “social marketing” and low price. The company's bulk-selling methodology readily generates large orders for vendors, giving them greater leeway to lower prices. And some scholars use models like SIR and the Bass model to fit the growth of Pinduoduo, providing a proper prediction of Pinduoduo's user growth as well as a new understanding of its business model for entrepreneurs and investors [5].

Merchants determine the scale and price of group purchases, while consumers initiate group purchases by taking advantage of their social relationships to obtain price discounts and value-added services. On the web page of the platform, you can see the individual purchase price of a product and the price of launching a single order. To form a group, shoppers need to send a link to the social networking platform and find a sufficient number of buyers within a specified period of time. If the number of participants does not reach the designated number within the opening time, the purchase will be invalid [8]. In order to reach the number of group members, consumers will consciously help merchants promote. Thus, buyers can obtain corresponding products at lower prices, and sellers can save marketing costs through self-marketing by buyers. At the same time, the advanced collection mode reduces production risk, so as to achieve a win-win situation for the buyer and the seller [9].

Problems brought by those strategies are also pointed out. The first one is frequent bargaining and sharing, which generates boredom and influences the relationship of users and may restrict the future development of the platform. The advertisements frequently appear in the public eyes, but are not attractive to young people, so this kind of viral-orientated marketing is not very ideal. And then low product quality and poor after-sales service lead to an unsatisfied shopping experience [10]. Thirdly, the order can be inexplicably cancelled after the group has successfully organized, which makes users busy in vain and causes dissatisfaction among users. And the last one is the imperfect platform construction, which has loopholes. A survey was conducted among the students of three high schools in the Maoming area, pointing out problems such as uneven product quality, fake marketing, frequent social shopping and bargaining that deplete interpersonal relationships, and imperfect after-sales services [6].

These are barriers for Pinduoduo to smoothly pass the late evolution stage of the stabilisation of the platform, where quality control and revenue structure truly matter [7].

In this background, the main research question of this paper brings out: whether existing marketing is positive for customer retention for Pinduoduo. Loyal customers are the most important assets of a company, the purpose of which is to ensure the maintenance of relationships with value-adding customers by reducing their defection rate [11]. This paper intend to figure out the characteristics of its social e-commerce and the causes of the problems with customer retention as the background, then analyze the question and offer some advice for possible transformation. Previous scholars analyzed Pinduoduo's characteristics and problems. However, the relationship between these problems and Pinduoduo's marketing strategies is seldomly shown in quantitative ways.

Thus, this paper uses data from data websites and surveys collected from consumers and merchants to analyze the customer retention problem at Pinduoduo in order to determine its cause and potential solutions.

2 Methods

2.1 Data Collection Method

In terms of data collection, there are two main components. The first one is the questionnaire design. This paper used a free online questionnaire design site called WJX.com to design a questionnaire named Pinduoduo Market survey. This questionnaire involves the personal information of the respondents (gender, age, income, residence, etc.) and their use of Pinduoduo. As of October 16, 2021, there are 422 valid responses have been collected. While waiting for the questionnaire collection, the data of many public websites have been checked, such as the annual reports and quarterly report from Pinduoduo's official website, and this paper simply divide the data collected into three types, such as merchant data, user data and financial data.

2.2 Data Analysis Method

And then, in terms of data analysis, this paper first used Excel. For example, making tables of the collected data (including the public data on the website and the data in the questionnaire survey) and drawing some line charts with Excel to see the trend of the data. Secondly, the questionnaire designed involves some text questions, which will be presented in the form of cloud pictures. The website weiciyun.com is used to make the cloud pictures. This paper also refer to the methods of some relevant literature, like the SIR model. The three groups of people studied by SIR can be compared with the three groups of people in the Pinduoduo market. For example, the susceptible group can target potential users of Pinduoduo, the infectious group can target users who are already using Pinduoduo, and the removed group can object to people who have used Pinduoduo but have not continued to use it.

3 Analysis

3.1 Success and Problems of Pinduoduo

Success of Pinduoduo. The part of data and analysis starts with the success of pinduoduo. in this paper, the trend of pinduoduo’s gross merchandise value (gmv) and monthly active users have summarized over the years from 2017 to 2021. the concept of Fig. 1 is about the gmv of pinduoduo. there has been a significant growth from 38.4 billion rmb to 2931 billion rmb in just four years. that is to say, pinduoduo has achieved jd’s 10-year achievement in just four years.

Figure 2 shows that monthly active users of Pinduoduo have been in a growing state, from 195 million at the beginning to 738.5 million now in just three years. And that’s just the growth of MAU, not the increase in total users or the number of downloads. This single number can be enough to prove the success of Pinduoduo.

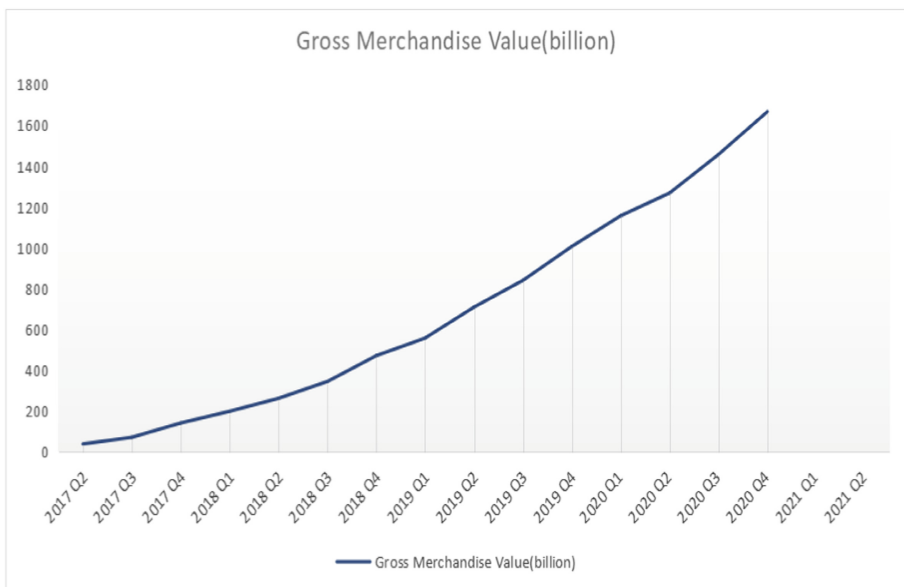


Fig. 1. GMV.

The next two charts reflect the active buyers and their annual spending. Active buyers’ skyrocketing from 77.9 million in the second quarter of 2017 to 738.5 million in the second quarter of 2021 in Fig. 3. The annual spending per active buyer is the concept of Fig. 4, and this figure also shows that the overall trend is upward.

The SIR model has been mentioned above, which proved that it could fully fit the user growth trend of Pinduoduo in the early stages. However, the user growth of Pinduoduo in the later period broke through the peak predicted by SIR and achieved constant growth. As shown in Fig. 5, the dotted line is the user growth of Pinduoduo predicted by the SIR model, and the line that keeps going up is the actual user growth of Pinduoduo, it is

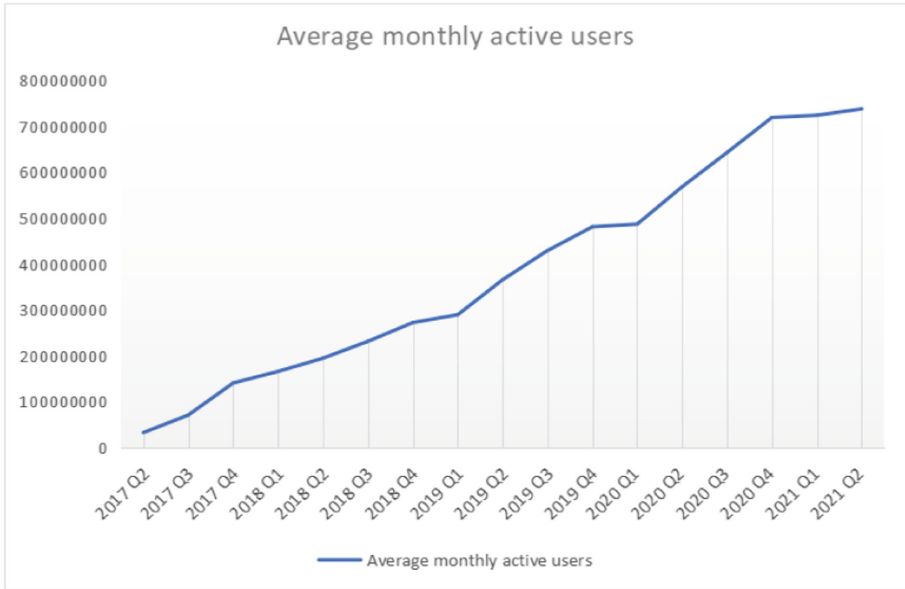


Fig. 2. Average monthly active user.



Fig. 3. Active buyers.



Fig. 4. Annual spending per active buyers.

clearly that initially the predicted line fit the actual line very well, but after a period of time, the predicted value peak and begin to decline while the actual user growth exceed the predicted growth and continue to increase.

It is precisely because Pinduoduo took certain measures before the first growth slowdown, such as the launch of “10 billion subsidies” activities, that they could break the predicted peak. In a word, Pinduoduo has been doing a very good job of attracting users.

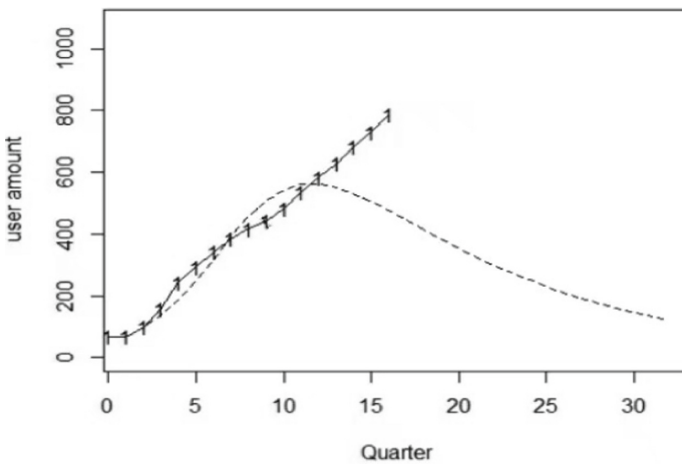


Fig. 5. SIR model predicted Pinduoduo user growth and actual user growth (Source: [5]).

Problems of Pinduoduo. As for the exciting problems of pinduoduo, Fig. 2 illustrates the situation again in this section. it can be clearly seen that, since quarter 4 of 2020, pinduoduo’s monthly active users are still growing but slowing down.

Figure 6 shows the change in Pinduoduo’s customer acquisition cost. In a fixed period, customer acquisition cost is the sum of marketing cost, marketing personnel cost, and marketing tool cost. The single customer cost is the customer acquisition cost divided by the number of customers (the data of monthly active users was used in the calculations). One of the key indicators used to assess long-term sustainable growth is customer acquisition cost. It can also be seen from this chart that Pinduoduo’s customer acquisition cost per person reached unprecedented heights in 2021. It also indirectly explains the decrease in monthly active users in 2021.

As shown in Fig 6, the customer acquisition cost of Q1 in previous years was also the highest in that year. The speculation is that this is due to the Spring Festival, a traditional Chinese festival, in the first quarter of the year, and the platform will promote it vigorously. The user growth will reach a peak just like the increase of people spreading a disease, and the gradual slowdown in the growth of these data indicates that this is the current situation of Pinduoduo. Although the value of Q1 is unique, the cost of customer acquisition in the second quarter of 2021 approached the peak value of 2020 (the customer acquisition cost in the Q1 period) and was much higher than in Q2 of previous years.

And then, in the Fig. 7 this red line is year on year percentage of GMV. This chart shows that although GMV has been rising, the actual growth rate is slowing. However, it can also be seen that the curve starts to show an upward trend in the first quarter of 2021, which is thought to be due to the launch of a new activity called “DuoDuo Grocery”.

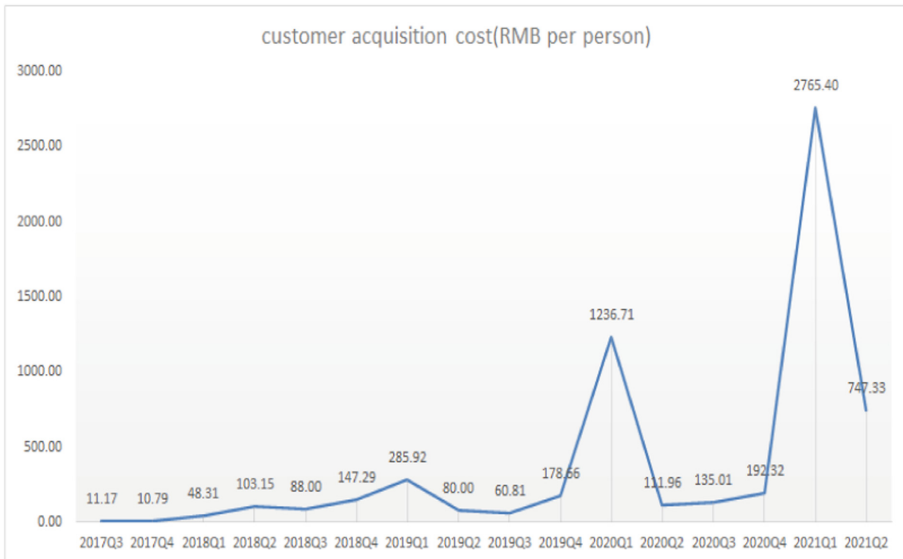


Fig. 6. Customer acquisition cost

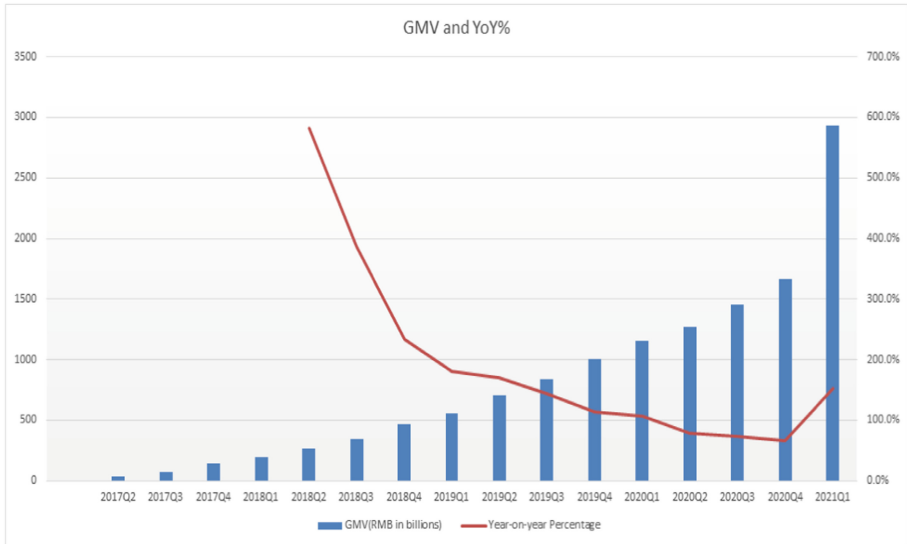


Fig. 7. GMV and YoY%.

3.2 Users' Evaluation of Pinduoduo

User Portrait. To further analyze the reasons behind the problems pinduoduo is facing now, this paper conducted a survey to collect consumers' true thoughts about the e-commerce platform. It is shown that 65% of them are females and the rest are males (Fig. 8). As for age, the most of them are young people from 18 years old to 29 years old (Fig. 9), which could match the current situation for the age group of pinduoduo (Fig. 12). And still, this paper is tempted to cover all age levels. As for the location, most of the respondents are from the first-tier cities and new first-tier cities in China (Fig. 10), which is not good enough because most of the purchasers of pinduoduo are from three-tier or four-tier cities in China, according to the authoritative report [12]. But still, the problems pointed out in the reflection from these users are collected and analyzed. This paper also investigated how much they spend on pinduoduo per month, showing an aggregation in middle expense (Fig. 11).

Evaluation. Then this paper divided all the respondents into three groups: users who had never downloaded pinduoduo, users who had downloaded one but were not using it anymore; and users who still use pinduoduo.

As for the last part: active users of Pinduoduo—the survey focuses on questions to get their evaluation of Pinduoduo from the angle of consumers who stay.

The first one focuses on their views towards “bargain-hunting” activity. The bargain and its spread mode are not repulsive to the majority of people (Fig. 13). Although they may not share the link themselves, they are willing to help others get the discount, especially for friends and families.

The second one is “Have you ever had any objectionable content since you have been using Pinduoduo? Why?” By gathering all the key words given by the answers,

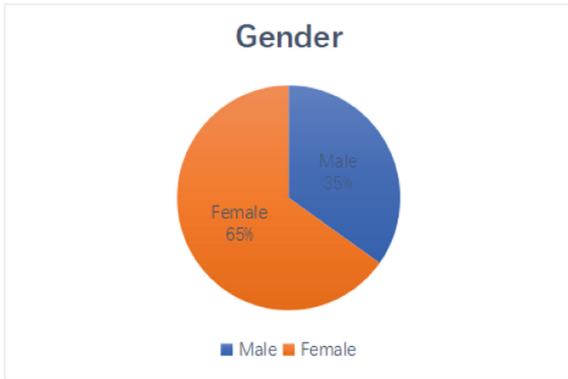


Fig. 8. Gender.

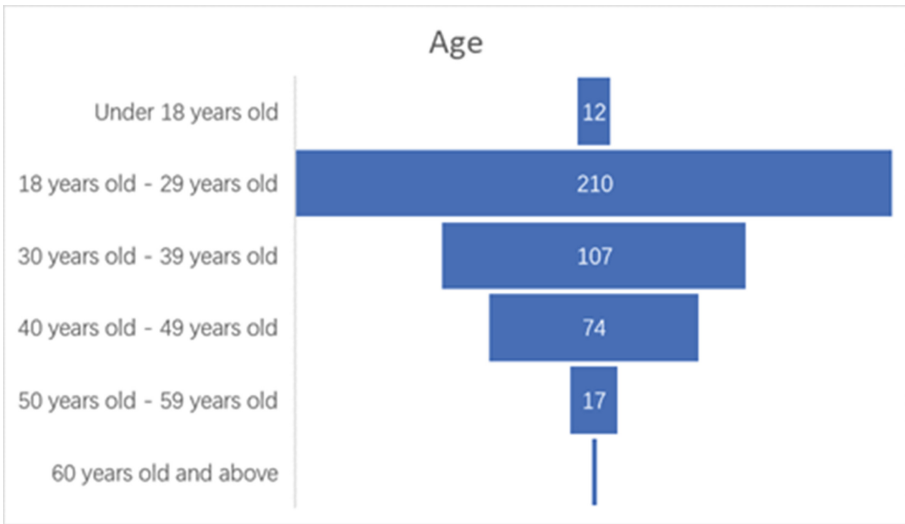


Fig. 9. Age

this paper form a word cloud, which shows the frequency of these words. Then it can be seen that many respondents take a dislike to the bargaining, advertising and helping activities offered by Pinduoduo (Fig. 14).

Similarly, the survey asked them what they thought the current problems with Pinduoduo were. Nearly half of them questioned the commodities' quality of Pinduoduo. The marketing strategies also cause problems for consumers' interpersonal relationships. The service and system of Pinduoduo are also criticized (Fig. 15). To sum up, apart from the appeal from the low price, Pinduoduo has a long way to go in all aspects of its platform, at least at the angle from current users.

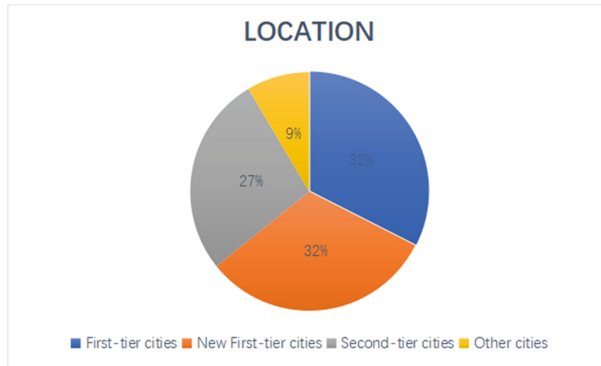


Fig. 10. Location

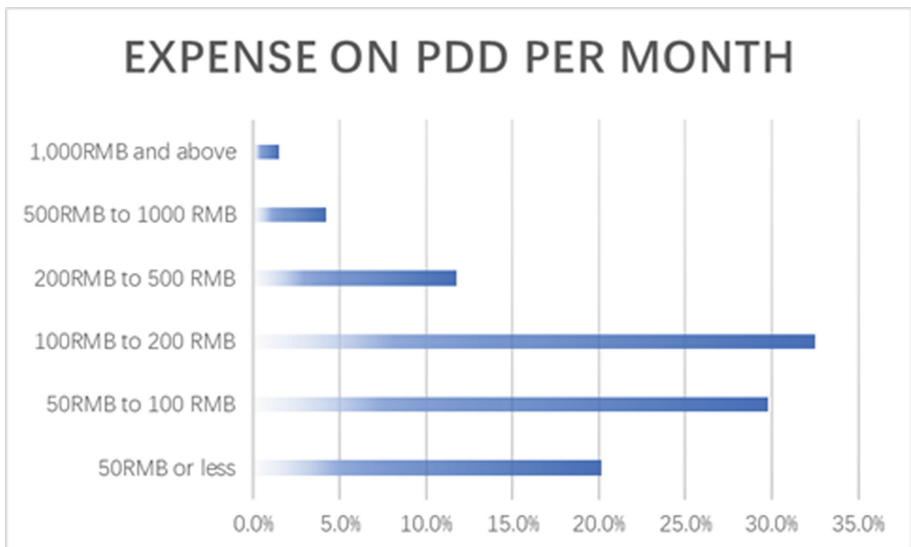


Fig. 11. Expense.

3.3 Comparison: After-Sale Service

For those who do not use Pinduoduo and choose to use other platforms, the reasons why they prefer to use other platforms in the survey are mentioned. According to the data collected by the questionnaire about the reasons given by those who did not download and those who did not continue to use Pinduoduo after downloading, the advantages of other platforms are mainly the more complete range of products and the better platform system, which are 32% and 42% participants chosen from Fig. 16 and 17.

According to the summary of the average grade for different platforms in the survey shown in Table 1, Pinduoduo's grade is 2.88 out of 5. As is shown, Pinduoduo's grade is lower than JD which is 2.94, and higher than Vipshop which is 1.71.

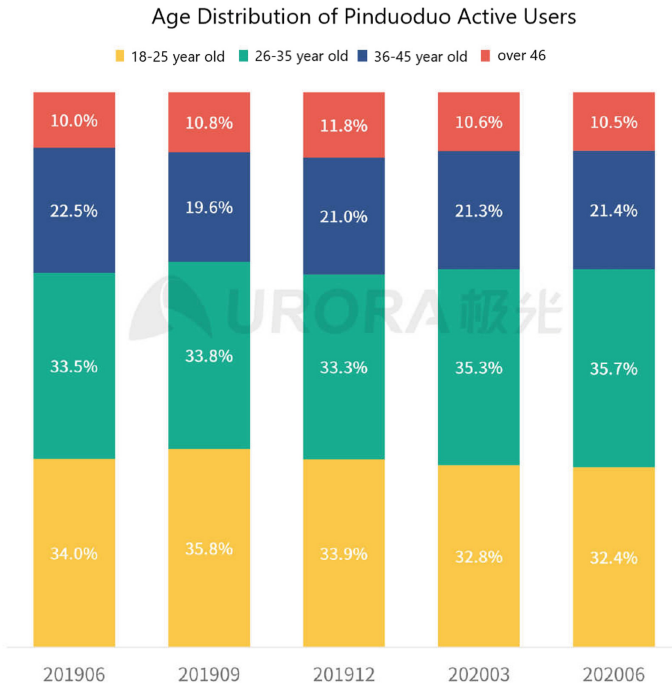


Fig. 12. Age distribution of Pinduoduo customers (Source: [13]).



Fig. 13. Views for bargaining activity.

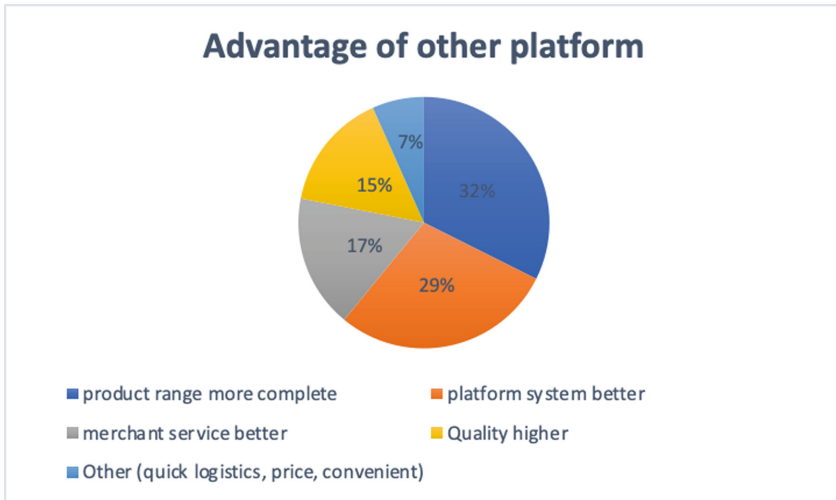


Fig. 16. Advantages of other platforms (not download Pinduoduo).

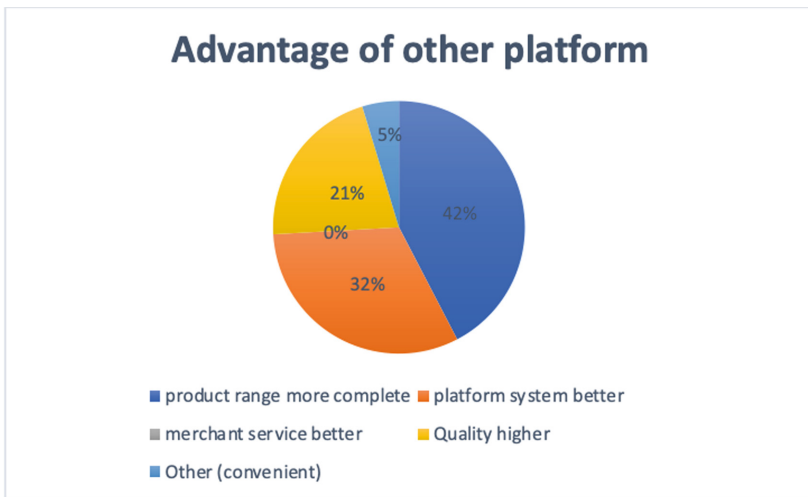
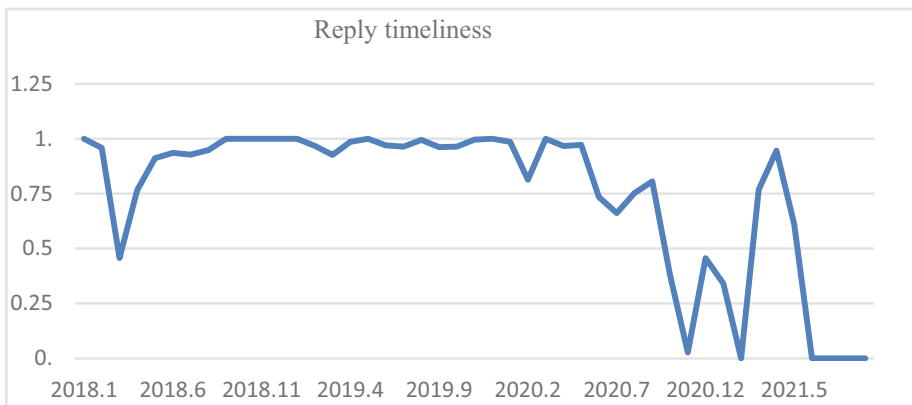


Fig. 17. Advantages of other platforms (stop use Pinduoduo).

Table 1. Grade for platforms.

	1	2	3	4	5	Did not use	Average
Pinduoduo	28	46	84	90	97	77	2.88
TaoBao	26	29	49	149	121	48	3.39
Taobao Special Edition	17	19	32	71	45	238	1.56
JD.com	18	14	51	115	116	108	2.94
Tmall	10	37	43	91	110	131	2.67
Vipshop	12	14	34	80	52	230	1.71
Mogu.com	5	15	30	24	28	320	0.86
Total	116	174	322	620	569	1152	2.29

of slower user growth and makes the issue of subsequent user retention increasingly apparent.

**Fig. 18.** Pinduoduo's reply timeliness.

Using JD and Vipshop as comparison platforms and data from Table 2, the platform response rate of Pinduoduo is 40.24% and is significantly lower than the other two platforms which are 96.20% and 100.00%. It is consistent with the information collected by the questionnaire. Pinduoduo's response rate is low, but overall user satisfaction is 3.333 points and higher than JD which is 2 points. Vipshop does a great job in after-sale service and gets 6.667 points of user satisfaction, but it did not get a high grade in the survey.

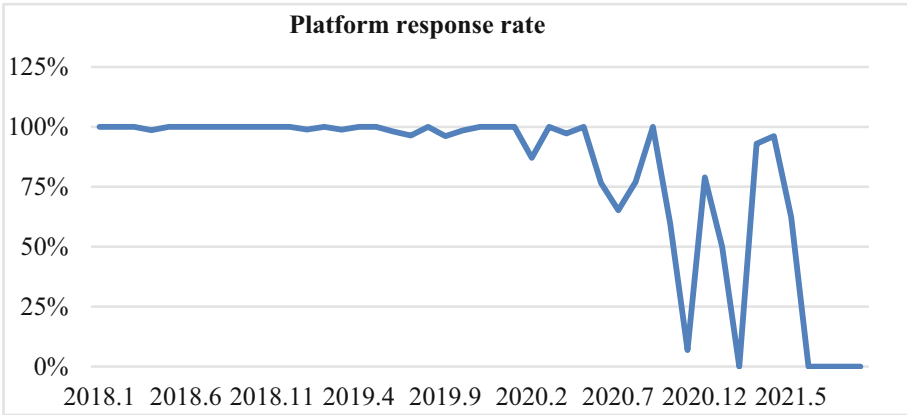


Fig. 19. Pinduoduo’s platform response rate.

Table 2. Garde for after-sale service.

	Platform response rate	Reply timeliness	Users’ satisfaction	Comprehensive index
Pinduoduo	40.24%	0.25	3.333	0.359
JD.com	96.20%	0.302	3	0.632
Vipshop	100.00%	0.844	6.667	0.893

4 Discussion

4.1 Current Situations

The charts of monthly active users and the SIR model show that although Pinduoduo’s active users and annual spending have been growing steadily in recent years and doing a good job in attracting users, Pinduoduo has problems. Its current problem is that its user growth is slowing down and will gradually reach a peak with subsequent user retention issues. In addition, Pinduoduo’s high customer acquisition costs are also affecting the user growth rate and hindering the acquisition of subsequent users. The high cost of acquiring users means retaining them is essential. According to the survey, users do not like the advertisements on Pindudouo, and because of the products and platform system, users choose other platforms. Through comparison, it is known that Pinduoduo’s after-sales service has a certain gap compared with other platforms and needs prove, and not only after-sales service matters, but also other aspects of the platform affect the rating, like product and marketing method mentioned before.

4.2 Suggestions: Reduce Its Customer Acquisition Cost

Due to all the information, Pinduoduo should try to reduce its customer acquisition cost in order to improve the conversion rate of users and make them stay. At first, it is

required to improve the after-sales service and introduce more products and merchants to become equal to other platforms and satisfy consumers' needs, so that users would be willing to download and stay. Pinduoduo needs to establish a more complete system of merchant entry and set up quality supervision to improve product quality and attract more brand merchants to enter. The speed and accuracy of customer service responses need to be improved since customer problems need to be solved quickly and accurately. After-sales service is very important for the subsequent development of Pinduoduo, but it is not the only criterion. Pinduoduo can also improve communication efficiency by changing marketing methods to precise marketing to attract and retain target customers. New activities can be properly carried out, just like the subsidy activities promoted by Pinduoduo in the early stage, to realistically meet the needs of customers and attract new customers. At the same time, it is necessary to avoid a large number of ineffective false advertisements and provide personalized advertisements and activities to promote to the corresponding groups, so that they are willing to continue to use Pinduoduo.

5 Conclusion

The paper examines the user retention problem of Pinduoduo and how to solve the problem through data and merchant data collected through web searches and questionnaires. The data are compared both horizontally and vertically. Change in growth rate over time and comparison between Pinduoduo and other platforms are included. The results show that the growth rate of Pinduoduo's users is slowing down and user's satisfaction rate is low. Problems with marketing and after-sales service make users leave or choose to use other platforms. It is suggested that Pinduoduo can improve its operations by reducing customer acquisition costs and retaining existing customers through accurate marketing and improving the platform's after-sales service.

There are several avenues for future research. The data collection of this paper falls short of Pinduoduo's current focus areas, which include three-tier and four-tier Chinese cities, as well as people with higher price sensitivity. The processing and analysis of the data is not comprehensive enough. A more specific division should be done for those surveyed. Then the evaluations of each group can then be quantitatively analyzed to produce more targeted conclusions and suggestions. The study can be also expanded to other aspects of the Pinduoduo marketing mode, such as the maintenance effect of interpersonal relationships, etc. In addition, this paper can refine the suggestion scheme and establish a model to simulate the specific effect of the suggestion proposed in the current analysis on Pinduoduo user retention.

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Evaluation of Countries' Performance in Epidemic Based of Factor Analysis Method

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Abstract. As corona virus spread around the world, a system of evaluating the performance of different countries is need in order to let the country facing serious condition to learn what's important when dealing with the epidemic. This article uses the factor analysis method to extract factors from economy data in recent years, health data and corona virus data of different countries, and build an analytic hierarchy model to rank the countries. These model gives a score representing the economy condition, health condition, and the severity of corona virus. After the comparison, the countries performing well in epidemic like America and China all have a strong economy condition and health system, and some countries performing bad are concentrated in Africa and Middle East.

Keywords: Corona virus · Economy factor analysis · Method analytic hierarchy model

1 Introduction

Since 2019 the corona virus has strongly infected the world's economy and health condition, some countries are still in serious condition while other countries also face the problem of decrease in economy. Based on the knowledge of probabilities and statistics scholars can do a lot about corona virus, like forecasting the tendency of number of infected persons using the ARIMA model [1], even forecasting the possibility of outbreak. Also, using the methods of statistics and analysis offers people a better way to view the condition of different countries and compare them, there are some people done the study about the evaluation of countries based on the anti-epidemic measures taken by those countries and the mental condition using the factor analysis method and analytic hierarchy model [2]. But there are still some factors can be taken into consideration, like the economy condition and the birth rate. So, we can consider more factors and use more criterion in the hierarchy model in order to build a better model. In this article we use the economy, health, epidemic conditions during the epidemic period as the criterions based on more detailed factors to build a general evaluation system of performance of more than 100 countries, including both big countries and small countries. Then we use

different criterions to rank different countries, showing that countries which keep good economy condition in epidemic period are mainly big countries like America and China; countries which ranks high in health condition are the countries with high technology and lower population like Switzerland and Germany; and the condition of corona virus are more serious in some poor and high-population density countries. Based on the different criterions finally we give a rank of different countries' performance in epidemic period, finding that the good countries are mainly the developed countries or countries with strong ability; the countries which get low ranks are centered in mid-east and Africa, with hot temperature and high population density.

2 Theoretical Basics

2.1 Factor Analysis

Factor analysis is a way to simplify the high-dimension data based on the correlation of all the indicators. For example, if we collect lots of data of the restaurants in the country, like the sales volume of each dish, the number of cooks and customers, how many years has the restaurant open. And we can summarize them into two factors: the strength of the restaurant and its performance in marketplace.

Suppose there are a p -dimension observable vector $X = (x_1, \dots, x_p)^T$ (the original indicators) and a m -dimension non-observable vector $F = (F_1, \dots, F_m)^T$ with $E(F) = 0$, $Cor(F) = I_m$, $m < p$, and a special vector $\epsilon = (\epsilon_1, \dots, \epsilon_p)^T$ with $E(\epsilon) = 0$, $Cor(\epsilon) = diag(\sigma_1^2, \dots, \sigma_p^2)$ satisfy that $X = AF + \epsilon$, where $A \in R^{p \times m}$ is called factor loading matrix with $a_{ij} = cov(x_i, F_j)$. According to the factor loading matrix we can extract m factors form the original indicators. Usually, m is determined by the rate of contribution of variance, if those m factors can explain more than 75% variance of X , then we can try to find m factors.

For calculating the exact parameters of the factor model, we have three ways. The first way is to use the principal component. Denote α_i and e_i are the i -st eigenvalue and eigenvector of $Cor(X)$, then we approximately have $A = (\sqrt{\alpha_1}e_1, \dots, \sqrt{\alpha_m}e_m)$ when $\frac{\alpha_1 + \dots + \alpha_m}{\alpha_1 + \dots + \alpha_p} > 0.75$. There are also two ways, principal factor method and the maximum likelihood method. And we can rotate the factor by max the variance to make it easier to explain [3].

At last, we can use A to calculate the score of each factor and use it for further analysis.

2.2 Analytic Hierarchy Model

Analytic hierarchy model is to build a evaluating system for a multi-indicators question. Usually there are three layers of the model: destination layer, criterion layer, index layer. Still take the restaurant as an example. The destination layer is the ranking of the restaurants in the country. The criterion layer provides some indicators, like the economic condition, the health condition and so on. Each indicator in the criterion layer corresponds with more smaller indicators in the index layer. For example we can write the analytic hierarchy model of restaurant ranking like Table 1.

Table 1. An example of hierarchy model

Destination layer	Criterion layer	Index layer
Restaurant ranking	Economic condition	Dish price
		Customer number
	Health condition	Cleaner number
		Expenditure for health

After building the analytic hierarchy model, if we want to calculate the exact weight of each indicator, we first need to construct the judgement matrix. Judgement matrix is used to compare the importance of each indicator, the exact value of it is given subjectively. Usually, we use the method called 19 proportional scale method. For the judgement matrix A we have

$$a_{ij} = \begin{cases} 1 & \text{indicator } i \text{ and } j \text{ are equally important} \\ 3 & \text{indicator } i \text{ is a little more important than } j \\ 5 & \text{indicator } i \text{ is obviously more important than } j \\ 7 & \text{indicator } i \text{ mightily more important than } j \\ 9 & \text{indicator } i \text{ is extremely more important than } j \\ 2, 4, 6, 8 & \text{the condition between them} \end{cases} \text{ and } a_{ij}a_{ji} = 1 \dots \quad (1)$$

When we build the judgement matrix A, we want it to be a consistent matrix, which means that $a_{ij}a_{jk} = a_{ik}$. Because for consistent matrix, it has only one non-zero eigenvalue, with its corresponding eigenvector e. We can do normalization for e to make it become the weight vector. Sometimes we can use Ae to replace e, because e implies the rank of the importance of each indicator, but A has the information of the subjective judgement of vectors given by people, so Ae is a comprehensive consideration of them.

But most of time the judgement matrix we build is not consistent, in calculation, if the matrix satisfies the consistent test [4], we can approximately think that it's consistent. For a n-indicators judgement matrix A, we first calculate the weight vector e. First way [1] is the geometric mean way with $e_i = \frac{(\prod_{j=1}^n a_{ij})^{1/n}}{\sum_{i=1}^n (\prod_{j=1}^n a_{ij})^{1/n}}$ and the second way is the arithmetic mean way with $e_i = \frac{\frac{1}{n} \sum_{j=1}^n a_{ij}}{\sum_{i=1}^n \frac{1}{n} \sum_{j=1}^n a_{ij}}$. Then we can calculate the max eigenvalue $\alpha = \frac{1}{n} \sum_{i=1}^n \frac{(Ae)_i}{e_i}$ and $CI = \frac{\alpha - n}{n - 1}$. At last, we can calculate the $CR = \frac{CI}{RI}$ where RI could be found in sheet. If $CR < 0.1$, then we can regard A as a consistent matrix (Table 2).

Table 2. RI value

n	1	2	3	4	5	6
RI	0	0	0.58	0.90	1.12	1.24

Using this we can express the indicators in criterion layer in a sum of indicators in index layer. The final goal is to express the destination layer in a sum of indicators in index layer. We just need to build the judgement matrix between destination layer and the criterion layer, then express the destination layer in a sum of criterion layer, and finally replace the indicators of criterion layer in the expression by the sum of indicators in index layer. At last, we can get a expression like $D = \sum_{i=1}^m \mu_i C_i$, where C_i is the number of each indicator in index layer and $\sum_{i=1}^m \mu_i = 1$. Then we can use D as a score for ranking.

2.3 Conclusion

In this section we introduce two ways in data analysis and evaluating system. Factor analysis can summary the high dimension data into fewer factors. And AHP is useful to build a model for ranking. We can use these two methods to analysis the epidemic condition in different countries and rank them.

3 Data Process

3.1 Data Collection and Pre-process

Considering the factors that have something to do with the epidemic condition, there are two mainly aspects: economic data and health data. For the first part, we use the country profile data (in 2020) which includes some basic data of each country like population, national territorial area, GDP, the unemployment rate, labor force participation, urbanization rate and so on. This dataset also includes some interesting data like international trade, the rate of people using internet and the rate of people access to improved drinking water. For health data, we use the data from global health expenditure database. We select some indicators like current health expenditure/GDP, primary health care (PHC) expenditure per capita and so on. At last, we must delete some useless data, like the national territorial area, we believe that the relationship between of it and epidemic condition can be replace by the population density. Finally, we choose 23 indicators in economy and 13 indicators in health, denoted as $E_1, \dots, E_{23}, H_1, \dots, H_{13}$. Also, we need the data of confirmed number of coronaviruses in each country.

For these data, because they are not in the same dimension and order of magnitudes, we can do this transformation for each indicator: $E_{ij} = \frac{E_{ij} - \min_j E_{ij}}{\max_j E_{ij} - \min_j E_{ij}}$ (for health data we do the same thing and for convenience we don't use another symbol to refer to the data after transformation). This transformation avoids the problem that one data is small and another one is too big so when consider the variance the bigger data will obviously take a huge part and the smaller data may be neglect.

3.2 Extract the Economic Factors

First, we need to confirm the number of factors. The gravel picture (picture 3.1) and the variance contribution sheet (Table 3) tells us that we can select 7 factors [5, 6]. Because

they take 77.2% of the whole variance and in the gravel sheet the eigenvalue doesn't change too much after 7, thus we can use the first 7 factor to explain the whole variance well (Fig. 1).

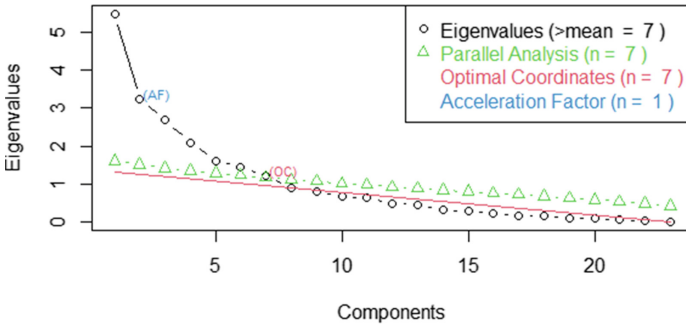


Fig. 1. Gravel sheet of economic factors

Table 3. Variance contribution sheet of economic factors

Factor number	1	2	3	4	5
Contribution rate (add up)	0.2384592	0.3790902	0.4953985	0.5863078	0.6564282
6	7	8	9	10	11
0.7193398	0.7720135	0.8112451	0.8461390	0.8746030	0.9021668
12	13	14	15	16	17
0.9230831	0.9422297	0.9557076	0.9674816	0.9771820	0.9843359
18	19	20	21	22	23
0.9903505	0.9937379	0.9969537	0.9989397	1.0000000	1.0000000

Then we use the factanal function in R language, we get the loadings of each factor on each indicator as picture 3.2

From the table we find that Factor 1 is mainly determined by E2 (Gross domestic product), E12 (International trade: Exports), E13 (International trade: Imports), E19 (CO2 emission estimates), so we can denote EF1(economical factor 1) as the production activity factor.

Factor 2 is mainly determined by E4 (Economy: Agriculture (% of GVA)), E8 (Employment: Services (% of employed)), E16 (Urban population (% of total population)), and E23(Pop. Using improved sanitation facilities (rural, %)), notice that it's negative correlation with E4 and E23, so we can donate EF2 as the urbanization factor (Fig. 2).

Factor 3 is mainly determined by E21 (Pop. Using improved drinking water (urban %)) and E22 (Pop. Using improved drinking water (urban, %)), denoted EF3 as the drinking water factor.

Loadings:

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7
[1,]			-0.171			0.623	0.110
[2,]	0.933			-0.217			
[3,]	0.112	0.256	0.187			0.931	0.102
[4,]		-0.857	-0.296		0.284	-0.195	
[5,]		0.329					-0.883
[6,]		0.444	0.218		-0.138	0.177	0.762
[7,]	0.107	0.426	0.415		0.274		-0.248
[8,]	0.130	0.560	0.426		0.375		
[9,]		0.232			0.166	-0.226	
[10,]					0.761		
[11,]		0.112			0.957	-0.179	-0.169
[12,]	0.946		0.126	0.248		0.128	
[13,]	0.974		0.130			0.133	
[14,]	-0.121			0.988			
[15,]				0.940			
[16,]	0.114	0.499	0.234			0.399	
[17,]			0.170		0.170	0.148	0.155
[18,]	0.403			-0.105	0.138	-0.124	
[19,]	0.792						
[20,]		0.278	0.341			0.414	-0.186
[21,]		0.277	0.814				0.113
[22,]		0.263	0.946				0.135
[23,]		-0.667	-0.168		-0.130		

Fig. 2. Loadings of economic factors.

Factor 4 is mainly determined by E14 (International trade: Balance (million US\$)) and E15 (Balance of payments, current account (million US\$)), denoted EF4 as the international trade balance factor.

Factor 5 is mainly determined by E10 (Labour force participation (female pop. %)) and E11 (Labour force participation (male pop. %)), denote EF5 as the labour force factor.

Factor 6 is mainly determined by E1 (Population density (per km2, 2017)), E3(GDP per capita (current US\$)), E20 (Energy production, primary (Petajoules)), denoted EF6 as the residents live factor.

Factor 7 is mainly determined by E5 (Economy: Industry (% of GVA)) and E6 (Economy: Services and other activity (% of GVA)), denoted EF7 as the service economy factor.

So after we calculate the score of each factor of economy, we can finally calculate the economy score of each country with $EconomyScore_i = \sum_{j=1}^7 CountryFactorScore_{ij} * f_j$, where $CountryFactorScore_{ij}$ is the country i's score on Factor j, and f_j is the contribution rate of the Factor j. We can do a rank every country by their economy score, here are the first ten (Table 4) and the last ten country (Table 5, 6).

From the list we can find some facts about the country which are good or bad in economy score. For example, China obtains a high score in EF4 (the international trade balance factor), showing that China is active in the international trade, exporting lots of things. Also, China gets a high score in EF5 (the labour force factor), which means that Chinese labor market is developing well, also we notice that some low economy score country also get a high score on this factor. Another thing worth notice is that the first ten country all obtain a high score in EF3 (the drinking water factor), supporting that many rich countries are all focus on how to provide healthy living condition for residents.

Table 4. First ten countries in economy score

Country	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Final score
United States of America	4.056347	2.561041	3.165842	-0.16765	1.524353	1.135001	0.689011	2.172198
China	3.477696	1.848282	2.214544	2.042822	1.661118	0.470503	-0.1304	1.917768
Germany	1.750401	2.343112	2.931263	1.776971	1.438525	0.877654	0.377335	1.751035
Japan	1.344656	2.364702	2.893078	1.338309	1.379365	0.825549	0.438064	1.594887
Netherlands	0.965547	2.346862	2.863352	1.31229	1.460495	0.895529	0.633573	1.535772
Iceland	0.614146	2.466401	3.096354	1.119835	1.749448	1.201209	0.358199	1.528713
Canada	1.106123	2.357133	2.883	1.08486	1.545965	0.855281	0.406714	1.526785
Qatar	0.761535	2.650802	3.113888	1.260686	1.754879	1.16455	-0.48895	1.52392
United Kingdom	1.172604	2.320515	2.871487	0.815111	1.447502	0.850206	0.680049	1.515316
France	1.141932	2.307994	2.836514	1.068734	1.340798	0.771941	0.655885	1.50852

Table 5. Last ten countries in economy score

Country	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Final score
Niger	0.103903	0.234572	0.597158	1.125608	1.610829	-0.08226	0.054399	0.482861
Tuvalu	0.052926	0.128643	1.479413	1.124257	-0.26116	0.298337	0.750979	0.472494
Chad	0.107861	0.426362	0.43888	1.155317	1.588244	-0.08259	-0.20103	0.466659
Central African Republic	0.095838	0.169288	0.496932	1.153939	1.663377	-0.08994	0.020309	0.461051
Sierra Leone	0.094953	-0.0619	0.316634	1.138603	1.575615	-0.07748	0.015897	0.384749
Kiribati	0.028227	0.296101	0.792245	1.128075	-0.09599	0.239917	0.479138	0.378016
Dominica	0.034818	0.561244	0.271248	1.123344	-0.08495	0.421315	0.448123	0.363263
Saint Kitts and Nevis	0.030068	0.59383	0.279737	1.116063	-0.06614	0.392045	0.292412	0.351157
Liberia	0.054281	-0.58714	0.287162	1.134616	1.573983	-0.14013	0.042259	0.280435
South Sudan	-0.00561	0.274401	0.217053	1.157384	-0.02604	0.125688	-0.29339	0.202495

3.3 Extract the Health Factor

We do the same thing for the health indicators. From the gravel picture and the variance contribution sheet we decide to use 4 factors (Fig. 3).

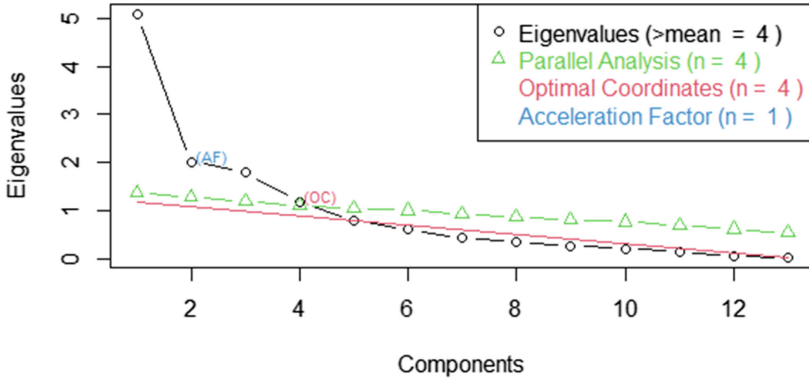


Fig. 3. Gravel sheet of health factors

Table 6. Variance contribution sheet of health factors

Factor number	1	2	3	4
Contribution rate (add up)	0.3910042	0.5463978	0.6847321	0.7756556
5	6	7	8	9
0.8377748	0.8849852	0.9180506	0.9448789	0.9655971
10	11	12	13	
0.9816063	0.9934631	0.9972959	1.0000000	

Then we use the factanal function in R language, we get the loadings of each factor on each indicator (Fig. 4).

```

Loadings:
      Factor1 Factor2 Factor3 Factor4
[1,]           0.866
[2,] -0.432   0.515
[3,] -0.708  -0.116           0.107
[4,]           0.232
[5,]           0.891   0.445
[6,]           0.792
[7,]           0.994
[8,]  0.965  -0.106
[9,]  0.972  -0.151
[10,] -0.664  0.422
[11,]  0.872  -0.179
[12,] -0.122  0.887
[13,] -0.607  0.299
    
```

Fig. 4. Loadings of health factors.

Factor 1 is positive correlation with H8 (Fertility rate, total (live births per woman)), H9 (Population age distribution (0–14years, %)), and H11 (Infant mortality rate (per 1000 live births), and negative correspond with H3 (Domestic Health Expenditure (DOM) as % of Current Health Expenditure (CHE)), H10 (Population age distribution (60 + years, %)), H13 (Health: Physicians (per 1000 pop.)). In conclusion this factor is positive correlation with living young child number and dead infant number, negative correlation with domestic health condition, denoted it as fragile child factor. This factor is a bad factor, so when calculate the final score we need to change this factor into negative.

Factor 2 is mainly determined by H1 (Current Health Expenditure as % Gross Domestic Product), H2 (Current Health Expenditure per Capita), H12 (Health: Total expenditure (% of GDP)), so this factor directly refers to the cost on health, denoted as the health cost factor.

Factor 3 is mainly determined by H3 (Domestic Health Expenditure (DOM) as % of Current Health Expenditure (CHE)) and H7 (Domestic General Government Expenditure on Tuberculosis (TB)), denoted as the domestic health expenditure factor.

Factor 4 is mainly determined by H6 (Domestic Private Expenditure on Governance, health system & financing administration), denoted as the government health expenditure factor.

Also we can calculate the final health score of each country, and rank them. We still list the first ten and the last ten countries in Table 7, 8 and 9.

Table 7. First ten countries in health score

Country	Factor1	Factor2	Factor3	Factor4	Final score
United States of America	-1.32039	2.324331	-0.05573	0.118271	1.165543
Switzerland	-1.5428	1.874086	-0.04252	0.103661	1.161887
Germany	-1.48836	1.674688	-0.02974	0.114704	1.092782
Austria	-1.48824	1.612122	-0.01685	0.117408	1.080621
San Marino	-1.63053	1.158218	0.00588	0.117341	1.042448
Japan	-1.40519	1.534734	-0.04185	0.111806	1.018246
Sweden	-1.31946	1.654133	-0.02625	0.113568	1.010462
Norway	-1.35865	1.579548	-0.02681	0.10455	1.009733
Denmark	-1.30724	1.548718	-0.02782	0.111828	0.979154
Cuba	-1.30538	1.453604	0.022225	0.128419	0.967215

Table 8. Last ten countries in health score

Country	Factor1	Factor2	Factor3	Factor4	Final score
Benin	1.574781	-0.04743	0.054733	0.095681	-0.71803
Burundi	1.79469	0.315388	0.050096	0.094963	-0.73392
Uganda	1.82333	0.271476	0.09094	0.108574	-0.74813

(continued)

Table 8. (continued)

Country	Factor1	Factor2	Factor3	Factor4	Final score
Niger	1.794061	0.170625	0.069141	0.128087	-0.76109
Mozambique	1.917241	0.401683	0.033562	0.041601	-0.77854
Central African Republic	1.972083	0.342389	0.044894	0.060293	-0.81389
Democratic Republic of the Congo	1.914348	-0.06332	0.08611	0.110284	-0.87091
Mali	1.988476	0.086288	0.063406	0.094875	-0.87547
South Sudan	1.965195	0.081256	0.041124	0.040905	-0.87577
Chad	1.902782	-0.13335	0.070564	0.121373	-0.88428

Notice that the first ten country all have a very low score for HF1 (fragile child factor), conversely the last ten country obtain a high score on it. This shows that some high-development countries are facing the aging problem, while other countries have higher birthrate but don't have enough health condition to take good care of the young child. HF2 (the health cost factor) also shows a great difference between the first and last ten country, that's obvious because the more money spent on health, the health condition will be better. But HF3 and HF4 don't show a great different, which means in all the countries that the families and the governments both attach importance to the health problem.

3.4 Extract Covid-19 Factors

Unlike the former data pre-process, we can't just simply use the confirm number or the death number to do the pre-process because the population number are different hugely among different countries. So, we use another method. Let $C_1 = \frac{ConfirmedNumber}{Populaton}$, $C_2 = \frac{Deathnumber}{ConfirmedNumber}$, $C_3 = \frac{Recovernumber}{Confirmednumber}$, $C_4 = \frac{Seriousnumber}{Confirmednumber}$. And we should also do the same transformation like other two. We consider these four indicators. From the gravel picture, we see that one factor is enough but the variance contribution sheet shows that one factor only accounts for 39% of the total variance. So we decide to directly use these four factors (Fig. 5).

3.5 Build the Analytic Hierarchy Model

Through the steps before we have successfully selected the index layer of the analytic hierarchy model. For the destination layer, we choose D to represent the general performance during the corona virus period, the higher D means the country performs better. Now we have to determine the criterion layer. We decide to choose two economy factor and one health factor and one covid factor. For the two economy criterions, we notice that E1, 2, 4, 5 is related to the country economy, and E3, 6, 7 are related to residents. So, we select the Country Economy Factor and Resident Economy Factor.

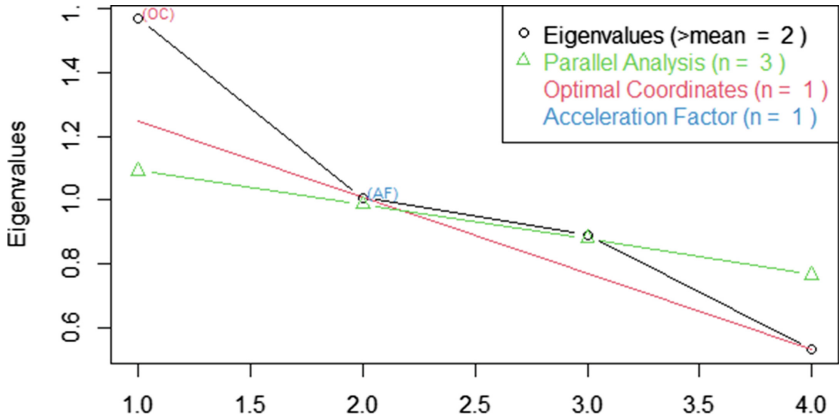


Fig. 5. Gravel sheet of covid-19 factors

Table 9. Detail of analytic hierarchy model

Destination	Criterion	Index
Rank of each country (D)	Country Economy Factor (Ea)	EF1 the production activity factor
		EF2 the urbanization factor
		EF4 the international trade balance factor
		EF5 the labour force factor
	Resident EconomyFaactor (Eb)	EF3 the drinking water factor
		EF6 the residents live factor
		EF7 as the service economy factor
	Health Factor (H)	HF1 the fragile child factor
		HF2 the health cost factor
		HF3 the domestic health expenditure factor
		HF4 the government health expenditure factor
	Covid Factor (C)	C1 the confirm rate
		C2 the death rate
		C3 the recovering rate
		C4 the serious rate

For the judgement matrix between Ea and EF1, 2, 4, 5, we think that EF1, 4 are more important. So we denote the $A_{E_a} = \begin{pmatrix} 1 & 3 & 1 & 5 \\ 1/3 & 1 & 1/3 & 3 \\ 1 & 3 & 1 & 5 \\ 1/5 & 1/3 & 1/5 & 1 \end{pmatrix}$, using the geometric mean

method we calculate that $CR = 0.016067$ with $e = (0.39, 0.15, 0.39, 0.07)^T$, so this result satisfies the consistent test.

For the judgement matrix between Ea and EF3, 6, 7, we think the importance rank is $E6 > E7 > E3$. So, we denote the $A_{E_b} = \begin{pmatrix} 1 & 1/3 & 1/2 \\ 3 & 1 & 2 \\ 2 & 1/2 & 1 \end{pmatrix}$, using the geometric mean

method we calculate that $CR = 0.007933$ with $e = (0.16, 0.54, 0.3)^T$, so this result satisfies the consistent test.

For the judgement matrix between H and HF1, 2, 3, 4, we think that HF2, 4 are more important, and HF3 is more important than HF1. So we denote the $A_H = \begin{pmatrix} 1 & 1/5 & 1/2 & 1/6 \\ 5 & 1 & 3 & 1/2 \\ 2 & 1/3 & 1 & 1/4 \\ 6 & 2 & 4 & 1 \end{pmatrix}$, using the geometric mean method we calculate that $CR = 0.01257$

with $e = (0.07, 0.31, 0.12, 0.5)^T$, so this result satisfies the consistent test.

For the judgement matrix between C and C1, 2, 3, 4, They all infer something important when dealing with virus, but we think that C1, 3 is more important. So, we

denote the $A_C = \begin{pmatrix} 1 & 2 & 1 & 3 \\ 1/2 & 1 & 1/2 & 2 \\ 1 & 2 & 1 & 3 \\ 1/3 & 1/2 & 1/4 & 1 \end{pmatrix}$, using the geometric mean method we calculate

that $CR = 0.003836$ with $e = (0.35, 0.19, 0.35, 0.11)^T$, so this result satisfies the consistent test.

For the judgement matrix between D and Ea, Eb, H, C, we think that H,C are more important than Ea and Eb because they directly relate to the virus condition. And Ea is more important than Eb when considering the country. So we denote the

$A_D = \begin{pmatrix} 1 & 1/2 & 1/2 & 1/2 \\ 2 & 1 & 1/3 & 1/3 \\ 2 & 3 & 1 & 1/2 \\ 2 & 3 & 2 & 1 \end{pmatrix}$, using the geometric mean method we calculate that $CR =$

0.079569 with $e = (0.13, 0.15, 0.30, 0.42)^T$, so this result satisfies the consistent test.

Finally, we have the expression of calculating D.

$$\begin{cases} D = 0.13E_a + 0.15E_b + 0.3H + 0.42C \\ E_a = 0.39EF1 + 0.15EF2 + 0.39EF4 + 0.07EF5 \\ E_b = 0.16EF3 + 0.54EF6 + 0.3EF7 \\ H = -0.07HF1 + 0.31HF2 + 0.12HF3 + 0.5HF4 \\ C = -0.35C1 - 0.19C2 + 0.35C3 - 0.11C4 \end{cases} \dots (2)$$

So, we can calculate D for each country and rank them. We select the first fifteen country and the last fifteen country in Table 10 and 11.

Table 10. First ten countries in final score

Country	Ea	Ea rank	Eb	Eb rank	H	H rank	C	C rank	D	D rank
United States of America	2.007452	2	1.326139	3	0.865418	1	0.057891	167	0.743829	1
Germany	1.827839	3	1.056136	15	0.677122	4	0.229571	94	0.695596	2
Japan	1.497617	4	1.040108	18	0.625012	8	0.321018	21	0.673038	3
China	2.546522	1	0.569278	89	0.279332	73	0.310663	37	0.630717	4
Switzerland	1.267473	13	1.123204	8	0.73569	3	0.172891	128	0.626574	5
Canada	1.316271	8	1.045146	17	0.578363	15	0.264946	61	0.612674	6
Iceland	1.168674	25	1.251529	4	0.538065	23	0.25903	64	0.609869	7
Australia	1.268592	12	1.035385	19	0.539516	22	0.283571	56	0.601179	8
Republic of Korea	1.362538	6	0.906541	27	0.545268	20	0.296184	49	0.601089	9
Denmark	1.145985	27	1.119378	10	0.624185	9	0.221906	101	0.597341	10
France	1.302215	10	1.067456	14	0.615766	10	0.168252	131	0.584802	11
Sweden	1.174831	24	1.086994	12	0.658778	6	0.162287	136	0.581571	12
Netherlands	1.342621	7	1.131793	6	0.604405	12	0.128188	148	0.57947	13
Belgium	1.253109	15	1.141939	5	0.584743	13	0.119064	151	0.559625	14
Italy	1.273016	11	0.928408	26	0.561394	18	0.2046	112	0.559103	15

Table 11. Last ten countries in final score

Country	Ea	Ea rank	Eb	Eb rank	H	H rank	C	C rank	D	D rank
Vanuatu	0.729166	155	0.402831	123	0.049449	150	0.111651	154	0.216945	172
Peru	1.032627	60	0.534684	100	0.187112	104	-0.13309	185	0.214681	173
Uganda	0.702703	161	0.067721	172	0.021724	158	0.252388	74	0.21403	174
Mali	0.678799	164	0.106295	167	-0.0574	180	0.301494	46	0.213596	175
Kiribati	0.488654	182	0.400056	124	0.245007	81	0.022938	174	0.206669	176
Congo	0.885479	118	-0.07408	186	-0.01705	171	0.231301	91	0.196032	177
Chad	0.667771	168	-0.03469	185	-0.10538	186	0.320703	23	0.184689	178
South Sudan	0.488531	183	0.014583	182	-0.08699	183	0.331558	14	0.178855	179

(continued)

Table 11. (continued)

Country	Ea	Ea rank	Eb	Eb rank	H	H rank	C	C rank	D	D rank
Democratic Republic of the Congo	0.761359	148	0.060961	175	-0.08816	184	0.231301	92	0.178819	180
Lao People's Democratic Republic	0.791737	140	0.299915	137	0.001438	166	0.041293	171	0.165688	181
Tonga	0.823374	132	0.399776	125	0.084243	143	-0.07775	184	0.159621	182
Nauru	0.823403	131	0.193943	156	0.107335	137	-0.06795	182	0.139795	183
Burundi	0.632956	174	0.167338	160	0.025635	157	0.010325	175	0.119412	184
United Republic of Tanzania	0.755829	149	0.04063	178	0.006495	163	-0.06946	183	0.077127	185
Central African Republic	0.629243	176	0.037037	180	0.003629	164	-0.04745	181	0.068515	186

3.6 Conclusion

In this part we use the factor analysis method and build the analytic hierarchy model evaluate the performance of each country. For the economy condition, we summary 23 indicators of economy during the outbreak into 7 economy factors, 4 of them are related to the government economy, 3 of them are related to the residents. For the health condition, we extract 4 main factors, refers to government of domestic expenditure on health. For the virus condition, we directly use the rate. Then we use the factors as the index layer of the analytic hierarchy model, build this model with a four-factor criterion layer. We than use this model to calculate the score of each country and rank them.

An interesting fact we find is that the first fifteen countries don't rank high in D, which means the epidemic in their countries are kind of serious. A good example is the United States of America, it even ranks 167 in 186 countries. But America ranks first in the health criterion, and also good in economy. So, we can know that during the outbreak America is still try to keep the economy going and treat patients based on its high-developed medical system. Another example is China, although China doesn't rank high in Eb and H, because the huge number of populations makes it hard to take care of every person in epidemic, but as one of the origins of virus, China still ranks 37 in D. That's because China makes fast and effective method at the beginning, successfully controlling the epidemic. Actually, the countries ranking high in D are mostly some small countries which are not so strongly affected by virus, in fact we can not consider them in ranking, but we still need them when doing factor analysis in order to make the factor we choose more convincing.

For the last fifteen countries, they are mostly countries in Africian and Middle East, these places are always with high population density and high temperature, which are both beneficial to the spread of virus. And those countries also rank low in Ea, Eb, and H, means that their economy condition and medical system are too poor to defend the epidemic.

In conclusion, the countries that perform well in epidemic are equipped with well economy condition and well-development medical system. Also, their government should make choices to avoid the spread of virus as soon as possible. Some countries in African and Middle East are facing the serious condition, other countries should try to help them.

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Criminal Law Protection of Citizens' Personal Information – From the Perspective of New Cyber Fraud in the Era of Artificial Intelligence

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Abstract. In recent years, modern communication and internet technologies have been rapidly upgraded. Under this background, the protection of citizens' personal information is facing more severe challenges. At present, the phenomenon of stealing citizens' personal information through network means and then implementing new network fraud emerges one after another, and other related criminal phenomena are also frequent, causing great harm to citizens and even society. It is necessary to punish the violation of citizens' personal information from the perspective of criminal law to reduce the risk of online fraud caused by the disclosure of personal information, and then realize the effective prevention of various types of related crimes. From the perspective of new online fraud, this paper focuses on the criminal law protection of citizens' personal information, analyzes and explores the deficiencies under the current legal system and puts forward corresponding countermeasures to curb the new online fraud crime, safeguard people's property safety and restore social stability.

Keywords: Personal information · Criminal law protection · New online fraud · Crime of infringing upon citizens' personal information

1 Introduction

With the development of social science and technology, the crime of infringing citizens' personal information has become increasingly serious. In recent years, it has even developed to a rampant level. A series of crimes such as fraud are caused by the disclosure of citizens' personal information. The advent of the era of artificial intelligence has also spawned new online fraud using artificial intelligence, such as forwarding WeChat voice to carry out fraud, voice synthesis to carry out fraud, using AI to change faces to carry out fraud, and using AI technology to screen fraudsters to carry out fraud, etc. National security, social property, personal property and privacy of citizens are all threatened by the intrusion of artificial intelligence into the traditional Internet to a certain extent. Judging from the social reality, the personal information security of citizens is closely related to the telecom network fraud. Therefore, it is urgent to strengthen the criminal law protection of the personal information security of citizens.

2 Overview of New Online Fraud

2.1 The Concept of a New Online Fraud

Internet fraud refers to the act of taking illegal possession as the purpose, taking the Internet as the carrier, and using various forms of computer viruses, phishing, violent cracking, social engineering and network attacks to defraud other people's property.¹

The new online fraud referred to in this article refers to the behavior that the actor uses the internet technology, uses the criminal means closely related to the internet characteristics, such as artificial intelligence technology and other fictitious facts, conceals the truth, and swindles a large amount of public or private property from a specific or unspecified majority of people in non-contact communication software and mobile payment terminals. The essence of such fraud is the extension of the traditional fraud crime in the internet information age.

2.2 The Characteristics of the New Online Fraud

Deception of Purpose. The new online fraud has its own characteristics of fraud. The subject of the behavior must have the psychological state of taking illegal possession as the purpose, obtaining other people's property by cheating, and realizing the result of the crime through the behavior.

Network Availability. Network plays an important role in (new) online fraud. According to the virtual, hidden and open nature of the network itself, fraud is more harmful than traditional fraud. The attribute of the network itself directly leads to the low cost of crime, fast speed and wide range of dissemination, and it is difficult to detect and fix evidence.

Diversity of Forms. With the gradual increase of openness and transparency of network communication, interpersonal trust relationships that are difficult to establish in the Internet can be formed even if both parties have not previously interacted or experienced. The advent of the era of big data or artificial intelligence has provided a large number of different criminal means for the perpetrators of new online fraud.

Immediacy of Property Transfer. In the new online fraud, the property loss is usually a set of data, not the loss in kind, and the transfer of possession is usually only between one thought and another. With the help of online fraud by electronic means of payment, the perpetrator can transfer the property by himself or by the victim in a more hidden way.

¹ Feng Qianjin: "On the Countermeasures to Contain the Crime of Internet Fraud", in Information Network Security, 2008, No. 4, p. 32.

2.3 The Necessary Means of New Online Fraud

In recent years, the extensive application of information technology has made our production and life more efficient and convenient, and has also provided convenient conditions for criminals to use information technology to commit crimes. The new online fraud takes the use of citizens' personal information to carry out "accurate" fraud as a necessary means. The perpetrator must obtain the victim's information illegally first, and then carry out various fraud activities based on the victim's information, and finally achieve the purpose of seeking illegal gains. For the fraud crime, obtaining the basic information of the parties is very important to the implementation of the crime, especially for the traditional telecom fraud and the new online fraud. Stealing and using personal information has become a key link in the criminal process.

According to relevant research, the proportion of telecommunication fraud involving personal information is extremely high, accounting for over 70% of the total number of telecommunication fraud crimes². Among them, the typical fraud is to forge the identity of the public security organs, or to pretend to be leaders, friends and so on. Criminals can not carry out fraud without mastering the personal information of the parties.

As a "successor", the new online fraud has a strong demand for personal information, which also constantly induces the occurrence of cases of personal infringement of citizens in the upstream. The two are mutually dependent and closely related. The perpetrator obtains various kinds of personal information and data through various black channels, or illegally purchases tens of thousands of citizens' personal information directly through the Internet, and then performs operations such as screening and correlation on the data by using artificial intelligence methods. By providing the accurate identity information of the victim, the perpetrator obtains the trust of the victim, and finally relies on artificial intelligence technology to carry out accurate fraud, repeatedly completing fraud with low illegal cost, high detection difficulty and high crime proceeds, so as to achieve the purpose of implementing fraud crime. The key element in the implementation of the new online fraud is to obtain the information of the victims. Therefore, if we want to control this type of fraud from the source, the first measure is to use national power to protect personal information security.

3 Current Situation of Criminal Law Protection of Citizens' Personal Information

3.1 The Security Issues of Citizen's Personal Information

In 2017, the Supreme People's Court and the Supreme People's Procuratorate (hereinafter referred to as the "Two Supreme") officially issued the "Interpretation on Several Issues Concerning the Applicable Law in Handling Criminal Cases of Infringement of Citizens' Personal Information" (hereinafter referred to as the "Interpretation"), which

² Tao Maoli and Wang Zecheng: "Research on the Protection Mechanism of Personal Information in the Age of Big Data", in *Intelligence Exploration*, No. 1, 2016, p. 16.

clarifies the concept of citizens' personal information.³ In recent years, with the promulgation and implementation of the Civil Code and relevant judicial interpretations, citizens' personal information has been protected to a higher level from the legal level. However, in practice, the phenomenon of infringing citizens' personal information emerges one after another, and it is facing more severe challenges under the background of the development of Internet information technology. Among them, the outstanding issues concerning citizens' personal information security at this stage can be summarized as follows.

Management Confusion of Citizens' Personal Information. Under the background of the information age, the media of personal information storage has undergone a fundamental change and the ways of using personal information have been greatly expanded. Nowadays, electronic storage and resource sharing are widely used in daily life. On the contrary, the process of personal information protection is extremely sluggish.⁴ The lack of personal information protection system has become a real problem that needs to be solved urgently. Some subjects have not taken up their due responsibilities and have adopted an indifferent attitude towards personal information protection. In terms of information collection and use, there is a widespread phenomenon of excessive collection and disorderly use in all sectors of society. The lack of citizen's awareness of personal information protection, not only providing personal information to unqualified units and individuals at will, but also not paying attention to encrypting personal information when using social networks. There are also defects in the protection of personal information of government agencies. Most of the office units have problems of aging systems and simple technology. As a result, the information held by the government is extremely vulnerable to network attacks and is used by criminals.

It is Difficult to Cut off the Black Industrial Chain. Violation of citizen's personal information can bring huge economic benefits to the criminals. In order to seek illegal gains, the transaction of citizen's personal information is forbidden repeatedly. Its black industrial chain has a long history and is difficult to cut off. The black industry chain consists of different main roles, among which hackers and those who have the conditions to obtain information are responsible for stealing the information and providing them with a black platform to trade personal information. Then criminals use such personal information to commit fraud and related crimes, thus forming a criminal chain.⁵ If an attempt is made to completely ban such acts of infringement of citizens' personal information, it can not be separated from the cooperation of various departments. It

³ "Interpretation on Several Issues Concerning the Applicable Law in Handling Criminal Cases of Infringement of Citizens' Personal Information" Article 1: Citizens' personal information refers to various kinds of information recorded electronically or otherwise that can identify the identity of a specific natural person or reflect the activities of a specific natural person, either alone or in combination with other information, including name, ID number, communication and contact information, address, account number, property status, track of whereabouts, etc.

⁴ Zhang Lanting: "Social Value and Strategic Choice of Big Data", Ph.D. Thesis of the Party School of the CPC Central Committee in 2014.

⁵ Lu Changgui: "Research on Crimes of Illegal Sale of Personal Information and Countermeasures", in *Public Security Research*, No. 12, 2013, p. 36.

requires the public security organs and other departments responsible for supervision to take joint actions to effectively improve the management system of citizens' personal information and reduce the occurrence of illegal leakage. In addition, individual citizens should also keep their own identity information and not give criminals an opportunity to take advantage of it.

High Incidence of Crimes Against Personal Information. Over the past period of time, China's public security organs have launched a series of special campaigns against criminal activities that infringe upon citizens' personal information, and achieved remarkable results. The Ministry of Public Security held a press conference on June 17, 2021 to introduce that from January to May 2021, the public security organs have cracked 114,000 cases of telecommunication network fraud, knocked out more than 14,000 criminal gangs, investigated and dealt with those involved and enterprises in accordance with the law, successfully dissuaded 7.71 million people from being cheated, and saved 99.1 billion yuan of economic losses for the masses. Compared with the past, the number of such cases filed has been kept at a certain level.⁶ As is known to all, in practice, the phenomenon of infringing citizens' personal information is very high, and generally presents the characteristic of extremely strong concealment. Citizens' personal information is often obtained and used by network hackers and relevant units and individuals who have mastered the information, which brings difficulties to investigate and deal with such cases. However, although the public security organs insist on both prevention and prevention, with outstanding results, crimes against personal information in our country are showing a high incidence trend at the current stage.

3.2 The Legal Protection of Citizens' Personal Information

At present, the legal protection of citizens' personal information can be divided into general protection and criminal law protection.

General Protection. For the general protection of citizens' personal information, its protection is mainly based on other legal norms other than the criminal law. At present, there is no specific legislation on the protection of personal information in our country, and the Personal Information Protection Law is still in the formulation stage. On the whole, the relevant legal basis for the protection of personal information is scattered in various legal norms and generally presents the characteristics of fragmentation. In this regard, the relevant provisions in the Constitution give a general description of the requirements for the protection of personal information in terms of principles. In addition, some provisions in the civil code, cyber security law and other legal norms also cover the protection of personal information. However, there is no denying the fact that the protection in the above legal norms is still inadequate, especially in terms of cohesion, coordination and unification of the provisions, which have not achieved satisfactory results.

⁶ Ministry of Public Security: 114,000 cases of telecommunication network fraud were uncovered in the first five months of this year, http://www.chinapeace.gov.cn/chinapeace/c100007/2021-06/18/content_12500475.shtml.

Criminal Law Protection. In the aspect of punishing crimes against personal information, the criminal law provides the citizens with a blanket guarantee. The special provisions on the protection of personal information in the criminal law have not been for a long time. It has also experienced a specific stage of development and perfection. On February 28, 2009, the Standing Committee of the National People's Congress deliberated and passed the Criminal Law Amendment (7), adding a paragraph after Article 253 of the Criminal Law, incorporating personal information security into the protection vision of the Criminal Law, and establishing the crimes of selling and providing citizens' personal information and illegally obtaining personal information. The addition of this provision has become the first appearance of personal information protection in China's criminal law, and has improved the long-term absence of personal information protection, which is of great positive significance. Since then, in order to adapt to the new situation in practice, and make adjustments in combination with the application of this provision to enhance the protection of personal information, the Criminal Law Amendment (9) promulgated in 2015 has revised this provision, and the crime of "infringement of citizens' personal information" has been formally clarified.

The Necessity for Criminal Law Protection. As mentioned above, the current problem of personal information insecurity of our citizens is still relatively prominent. In recent years, new online fraud cases have been occurring frequently and frequently, seriously infringing on the property safety and legitimate rights and interests of the people, undermining social integrity and affecting social harmony and stability. In addition, the citizens' current legal consciousness is not very strong, and the various network behaviors they participate in can enable citizens to disclose personal information under the condition of unconsciousness, while criminals can identify and integrate the citizens' personal information, thus outlining the basic situation of citizens. This phenomenon is common. In practice, many fraud crimes committed by using citizens' personal information have also occurred, which have caused serious damage to the rights and interests of citizens and even the interests of society as a whole. At the same time, as can be seen from the above discussion on the general provisions on the protection of citizens' personal information, there is no specific legislation on the protection of citizens' personal information in our country at present. It is scattered in various legal norms, and there is no good cooperation between them. As a result, citizens are difficult to safeguard their rights and interests through legal means when their personal information is infringed, and the imperfection of legislation is also detrimental to the protection of citizens' personal information. As a result, it is difficult and inefficient for personal information to be infringed, which leads to the rampant crime of infringing citizens' personal information in practice. It is urgent to regulate it by various means. In the future development, the importance of citizens' personal information is self-evident, so it is more necessary to pay more attention to its protection. In view of the frequent occurrence of telecommunication fraud and network fraud in current practice, it is also necessary to combine the content of personal information protection to prevent the above-mentioned crimes from the source. Therefore, in order to achieve this goal, it is very necessary and urgent to use the national power to protect the personal information security. On the basis of perfecting the relevant criminal law protection, it is necessary to protect the rights and interests of citizens and make the society develop healthily and steadily.

4 Difficulties in Criminal Law Protection

4.1 The Lack of a Complete Premise of Administrative Legal Sanctions

At present, when dealing with the violation of citizens' personal information in practice, there is no good connection between administrative and criminal sanctions in dealing with the means.⁷ "Public Security Administration Punishment Law", as the convergence of the Criminal Law, punishes illegal acts of public security administration under the non-crime boundary. Its punishment measures, disposal procedures and other aspects should be effectively converged and coordinated with the Criminal Law. However, the Public Security Administration Punishment Law does not take the violation of citizens' personal information as the measure of administrative illegal behavior, which makes the two kinds of crimes stipulated in Article 253 of the Criminal Law of our country become atypical administrative criminals, and also makes the provision in Article 7 of the Criminal Law Amendment (7) become a rather embarrassing legislation under the era of statutory crimes.⁸

4.2 The Relevant Provisions of the State are not Clearly Defined

Although our country's criminal law stipulates "the crime of violating citizens' personal information", which provides a basis for punishing the criminal acts related to citizens' personal information, looking at this provision, it still has the problem of unclear definition, which also brings obstacles to its application in practice. The main reason for this obstacle is the adoption of blank counts in the provision, which requires that in the process of determining whether a crime constitutes such a crime, the first step is to determine whether the perpetrator "violates the relevant provisions of the state."⁹ This kind of stipulation not only causes the criminals to take advantage of the imperfect relevant documents, but also makes it difficult to achieve the purpose of punishment and prevention when the crime is actually executed, and even more difficult to achieve the purpose of legislators' sanctions against criminals. If the "relevant provisions of the state" can not be well explained, the smooth implementation of this provision will inevitably be affected. In addition, article 2 of the Interpretation expands the specific scope of "violation of the relevant provisions of the state" by the actor, which also brings doubts about its violation of the principle of a legally prescribed punishment for a specified crime and requires careful consideration.

⁷ Zhao Bingzhi: Research on Criminal Law Protection of Citizens' Personal Information, Journal of East China University of Political Science and Law, No. 1, 2014, p. 120.

⁸ Chu huaizhi: "to face up to the arrival of the era of statutory criminals", in "procuratorial daily" on June 1, 2007, 2nd edition.

⁹ Hu Jiang: "Limited Interpretation of" Violation of Relevant Regulations of the State "in the Crime of Infringement of Personal Information of Citizens-A Query on the Application of Article 2 of the Judicial Interpretation to the Law of Criminal Cases of Infringement of Personal Information", in Politics and Law, No. 11, 2017, p. 40.

4.3 The Objective Aspects of the Crime are Incomplete

In view of the behavior pattern of the crime of infringing citizens' personal information, the current criminal law and judicial interpretation of our country mainly stipulate illegal provision, sale, theft, purchase, etc. Such stipulation is not strict, and there are still some behavior patterns that are not included in the legal provisions. For example, some people obtain personal information through legal means but use it illegally. Therefore, it is necessary to improve the behavior that the objective aspects of the crime do not cover all, and to bring both the practical and potential means of behavior into the scope of the adjustment of the criminal law. Only in this way can we punish the various and endless criminal acts that infringe upon citizens' personal information, and we cannot leave out anything.

4.4 The Way of Criminal Responsibility Prosecution is not Reasonable

At the present stage, the criminal responsibility prosecution method adopted by our country for citizens' personal information crimes is public prosecution, which does not fully take into account the private rights nature of citizens' personal information rights and has certain irrationalities. There are various ways to infringe on citizens' personal information crimes, and the consequences are different according to the actual situation of the case. It is possible to commit related crimes such as fraud, and it is also possible to bring material losses and spiritual damages caused by information leakage to the parties. However, in criminal incidental civil actions, compensation for spiritual damages is very rare. It is very difficult to adapt to the complicated situation in practice if we only adopt the prosecution method of public prosecution, which is not conducive to the conservation of judicial resources, nor is it conducive to the comprehensive protection of personal information security and the proper resolution of social conflicts.

4.5 The Punishment of Related Crimes is not Strong Enough

In practice, many fraud crimes cannot be separated from the illegal acquisition and use of citizens' personal information. It is precisely because of stealing personal information that criminals can carry out accurate fraud based on such information. This kind of crime associated with the infringement of personal information, due to its prepositive and necessary means of implementation, has caused great harm and influence, which not only causes the infringement of citizens' property rights and interests, but also damages citizens' personal information. However, the investigation of such crimes also faces many obstacles. Due to the limitation of objective conditions, such cases often have strong concealment and cross-temporal characteristics, which leads to a sudden increase in the difficulty of investigation. If such crimes are not severely punished and the punishment on criminals is increased, it is difficult to deter criminals, and it is even more difficult to effectively prevent such crimes from the root. Therefore, the judicial organs should carefully consider the application of charges and the combination of punishment for several crimes, so as to make punishment the crime.

5 The Improvement Measures of Criminal Law Protection

As mentioned above, the criminal law provides a blanket guarantee for the protection of personal information, and its important role and significance are self-evident. At the present stage, the content of the protection of citizens' personal information in our criminal law is not fully mature, and is still in the process of continuous development and change. In this case, there are certain obstacles to the specific identification of crimes against citizens' personal information. At the same time, the criminal risks faced by those who legally use citizens' personal information have also increased objectively.¹⁰ In response, the following measures can be tried to effectively protect the personal and property safety of citizens and promote social stability and development.

5.1 The Establishment of Administrative Sanctions Premise

The "Interpretation" explains the "serious circumstances" of the crime of infringing citizens' personal information, which stipulates that if "an administrative penalty has been imposed within two years" and then various acts of infringing citizens' personal information as stipulated in the Criminal Law are implemented, they shall fall into the category of serious circumstances. At the same time, the Law on Administrative Penalties for Public Security does not stipulate the administrative penalties for violating citizens' personal information, and there is an obstacle of convergence between the two legal provisions, which is rather embarrassing.

In dealing with the violation of citizens' personal information, in order to solve the problem of unsmooth connection between administrative and criminal sanctions in the current legal provisions of our country, we must make adjustments and modifications to the administrative legal norms. We can refer to the relevant views of the academic circles, and impose penalties such as detention and fines on the acts violating citizens' personal information according to the different harm degrees.¹¹ In this way, by improving the punishment provisions in the administrative laws and regulations, and combining the provisions of the right of personality and the tort liability in the Civil Code, there will be a very sound accountability system for violations of citizens' personal information security, which can form a good interface between criminal, administrative and civil liabilities.

5.2 Limit the "Relevant Provisions of the State"

Article 2 of the "Interpretation" expands the specific scope of "violation of the relevant provisions of the state" by the actor, which also brings doubts about its violation of the principle of a legally prescribed punishment for a specified crime and requires careful consideration. Although the starting point of the "Interpretation" is to crack down on

¹⁰ See Jing Lijia: "The Necessary Turn of the Legal Interest of the Crime of Infringing Citizens' Personal Information in the Big Data Environment", in *Law Review* 2018, No. 2, p. 116.

¹¹ Ma Shenghua, Zhang Huiyun, et al.: "Judicial Determination of Crimes of Infringing Citizens' Personal Information", in *People's Procuratorate*, No. 14, 2017, p. 77.

crimes that infringe on citizens' personal information, it must meet the basic requirements of the principle of a legally prescribed punishment for a specified crime.

From a natural point of view, it is necessary to clarify the "violation of the relevant provisions of the state". Its basic scope should only include the national laws and administrative regulations, while the rest of the local regulations and norms should not fall within the scope stipulated in this article. In addition, the departmental regulations also need to be specifically determined based on their contents, among which the specific regulations for the implementation of the "national regulations" can be applied by reference. On the contrary, there is no possibility of application by reference. In other words, the definition of the specific category of "violation of the relevant provisions of the state" should only be limited to the national laws and regulations and some departmental rules. Such consideration is also in line with the basic situation of China's legislation and the actual need to combat crime. Besides, it is also a necessary choice under the principle of a legally prescribed punishment for a specified crime to limit its application.¹² At the same time, as the meaning of "relevant provisions of the state" is not explained in detail in our country's legislation, the judicial authorities need to interpret it in light of the actual situation. In the process of interpretation, it must be unified with the relevant provisions of the Constitution and the basic principles of the criminal law.

5.3 Expand the Criminal Behavior

At present, there are some acts of obtaining personal information by legal means but using it illegally in practice. It is not the behavior pattern of violating citizens' personal information as clearly stipulated in our country's criminal law, and there is a big defect in the investigation of criminal responsibility of such perpetrators. However, this kind of behavior is becoming more and more serious in practice, and it shows great social harmfulness. It is urgent to bring the behavior means appearing in practice and potential into the scope of adjustment of the criminal law, so as to provide due protection for citizens' personal information.

In this case, it is necessary to timely expand the criminal behavior stipulated in the current criminal law and its judicial interpretation. At this time, we can refer to the legislative experience of other countries or regions. For example, the criminal codes of Macao Special Administrative Region of our country and Germany respectively stipulate "the crime of using another person's secret" and "the crime of improper use of a secret" to specifically regulate the use of another person's personal information. Some scholars in our country have also pointed out that the illegal use of information should be clearly stipulated. For example, Professor Zhao Bingzhi proposed to add legal provisions to regulate the "illegal use" of information and to punish the illegal use of other people's information.¹³ If such perfection can be made in legislation, the protection of citizens' personal information will be greatly enhanced. At the same time, criminal acts committed

¹² See Liu Xianquan and Fang Huiying: "Re-analysis of the Conviction and Sentencing Criteria for Crimes of Infringement of Citizens' Personal Information", *Journal of East China University of Political Science and Law*, No. 6, 2017, p. 110.

¹³ Zhao Bingzhi: *Research on Criminal Law Protection of Citizens' Personal Information*, *Journal of East China University of Political Science and Law*, No. 1, 2014, p. 122.

by using other people's information will be investigated and dealt with in practice, thus protecting citizens and social public interests.

5.4 To Improve the Recourse Remedies

There is no doubt that citizens' personal information has the nature of private rights, so in terms of its protection, certain space should be given to private rights. There are many countries in the world that adopt private prosecution as the main form of prosecution and public prosecution as the auxiliary form of prosecution¹⁴ in dealing with citizens' personal information crimes, which is different from the single mode of prosecution in our country. In view of the acts of infringing citizens' personal information, they should be dealt with differently according to the specific circumstances of the acts. Public prosecution organs should prosecute serious criminal acts, while general acts of infringing citizens' personal information should be given room for private prosecution. Only in this way can judicial resources be saved and better protection be provided for citizens' personal information.

5.5 Severely Punish Downstream Related Crimes

At present, the internet fraud combined with the characteristics of the internet is more specific, which not only has the characteristics of infringing property rights and interests of general fraud, but also causes serious harm to the normal social management order and integrity system such as financial management and telecommunication management.

In the process of dealing with such crimes, there are many disputes on the number of crimes in judicial practice. Some scholars believe that this kind of criminal behavior should be dealt with as an absorption crime. Although it conforms to the behavior characteristics of the crime of violating citizens' personal information and the crime of fraud, it should be dealt with as only one crime in the end because it conforms to the handling situation of the absorption crime. However, the author believes that this view is untenable. For the actor, the purpose of the actor's fraud can be achieved through a variety of ways of behavior, and not only limited to the infringement of citizens' personal information, that is to say, the infringement of citizens' personal information is not necessary for the fraud. If one crime is adopted, it will lead to the inappropriate adverse consequences of the crime and punishment, which is not conducive to the prevention and punishment of this crime in practice. Looking at several typical cases released separately by the "two high schools", the "two high schools" tend to combine the crime of fraud with the crime of infringement of citizens' personal information for several crimes. The results of this kind of treatment can also echo the principle of suiting punishment with guilt. Punishing the related crimes of infringement of personal information severely can serve as a deterrent to criminals, increase the crackdown on the telecom network fraud that occurs frequently in practice. It also help to protect citizens' rights and interests, and establish a good social order at the same time.

¹⁴ Ji Pengfei: "On the Criminal Law Protection of Citizens' Right to Privacy in China", *Journal of Changchun Normal University*, No. 7, 2016, p. 37.

6 Conclusion

Modern communication and Internet technologies are rapidly upgrading. The advent of the 5G era has brought many conveniences to people's lives. However, while communication is more convenient and transparent, the protection of citizens' personal information is facing more severe challenges. At present, every major network platform can obtain and use citizens' personal information in a very convenient way. Internet carriers also bring potential dangers to the protection of citizens' personal information. As a result, the phenomenon of stealing citizens' personal information by using network means and then implementing new online fraud is very high, which is extremely harmful to the personal and property safety of citizens and the normal social order.

Therefore, it is necessary to punish the violation of citizens' personal information from the perspective of criminal law to reduce the risk of online fraud caused by the disclosure of personal information, so as to effectively prevent various types of related crimes. At this stage, it is urgent to continue to improve the relevant provisions of crimes against citizens' personal information in order to enhance the protection of citizens' personal information. Up to now, our country has successively enacted many amendments to the criminal law and judicial interpretations to explain the crime of infringing citizens' personal information, which to a certain extent provides a basis for punishing the criminal acts of infringing citizens' personal information. The Civil Code, which came into force this year, has clearly stipulated the protection of personal information and other aspects, and has built a more strict legal wall for it, in which answers can be found to various questions concerning citizens' personal information security. Is this authoritative and rigorous civil code not a "guide to life" in the information age? Since then, the protection of personal information has become more explicit and authoritative. However, if we want to keep improving, we must further strengthen the criminal law protection measures in this field, so that the criminal law norms in the protection of citizens' personal information can be more perfect. Specifically, we need to improve from the following aspects. On the one hand, we need to clarify the meaning of specific crimes, expand the criminal behavior of infringing citizens' personal information stipulated in the criminal law, and give specific explanations to "providing", "illegally obtaining" and "serious circumstances" for the purpose of establishing a unified standard in judicial practice. On the other hand, it is necessary to clarify the principles of dealing with the related crimes of violating citizens' personal information, conduct scientific research on the problem of the number of crimes, and clarify the basic standards of conviction and sentencing. Only in this way, through the realization of legislative, judicial and other aspects of the system improvement, can make our citizens' personal information protection into a new stage.

To sum up, in the current issue of citizen's personal information protection, we must combine the basic background of the Internet era to enhance citizens' awareness of information protection on the network platform, and at the same time complement it with scientific and technological protection power to protect citizens' personal information. In addition, we must establish a perfect legal system for citizen's personal information protection, and effectively enhance the protection level of citizens' personal information through the interaction of civil, administrative and criminal aspects, so as to achieve

the basic goal of protecting citizens' personal and property safety in the era of artificial intelligence, maintain normal social order, and promote social stability and harmony.

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The Impact of Matching Degree Between Financial Development and Capital Account Liberalization on Financial Instability

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Abstract. It has long been an issue of academic debate in empirical literature whether capital account liberalization and financial development have a positive impact on the economic and financial system. Based on the data of emerging market economies from 2010 to 2019, this paper analyzes the effect of these two variables on financial instability from the perspective of matching degree. Empirical analysis shows that the greater the mismatch between variables, the higher the financial instability. The conclusion is that the coordination and gradual liberalization of financial market provides a more stable and effective way of reform.

Keywords: Capital account liberalization · Financial development · Financial instability · Matching degree

1 Introduction

As one of the factors of production, according to the classical economic theory, the free flow of capital should bring about corresponding economic benefits and efficiency improvement, whether for countries with capital flowing or countries with capital inflow. For developing countries, the inflow of foreign capital can make up for the shortage of domestic savings and stimulate economic growth with investment. Because capital liberalization can bring predictable benefits, under the general trend of globalization, the degree of openness of capital flow and the degree of integration of international capital markets have been increasing year by year in both developed and developing countries since the 1980s. However, with the opening of the capital market, currency crises and balance of payments crises occur frequently in developing countries, including the Mexican Currency crisis in 1994, the East Asian financial crisis in 1997, the Argentine financial crisis in 2001. These crises have not only led to the collapse of the financial system, but also led real economic recession.

On the one hand, capital liberalization can bring external capital and increase efficiency. On the other hand, it may also bring huge risks. Most developed countries have achieved the improvement of financial markets and the complete of capital markets opening. Therefore, how to grasp the opportunity of opening capital accounts has become

an important issue for policymakers in developing countries. This paper will discuss the relationship between capital account liberalization, financial development and financial instability, in order to make some contribution to this problem.

2 Literature Review

There are different views in literature on the influence of capital account opening on financial stability. Generally speaking, the positive channels mainly include: (1) increasing the diversity of company's financial portfolio; (2) promoting the development of the financial system and the regulation of government governance through indirect effects; (3) introducing international competition to eliminate inefficient enterprises and resulting in better corporate governance, so as to reduce the risk of debt non recovery; (4) after the exchange rate control is liberalized, the fluctuation of interest rate and price level will be absorbed by the fluctuation of exchange rate; (5) Macro-policies will be regulated and the independence of the central bank will be strengthened, thus improving the quality and effect of macro-policies; (6) the possibility of speculative impact will be reduced. The negative channels mainly include: (1) increasing systemic risk; (2) the massive inflow of international hot money can increase the possibility of sudden stop or currency crisis; (3) the integration of capital market can lead to a faster transmission of financial crisis; (4) due to the existence of the ternary paradox of macro policy, the liberalization of capital will damage the stability of exchange rate and increase the difficulty of macro-control [1–3]. Faced with the complex impact of capital opening, Huang describes the relationship between capital account liberalization and interest rate stability as a nonlinear relationship [4]. With the open of capital account, money market stability is first low and then high.

Financial development is a broad concept, and different scholars' research focuses on different connotation levels. Loayza and Ranciere regard financial development as a process of financial liberalization or financial deepening, that is, the process in which the state gives up administrative intervention in the financial market [5]. Some scholars have focused on the development of financial market scale, including the proportion of liquid liabilities, private credit in GDP, the proportion of stock market and bond market in GDP, etc. [6, 7]. Some literature also shows that the process of financial development should include the process of financial supervision and gradual improvement of the financial system [8]. Referring to the mainstream research perspective in academic circles, this paper chooses to study the financial development from the scale of financial market.

From this perspective, the relationship between financial development and financial instability is still inconclusive. From the mainstream view, financial development plays a positive role in the economy in the long run. However, in the short term, the rapid development of financial markets may lead to financial instability and macroeconomic fluctuations [9, 10].

Thus, in order to exploit the benefits of capital liberalization or financial development and reduce its internal risks as much as possible, there should be some preconditions. There are many literatures on the threshold effect of capital account opening. Kunieda and Okada point out that a corrupt government will amplify the negative effects of capital liberalization [11]. Eichengreen et al. believe that the development of financial market

must precede the opening of capital account [12]. Dehghan and Shahnazi believe that a good business environment can ensure that the advantages of capital liberalization outweigh the disadvantages [1]. Other factors, such as system quality, macro policy, trade opening and government expenditure, are also considered to influence the effect of capital opening [2].

Similar to the research on capital liberalization with threshold regression model, some scholars have studied similar methods and concluded that the effect of financial development on the economy will be affected by the level of inflation, economic growth, development stage, trade and capital opening [13, 14].

3 Theoretical Analysis

From the above summary, we can find that neither the capital account opening nor the financial development necessarily have a positive impact on economic development and financial stability. Therefore, how to make use of the benefits of capital liberalization and financial development and avoid the accompanying risks will be an important issue for policy makers to solve.

To solve this problem, this paper puts forward a hypothesis, that is, the degree of matching between capital account liberalization and financial development will affect financial instability.

Specifically, whether financial development is ahead of capital liberalization or capital liberalization is ahead of financial development, it will increase the instability of the financial market. This paper will further explain possible influencing mechanism.

3.1 Excessive Changes in Capital Opening or Financial Development

Normally, financial development should be a stable process. However, once the internal and external influences occur, one of the two variables may undergo significant changes, such as the abandonment of the fixed exchange rate system under the impact of speculation. The matching relation between capital liberalization and financial development will not be maintained. In this case, the matching relationship between capital liberalization and financial development actually reflects fast changes.

The rapid changes mean that relevant regulations and systems cannot respond in time. Excessive prosperity can also lead to bubbles, and finally lead to market confusion. Specifically, the rapid opening of developing countries' capital accounts allows large amounts of capital to enter in a short time. As the relatively weak regulatory system, financial system and macro-economy in developing countries, the surface prosperity brought by capital inflow may lead to the emergence of large bubbles in the financial system.

Similar to capital liberalization, if the speed of financial development is too fast, the asymmetric information problem in the financial system may aggravate, and it will also bring a lot of bubbles and corresponding financial instability. Historical evidence shows that before most currency crises or balance of payments crises, there was a surge in the scale of financial markets [15].

3.2 Intermediary Role of Better Market System

Capital liberalization and financial development can promote economic development and stabilize the financial system, largely because resources are transferred to the place where they can play the greatest role, eliminating the inefficiency brought about by human intervention, and finally improving the market system. If the development of finance is only the expansion of the financial market scale, or the opening of the capital account only enables capital to freely entry and exit, and the market system and financial system still remain in an imperfect state, then this development or opening means that the opportunities for taking advantage of institutional loopholes and speculative behavior will increase, and instability will naturally accumulate.

3.3 Collaborative Opening Under Theory of Second Best

Theory of second best means that when some of the conditions required for Pareto optimality are not satisfied, even if all the other conditions are satisfied, this state is not necessarily closer to Pareto optimality. Eichengreen concludes that such phenomena may also occur in the capital market. Specifically, if there are distortions in the market, such as enterprises protected by the government, a stricter minimum wage system, the proliferation of information asymmetry and so on, capital opening will not mean the improvement of efficiency, and the introduced capital will flow to inefficient enterprises under the guidance of distorted prices, eventually deepening the distortion and increasing the instability in the market. In the study of exchange rate marketization and capital account liberalization, Peng et al. also find that if the market is not completely free, unilaterally relaxing the control of capital or exchange rate will increase volatility and reduce welfare. The coordinated deregulation of capital and exchange rate is the most stable and effective opening path.

3.4 Expand the Market to Spread Risks

Compared with relying solely on domestic or international markets, the development of domestic finance and the introduction of international financial markets can both expand the scale of financial markets, expand financing or investment channels, thereby increasing the diversity of asset portfolios and dispersing risks [10]. In addition, according to the formula $S-I = NX$, in order to maintain the internal balance of the country, the opening of capital can iron out the imbalance between savings and investment by introducing a larger international market. At the same time, to maintain the country's external balance (maintain the target value of current account surplus), domestic investment is also an important influencing factor. The development of domestic financial market will contribute to the realization of external balance. If the internal and external balance of the country is achieved, economic stability will be improved [8].

4 Empirical Analysis

For the measurement of capital account liberalization, this paper selects Chinn-Ito index proposed by Chinn and Ito. The data source is the database on the official websites of

Chinn and Ito. For the degree of financial development, this paper selects the proportion of private credit in GDP as the proxy [9, 12]. The data source is the WDI database. For the measurement of financial instability, considering the basic role of the banking system in the financial system and the coupling between banking crisis and other types of financial crises [15], this paper mainly uses the financial indicators of the banking industry to measure financial instability, referring to the research of Gersl and Hermanek and the FSI database released by IMF.

In order to measure the matching degree between financial development and capital liberalization, this paper draws on the measurement method of the coordination relationship between urbanization quality and scale by Zhang et al., standardizes the two variables of financial development and capital opening, and takes the absolute value as the indicator of the matching degree between them. The larger the value of the indicator is, the higher the mismatch between financial development and capital liberalization.

For the scope of the sample, referring to the definition of developed countries and emerging market countries in the *World Economic Outlook* released by IMF and the research of Kose et al. [2] and Baum et al. and considering the availability of data, the sample scope selected in this paper is the data of the following emerging market countries from 2010 to 2019, including Argentina, Brazil, Chile, China, Colombia, Hungary, Indonesia, Korea Rep., Malaysia, Pakistan, Peru, Philippines, Poland, Turkey, South Africa.

The trend charts of typical countries reflect the relationship between key variables clearly, as shown in Fig. 1.

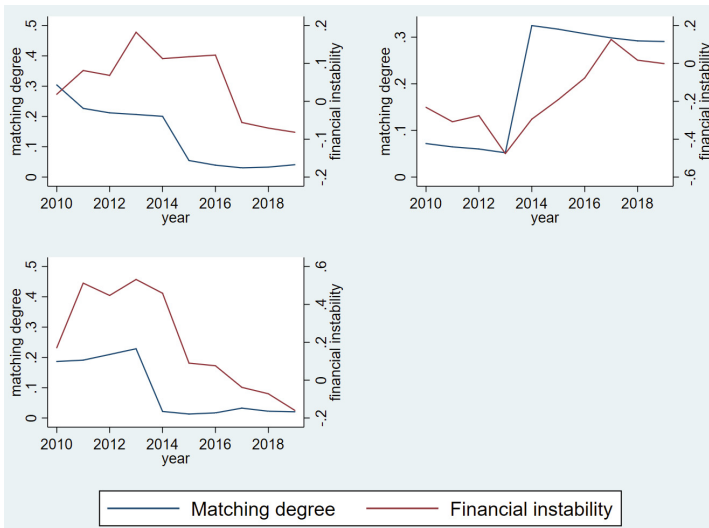


Fig. 1. Trend of matching degree and financial instability in typical countries.

As shown in Fig. 1, when the matching degree increases or decreases, the financial instability will also change in the same direction, indicating a positive correlation between the matching degree and financial instability.

In order to further prove the hypothesis proposed, taking matching degree as the core explanatory variable, this paper makes a panel regression analysis on financial stability. The regression model is as follows.

$$Ins_{it} = \beta_0 + \beta_1 Match_{i,t-2} + \beta_2 X_{i,t-1} + \beta_3 Ir_t + u_i + \varepsilon_{it} \tag{1}$$

Ins is the explained variable, financial instability. Match is the core explanatory variable, matching degree. **X** and Ir are control variables. **X** is a vector of domestic macro variables, including real GDP growth rate, unemployment rate, inflation rate, currency depreciation rate and changes in terms of trade. Ir is the US interest rate. Considering the lag of the impact of macro-economic variables, Match is second-order lag term, and all the domestic macro control variables in **X** are first-order lag term. The regression results of fixed effect are shown in (1) of Table 1.

Table 1. The effect of matching degree on financial instability.

	(1) Ins	(2) Ins2
Match	0.450** (2.02)	0.516* (1.68)
GDP	-0.042*** (-2.69)	-0.022 (-1.34)
Ir	-0.078** (-2.33)	-0.109*** (-3.34)
Un	0.026** (2.03)	0.052** (2.27)
Inf	-0.003 (-0.53)	-0.010* (-1.91)
Er	-0.434** (-0.44)	-0.422* (-0.15)
_cons	-0.166 (-0.90)	-0.427 (-1.65)
N	118	118

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The variable Match is the second-order lag term and the variables GDP, Un, Inf, Er and Term are the first-order lag terms.

As shown in Table 1, the degree of matching has a positive impact on financial stability at the significance level of 5%. One unit deviation of the matching degree aggravates the financial instability of 0.45 units.

In addition, the robustness test is carried out in this paper, as shown in (2) of Table 1. In the robustness check, the weight of each indicator measuring financial instability is no longer obtained by principal component analysis but by expert judgment.

5 Conclusion

By theoretical and empirical analysis, it can be basically concluded that the matching degree between capital account liberalization and financial development has an impact on financial instability in the chosen emerging market economies. Furthermore, whether the situation of matching is led by advanced capital liberalization or financial development, the degree of financial instability can increase.

Therefore, for developing countries with imperfect financial markets, policies to open capital markets or promote financial development need to take maturity of the domestic market and the development stage of their own economy into consideration.

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Research on Globalization Impact Factors and Sustainable Development Strategies

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Abstract. Economic globalization itself is known for facilitating the distribution of the means of production, but it often has a negative impact because the distribution process is not efficient enough. COVID-19 has largely curbed globalization since its massive outbreak in late 2019 and shifted the process of globalization, which had been experiencing protectionist shocks, into reverse globalization. Globalization seems to be in a tense situation and at risk of extinction: Differences in policy responses among nation-states reveal different attitudes toward economic globalization; Individual psychological satisfaction with the sense of recognition and the rapid development of the market economy are opposing and circular features. This paper addresses the question of the pros and cons of globalization, used literature research to study the imbalance rules of globalization, the mechanism of populism's influence on globalization, found the cyclical development trend of globalization, and used China's response as a practical case to support and analyze, with a view to providing reference for other countries to deal with globalization in the current internationally situation.

Keywords: Globalization · Impact factors · Sustainable development

1 Introduction

“Globalization” has been a familiar and popular concept since it was first mentioned in the 1960s. From Globalization 2.0 and Globalization 3.0 in Thomas Friedman's “The World is Flat: A Brief History of the 21st Century” to Globalization 4.0 mentioned at the 2019 World Economic Forum, the history shows that humankind is constantly and actively participating in the construction of globalization so that it exhibits a dynamic development [1]. From the international governance system established after World War II (e.g., the emergence of specialized agencies such as the IMF/World Bank), to hyper-globalization and global value chains, to the development of new technologies or new things such as 5G, the Internet of Things, and artificial intelligence - people are hoping to drive the evolution of globalization with a more open attitude by constantly breaking through themselves, including the limits of their perception of the outside world.

Nevertheless, in recent years, the momentum of globalization has slowed down for a while. One of the symptoms is that after the crisis period following rapid global economic

growth, the Western countries, which were the pioneers and main leaders of globalization, began to question the liberal globalization they had previously implemented, and their domestic discontent was brewing in the face of massive foreign immigration, rising inequality, and unemployment. The short-term prevalence of counter-globalization marked the outbreak of discontent: the rise of populist governments and the emergence of trade protectionism brought stagnation and regression to the world economy. Moreover, of course, the repeated COVID-19 Pandemic that followed shook confidence in globalization to its core. Globalization seemed to be at a crisis point, and a pessimistic attitude toward the future of globalization seemed logical. Some scholars even believe that globalization can come to an end [2].

Nonetheless, just as the economic crisis as a necessary stage in the cyclical economy, it can hardly be directly defined in terms of that complex source of pessimism in globalization. Globalization has flourished for decades and encompasses a multifaceted change process in the political, economic, cultural, and social spheres; it is difficult to predict its future from a non-material perspective alone. Therefore, this paper will explore the feasible future direction of globalization by examining the impact mechanisms of globalization, analyzing the phenomenon of de-globalization and the aftermath of COVID-19, and supplementing it with China's recent practical experience.

2 Literature Review

According to libertarian G. John Ikenberry: the United States can act as a "Liberal Leviathan" to preserve world order [3]. After World War II, the victorious United States, as the advocate and pioneer of globalization, established the financial and monetary rules represented by the Bretton Woods system and the international trade rules system represented by GATT according to its interests and those of its allies and made these two systems gradually become the pillars of the world order. As more and more countries followed the international rules and opened their countries, it became obvious that the globalization circuit became crowded and competitive.

One of the results was that the original rules of globalization also inevitably suffered from the impact of the development of the diversity of economic models: Li Xiangyang sees this as part of the cyclical fluctuations in the development of economic globalization [4]. The possibility that there are also globalization participants who want to profit quickly by cheating cannot be excluded. Furthermore, according to Fariborz., through strong international institutions and international cooperation, the impediments to trade cooperation as well as openness are gradually removed - issues such as parochial local bias, Feldstein-Horioka puzzle, consumption patterns, and national stock bias help to be solved [5]. So the presence of international institutions is one of the necessary ways of globalization governance. Only according to theorists such as Robert Keohane: institutional cooperation has inertia, i.e., once established, no matter how many crises are faced, eventually the original institutions will still exist and play a relevant role [6]. This explains why the International Monetary Fund or the World Bank, originally established by Western countries, still plays a leading role in the many problems that arise in globalization, even if some crises have hit the existence of these international institutions, such as the Argentine financial crisis of 2001. Moreover, according to Collins and Rhoads, the

credibility of the original institutions is declining due to their opacity [7]. This undoubtedly exposes the asymmetry between rich and developing countries - underlying this is the growing need for emerging countries in globalization to participate in the globalization dialogue on an equal footing. Extrapolating from an important feature of Paul's work on collective action [8], as some sense of collective action In the early stages of the globalization game, all cooperation around the relevant international constraints was successful due to the involvement of fewer players (with essentially the same values).

On the other hand, as rapidly growing emerging economies, including China and India, look to take their place in the global community, successful international trade cooperation has become increasingly difficult to achieve. This is because the global political and economic landscape has been changing rapidly in recent years - and this change is certainly reflected in globalization, as Grinins suggests [9]. Although financial liberalization and globalization have been vigorously promoted by the advanced industrial countries of the West: policymakers have endeavored to steer and adjust through policies [10] - but as globalization has revealed a series of problems that have intensified, such as the deterioration of the climate environment due to the lack of worldwide rules for global growth, the process of globalization is being held back. The recession and depression that resulted from the same erratic growth of the global economy have now inevitably curtailed the momentum of globalization's continued growth to a sluggish status quo [11]. Starting with the economic crisis of 2008, the future of globalization seems less clear: confidence in globalization, including among liberal believers, is suffering; protectionism is also gaining ground, representing the beginning of a query of international economic integration. From the Doha Round negotiations [12], which began at the beginning of the 21st century but are constantly suspended, to the China-United States trade war in 2018: protectionism is on the rise. With the further impact of COVID-19 in 2020, this stagnation of globalization is further amplified - and even shows a trend towards de-globalization. Nevertheless, there is also a history of this situation, as Prof. Antrà suggests in his article: the same nationalism that prevailed during the 1918 flu pandemic (Spanish flu) and the de-globalization between the two world wars, and the same political rhetoric of "blaming foreigners for economic woes" [13].

In an era like the present one with significant health, economic, and policy uncertainty", the world seems to need a new engine to lift this wobbly paper airplane into the clouds. Given that the global economy is non-zero-sum (positive-sum game) and that the problems revealed by globalization are not insurmountable, is it possible to revive the decline of globalization by restructuring it? We are forced to constantly make adjustments to discover the future direction of a whole new version of globalization.

3 Globalization Impact Analysis

Economic globalization has two attributes. On the one hand, it manifests itself in the transnational flows of goods, services and factors of production, and on the other hand, it manifests itself in the rules and order that influence and constrain such transnational flows. The former is determined by technological progress and the deepening of the international division of labor, so economic globalization is inherently inevitable from low to high; the latter is determined by the interrelationship among nation-states, so the development of economic globalization again shows cyclical fluctuations.

3.1 Analysis of the Benefits of Globalization

Globalization has brought a perfectly well supply chain system, which greatly shortens the time of running raw materials and products in business, reduces costs and wastage of time. The business efficiency is also improved by it [14]. For developed countries, smooth dissemination of information makes enterprises to maximize their benefits liberally. For developing countries, globalization has also brought opportunities of development for countries and has enhanced countries' economic dynamism. There, the majority of countries in the world are attracted to participate in the globalization initially. Many enterprises are becoming more and more international to fit the development of globalization. Especially in the process of financial globalization, the flow of capital to developing countries has greatly increased; if we do not care whether these capitals are playing the art of flash, the influx of capital has undoubtedly promoted the development of developing countries [15]; and the establishment of WTO has also brought the implication of the rule of law to international business, which has ensured the security of liberal trade (Shaffer 2018). Through globalization, countries are collaborating and developing, contributing to both developing and developed countries' prosperity.

3.2 The Downside of Globalization Emerges

However, with the further development of globalization, many problems have been exposed to the dissatisfaction of most people. What we can see due to globalization, countries cooperate but do not prevent competition from happening unhindered: for example, American workers' jobs are being threatened by Bangladesh because of offshoring [16]; highly subsidized crops (such as corn) in the United States also threaten the survival of farmers in most developing countries [17]; job protections long fought for in Europe are easily destroyed [18]; and some potent drugs from big pharma, such as COVID-19 vaccines, become unaffordably expensive as intellectual property rights are protected [19]. At the same time, protectors of environmental security and cultural diversity keep their eyes on the process of globalization [20]. It has to be admitted that globalization is an unbalanced state, where wealth is created through the more efficient distribution and use of resources. However, it does not mean that every citizen of the planet can get their share of the process - the result of unfulfilled wishes is plummeting confidence in globalization - unemployment is rising along with inequality. However, more interesting is that the national GDP is still rising in this process, but gradually, rich countries and poor people are created [21].

To sum up, the rules of globalization are not fair, so globalization brings too many disadvantages. Under the influence of neoliberalism, material values gradually take precedence over everything else, including life and the environment; developing countries are deprived of their sovereignty in the form of conditional economic assistance from industrialized countries: they are unable to engage in well being and democratic politics (Stiglitz.); many economies do not benefit from the relationship of real competition [22]; developing countries are forced to join the economic model of Anglo-American liberalism without alternative models: GDP rises but welfare, especially for the middle class, is in trouble, with the decline of the qualified life and the increase of poverty (such as Argentina); developed countries such as the U.S. also have welfare problems: capitalists

are more concerned about corporate interests than about what gives back to society, and workers' real wages stagnate without increasing [23].

3.3 De-globalization and the Impact Factor of COVID-19

According to Compartmental models in epidemiology [SIR models: $N = S(t) + I(t) + R(t)$], because the world's susceptible population of S is large, a more direct way for governments to influence beta infection rates is by "Flattening the curve" [24], i.e., directly blocking the exposure of S to the epidemic. Efforts in the early stages of an influenza outbreak in the beta direction are more important than the later impact of the development and application of effective drugs and vaccines on the recovery rate in the gamma direction. The application of great lockdown, as evidenced by social isolation and border closures to control the spread of the virus, and the "great lockdown" to contain the COVID-19 epidemic were also recognized and adopted by most countries. Thus, the emergence of the COVID-19 has completely reversed the process of "super-globalization", which was focused on the market and not on society.

There is no doubt that the measures were effective in containing the spread of the epidemic, but they also brought the economies of many countries to a halt, disrupted the global supply chain, and had a significant impact on the world economy. At the same time, populist demands have become highly justified in the face of the value of safety of life. One further manifestation of this is that U.S. isolationism is re-emerging on the historical stage; however, the impact of de-globalized national policies is also being eroded following the return of President Joe Biden to power.

Karl Polanyi's "Double Movement" theory argues that the expansion of globalization has increased market power while increasing the need for social protection for individuals [25]. The oscillation between the development of the market economy and the satisfaction of social psychology has become an increasingly visible feature of globalization: the inequalities generated by globalization and the purification of the market economy have intensified populism, based on the lack of welfare protection for vulnerable groups in the countries of globalization (growing inequality); conversely, the proliferation of populism has influenced and led to the emergence of nation-states with trade protection as the main manifestation. In turn, populism has influenced and caused nation-states to develop xenophobia, with trade protection as the main manifestation, and identity as a distinction, making the state nationalistic and conservative in its policies, which in turn has aggravated the phenomenon of reverse globalization.

3.4 Analysis of Globalization Response Strategies: China as an Examples

The poverty that was expected to be reduced through globalization is deepening: not all economies have been able to control population growth and escape poverty through a prudent management of globalization and an export-based economic growth model, as China has done. It is certain that China, with its different values, has followed a unique path of globalization different from the West: a path in which liberalism is limited - freedom is often sacrificed for the sake of order, prosperity and national prestige - and there are times when China has had to do so, such as in the face of the COVID epidemic, where in the SIR model, as the most populous country in the world, China's S variable

is so large as a susceptible population that it is forced to do its best to control β by strictly isolating it at home (flattening the curve), especially since the early stages of the epidemic appear inhumane. Although China's model is different from the West, it is undeniable that this diversity of economic models will make globalization more stable. In the 2008 financial crisis, China experienced a relatively small blow. On the other hand, it is undeniable that China's current outward-looking economy is growing faster than the economy due to overexpansion. The bubble in the real estate sector also seems to have burst with the shrinking of Evergrande Real Estate. China is more interested in getting out of the woods through broad international cooperation, such as the "One Belt, One Road".

More often, poor developing countries such as those in Africa have to limit their investments in infrastructure and education and invest less in their future in the face of capitalist exploitation and high debt. Moreover, it has to be mentioned that democracy rode on globalization but had to be destroyed because of conditional aid. So we have to question whether globalization is equally undemocratic in its macro-management. Given the examples of countries like China and India, development experience is certainly not monolithic [9]. However, the voices of developing countries are still not taken seriously in the World Bank and the IMF - the head of the World Bank is appointed directly by the American president. New developing countries like China are underrepresented in the IMF while only the U.S. has a veto. Finally, many countries question organizations under the old international framework.

4 Conclusion

This paper defines the concept of globalization and analyzes the advantages and disadvantages of the dual attribute characteristics of globalization: on the one hand, it promotes the global flow of production factors, goods and services, bringing about perfect supply chains and much higher business efficiency from which all countries can profit; on the other hand, the problem of inequality increases and raises public psychological problems behind social welfare, while the rules and mechanisms of globalization at the beginning need to be improved.

Then this paper analyzes the mechanisms of different factors affecting globalization from the perspective of globalization rules and populism, and discovers how the COVID-19 epidemic affected the de-globalization process. Through the antagonism between de-globalization and globalization behind populism, the cyclical character of globalization in the development process is laterally confirmed. On this basis, the measures taken by China to cope with globalization in the present time are summarized and analyzed, and some references are provided for other countries in the international arena.

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The Relationship Between COVID-19 and Investor Preference in Agricultural and Machine Industry

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Abstract. This paper explores how Covid-19 and the vaccine affect investor interest in the agricultural and machine industry. The difference-in-difference model and the Five-factor Fama-French model are adopted to process the French data library. Certain assumptions have to be made due to the nature of the model, such as autocorrelation and those five factors have to be significant. According to the complex nature of the effect of Covid-19, the result on the agricultural industry were abandoned due to unreliable and unrealistic results. Nevertheless, the result indicates that Covid-19 has a limited effect on investor preference. Therefore, a different model should evaluate the effect on the agricultural industry. On the other hand, the result reveals that the machine industry was heavily affected by Covid-19, which shifted investor interest to aggressive firms and less operation revenue firms. The introduction of vaccines offset the shock on investment style but taking growing stock is preferred. Therefore, investors assume the machine industry will become riskier. The result suggests that Covid-19 and vaccine may not have the opposite effect. In another word, the effect of the vaccine may not offset the effect of Covid-19 due to their effect being different, and the investor does not take the vaccine as an event to settle Covid-19, or there is a problem in the assumption or model. It is still a long way to find out how those two events affect investors or the stock market.

Keywords: Agricultural industry · Machine industry · Covid-19 · Difference-in-difference method

1 Introduction

Covid-19 has affected most citizens' lives for around two years, the first confirmed case in 2020 January and declared public health emergency on February 3. The issue in the united states has boomed since then and got of control. Multiple restrictions apply to international travel or even dining and gathering. The pandemic ease with the vaccine's introduction on December 12, 2020, but it did not completely solve the situation. Some news suggests vaccines have recovered the impact of Covid19, which is a questionable assumption since the vaccine does not set the number of new patients to zero, and there are multiple lockdowns afterward. The introductory of vaccine passports even

backfire on specific populations. These may further destroy public trust and affect stock performance. Other claims are that the vaccine and its passport would surely recover the economy. This paper remains a doubt and will be part of the investigation.

It has affected many things relative to citizens' life. It had a significant impact on stock, prices and shipping, creating much incontinence in people's lives. Tons of stores have to close down, and new opportunities emerge. When this paper considers businesses, the investment part is critical, and some are still unclear. There is other research studying how much were stock affected by Covid 19 [1, 2], for example, the required rate of return. The object of this paper will dive a little bit in the other direction, how does Covid 19 affect the stock market as human decisions control the stock market. How does the market react and consider a reasonable return for an industry? The main problem of this paper is how Covid 19 reshape investor preference on the stock.

Many industries can be considered; the industry this paper focuses on will be agriculture at first. However, as a critical part of the economy, almost 4% in a developed country can quickly jack up to 25% in a developing country as part of the basic human need for food [3]. Moreover, in the long term, 25% of greenhouse gas is also responsible for agriculture [4]. Therefore, the investment in such an industry should be carefully understood since it plays a critical role in human life.

A problem occurs that causes the analysis of the above industry to become unreasonable. However, it is still helpful as an example and inspires future research. It is also the groundwork of the other industry.

Another industry was selected; the main focus of this paper will be one of the other industries as necessary as the one above, the machine manufactory industry. It already takes care of 12% of all U.S. manufacturing jobs, and 91% of people think it is critical to the U.S. economy [5, 6].

The past papers usually focus on the supply chain rather than the industry itself, but they provide a specific groundwork for this paper to understand the situation of this industry, and there are one particular paper talks about the return and stock price [7]. The paper uses regression analysis to study the relation between stock price and a couple of factors, such as a book to market ratio, leverage ratio and cash to asset ratio. That paper suggests the preference changed for the leverage level. The data show leverage level was not correlated with the stock price before the Covid-19 outbreak and negatively correlated between stock price and leverage. The main takeaway of this paper is all the wrong reasons which this paper will adjust. Although those factors make sense, the lack of theory support causes an easily omitted variable bias. The sample size is pretty tiny; only three to four companies per region generate a high standard deviation, making most variables insignificant. That makes no sense and should be considered a problem. That problem will be checked in this paper.

The other paper talk about the supply chain and the unit price of the industry's product this paper will study those data showcase a drop when the Covid-19 hit the USA due to reducing demand and blockade of transportation heavily affecting import and export of agricultural products. That would be a reason or risk that investors consider and influence their decision-making.

This paper aims to study how pandemic affects investor preference on the stock that translates into how much return they are willing to take. Fama-French five-factor

Asset Pricing Model will be considered as the primary base model [8]. The model captures the following preference and return spread on size, value, range of profitable and aggressiveness. Those measuring the return spread of those factors can tell us how investor preference changes by Covid-19. At the same time, this paper will also consider how vaccines affect those behaviors. By the end of the paper, this paper should clearly understand how those five factors' return spread behave during the pandemic and vaccine. This paper will consider the shock first and the cumulative effect afterward over time. There are also serial problems that would be checked to ensure the result is accurate. First of all, those five factors should significantly affect the return. Otherwise, the fundamental theory will not hold for the whole paper. This is why the agricultural industry failed in this analysis and required a substitution.

2 Method

This paper uses multiple regression based on time series analysis and different-in-different methods to determine the change of return spread in three periods: pre-Covid-19, post Covid-19 and post-vaccine. The first period in 2020 may be the first as nothing big happened before Covid-19 appears. Then, march 11 was considered the day Covid-19 hit the stock market. Starting from March 11, this paper assumes that post-Covid-19. Finally, on December 12, 2020, the first patch of vaccine role out to the general public, such a period considered as post-vaccine. By considering three time periods, this paper is interested in how the return spread changes over in these three time periods. Moreover, different methods can give us an accurate result using one regression formula, and the whole analysis gives us maximum data points and lowers this paper's standard deviation.

The data set contained the industry's return, the market return required, the data relative to 5 factors and the risk-free rate. The data set itself is enormous, which contains data from 1964 to 2021 and covers many industries. The problem was that such a long time frame would include many noises due to events. The different sectors also have dramatically different conditions, making it challenging to be a panel data set.

$$\begin{aligned}
 R_i - R_f = & \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML + \beta_4RMW + \beta_5CMA \\
 & + \beta_6(R_m - R_f) * Covid + \beta_7SMB * Covid + \beta_8HML * Covid + \beta_9RMW * Covid \\
 & + \beta_{10}CMA * Covid + \beta_{11}(R_m - R_f) * vaccine + \beta_{12}SMB * vaccine \\
 & + \beta_{13}HML * vaccine + \beta_{14}RMW * vaccine + \beta_{15}CMA * vaccine
 \end{aligned} \tag{1}$$

β_1 to β_5 is the regular five-factor model from the original Fama-French model. The additional β is how this paper use difference indifference to determine how much was changed after Covid-19 and vaccine. Generally, in any difference in difference model, this paper should include Covid-19 and vaccine as a stand along with the variable. However, they are ignored in this paper model because the Fama-French assume only those five-factor factors can be affected the return investor is looking for. If this paper includes those variables in the regression, this paper allows Covid and vaccine affect return investors are looking for directly, which is the opposite of the assumption from a fundamental theory of this paper.

Such a model work as follows as some of the readers may not be used to a difference in difference model, which is a classic in economic.

This paper runs three regressions as one significant regression to give us a hopefully more minor standard deviation and is much easier to compare relative to three regressions—such benefit forms as they are from the same regression and larger sample size.

This is the classic Fama-French model, and this would be what this paper should run three regression in three different periods, which is before anything happened after Covid-19 hit the stock market and after vaccine rollout. Then this paper compares their β s.

$$R_i - R_f = \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML + \beta_4RMW + \beta_5CMA \quad (2)$$

Some problems occur; comparing β is not accessible. Some statistic tests should be performed since they have a confidence interval; it will be quite challenging to perform for three different regressions, and without it, the number is meaningless. The way it works is as follow:

First, for the period before Covid-19 hit the stock market, both Covid-19 and the vaccine were equal to zero. Then, this paper is left with $R_i - R_f = \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML + \beta_4RMW + \beta_5CMA$, which is the original Fama-French model. B 1 to 5 will capture the return spread before Covid-19. Then, after Covid-19 hit the stock market, this paper has Covid = 1 and vaccine = 0.

This paper have this:

$$\begin{aligned} R_i - R_f = & \beta_1(R_m - R_f) + \beta_2SMB + \beta_3HML + \beta_4RMW \\ & + \beta_5CMA + \beta_6(R_m - R_f) * Covid + \beta_7SMB * Covid \\ & + \beta_8HML * Covid + \beta_9RMW * Covid + \beta_{10}CMA * Covid \end{aligned} \quad (3)$$

And taking some simplification:

$$\begin{aligned} R_i - R_f = & (\beta_1 + \beta_6)(R_m - R_f) + (\beta_2 + \beta_7)SMB + (\beta_3 + \beta_8)HML \\ & + (\beta_4 + \beta_9)RMW + (\beta_5 + \beta_{10})CMA \end{aligned} \quad (4)$$

Since β_1 to β_5 are provided, they are calculated using last period data. The combination of $(\beta_n + \beta_{(n+5)})$ will give us the return spread of this period. If this paper takes β 1 to 5 as constant, β 6 to 10 will be the difference of return spread on that five-factor relative to the period before Covid 19 occurred.

For the last period, as vaccine roll-out, both vaccine and Covid equal one since that would be vaccine roll out after Covid hit the stock market. So this will be what the regression looks like in that period.

$$\begin{aligned} R_i - R_f = & (\beta_1 + \beta_6 + \beta_{11})(R_m - R_f) + (\beta_2 + \beta_7 + \beta_{12})SMB \\ & + (\beta_3 + \beta_8 + \beta_{13})HML + (\beta_4 + \beta_9 + \beta_{14})RMW + (\beta_5 + \beta_{10} + \beta_{15})CMA \end{aligned} \quad (5)$$

Since β_1 to β_{10} are provided, they are calculated using last period data. The combination of $(\beta_n + \beta_{(n+5)} + \beta_{(n+10)})$ will give us the return spread of this period. If

this paper takes β_1 to 10 as constant, β_{11} to 15 will be the difference of return spread on those five factors relative to the period before the vaccine occurs. Moreover, since all β is in the same model, the t-test of every individual β works well as an indicator or significant level.

3 Result

The result is the agricultural industry, the first industry we study based on our equations Eq. (1) (Table 1).

Table 1. Linear regression for the agricultural industry

agric_d	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
metre	1.114	0.11	10.15	0	0.898	1.329	***
smb	0.304	0.305	1	0.319	-0.295	0.903	
hml	0.145	0.239	0.61	0.543	-0.324	0.615	
rmw	0.271	0.398	0.68	0.497	-0.512	1.053	
CMA	-0.077	0.368	-0.21	0.834	-0.8	0.645	
mktrf*Covid19	-0.288	0.146	-1.97	0.049	-0.575	-0.001	**
smb*Covid19	-0.068	0.366	-0.19	0.852	-0.788	0.651	
hml*Covid19	0.262	0.277	0.95	0.344	-0.282	0.806	
rmw*Covid19	-0.149	0.481	-0.31	0.757	-1.094	0.796	
Cma*Covid19	-0.327	0.513	-0.64	0.524	-1.334	0.68	
mktrf*vaccine	0.106	0.13	0.82	0.414	-0.149	0.361	
smb*vaccine	-0.011	0.25	-0.04	0.966	-0.501	0.48	
hml*vaccine	0.278	0.193	1.44	0.15	-0.101	0.656	
rmw*vaccine	-0.321	0.315	-1.02	0.308	-0.941	0.298	
Cma*vaccine	-0.129	0.431	-0.3	0.766	-0.975	0.718	
Mean dependent var	0.082		SD dependent var			2.244	
R-squared	0.552		Number of obs			611	
F-test	35.175		Prob > F			0	
Akaike crit. (AIC)	2261.164		Bayesian crit. (BIC)			2327.391	

*** $p < .01$, ** $p < .05$, * $p < .1$

The result of table one for agriculture suggest the following, as most of the variable is insignificant, and F tests were also performed. The result indicates that only excess returns are significant as return spread and jointly, all five factors are significant which have p-value close to zero and reject the null hypothesis that those five-factor factors are all close to zero. So then, Covid-19 has an effect on return spread on excess return, but none of the other factors is affected. The F test suggests both vaccine and Covid-19

have no effect on return spread as a whole by giving us a p-value above 0.1. For specific reasons, such a result suggests a problem in the regression, and the data does not do anything (Table 2).

Table 2. Linear regression for machine industry

mach_d	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
mktrf	1.123	0.033	33.75	0	1.058	1.189	***
smb	0.447	0.067	6.7	0	0.316	0.578	***
hml	0.209	0.071	2.93	0.004	0.069	0.348	***
rmw	0.718	0.122	5.86	0	0.477	0.958	***
CMA	-0.029	0.139	-0.21	0.836	-0.301	0.244	
mktrf_Covid-19	-0.028	0.05	-0.56	0.576	-0.126	0.07	
smb_Covid-19	-0.076	0.101	-0.75	0.452	-0.274	0.122	
hml_Covid-19	-0.084	0.097	-0.87	0.386	-0.273	0.106	
rmw_Covid-19	-0.409	0.176	-2.32	0.021	-0.755	-0.063	**
cma_Covid-19	0.49	0.197	2.49	0.013	0.103	0.878	**
mktrf_vaccine	0.157	0.07	2.26	0.024	0.02	0.294	**
smb_vaccine	-0.142	0.122	-1.16	0.247	-0.382	0.098	
hml_vaccine	0.196	0.094	2.07	0.039	0.01	0.381	**
rmw_vaccine	-0.295	0.156	-1.89	0.06	-0.602	0.012	*
cma_vaccine	-0.58	0.195	-2.98	0.003	-0.963	-0.198	***
Mean dependent var	0.107		SD dependent var			2.021	
R-squared	0.898		Number of obs			611	
F-test	250.426		Prob > F			0	
Akaike crit. (AIC)	1231.12		Bayesian crit. (BIC)			1297.347	

*** $p < .01$, ** $p < .05$, * $p < .1$

The result for the other industry turns out very differently, most of the variables are significant and jointly, five-factor, and both vaccines and Covid-19 are significant, by giving us p-value close to zero, which implies those five factors affect return before Covid-19, and both events have a shock on return spread by rejecting the null hypothesis that each subgroup of variable have all coefficient close to zero.

4 Discussion

The first table's result is unreliable: It is acceptable that both Covid-19 and vaccine do not affect investor desire return; the problem was that only the excess return is considered, which violates the assumption when this paper uses the five-factor model. It may follow the CAPM model. However, this paper may spend some time finding other ways to explain this.

One of the reasons is that there may be a serial correlation; the Dubin Watson d statistic equal to 1.65 implies a serial correlation. The problem is that the regression method only allows us to take an average of return spread over time; as long as that period has an average of zero, the result will be insignificant.

The other reason is that this paper does not have enough data points when the shock is the relatively low magnitude; in this case, this paper cannot expand the duration of the regression because there may be other events that affect the result and, for some period, the time cannot be expanded. This paper may also look for panel data if this paper is interested in the effect on all industries in general.

With that said, if the result is correct, this paper might have to tap into the nature of the two events and the industry. First of all, in the first period, the investor does not care about any of the other five-factor factors other than the excess return.

The industry is already in a poor state due to past hurricanes and consistent decrease in price and increase in cost [9]; for many crop, the future price has some peak around 2012 and drop from there. The problem farming faces when the Covid-19 star is that the crop price is growing for the consumer. The demand decrease in terms of transportation and restaurant requirement. A sharp drop in price for products that can not be stored.

The investor how a lower return spread on excess return, from above one to below one, indicates the investor considers it less risky than the market compared to riskier before Covid-19. The other factor may still not be considered, or the constantly changing background casing the return spread to keep changing with an average of zero (Fig. 1).



Fig. 1. The cotton price from 2007 to 2021 [10]

At the same time, the net income forecast cautiously decreases during Covid-19 and after the vaccine, which also explains why the effect started by Covid-19 usually would not stop by the existence of the vaccine (Fig. 2).

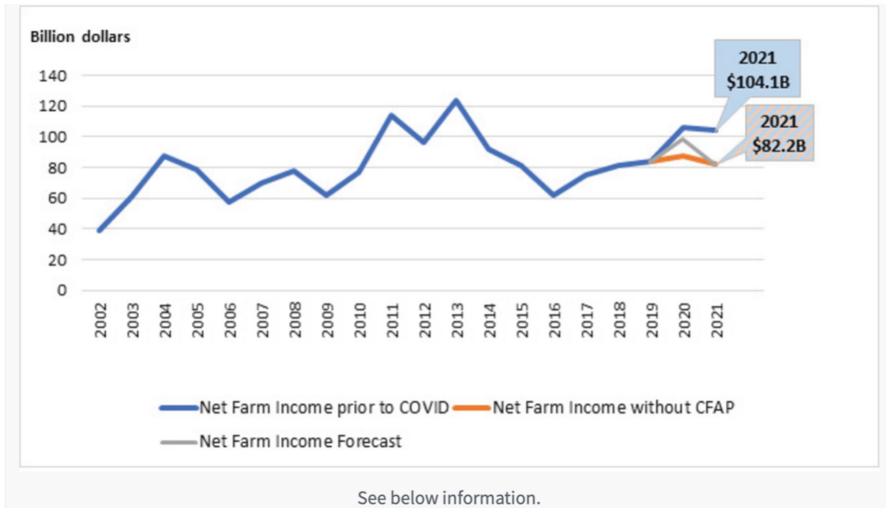


Fig. 2. The farm income and forecast from 2002 to 2021 [11]

The effect of the vaccine can be easily explained. Only 63% of Americans took the vaccine first shot. This paper will not talk about the vaccine’s effectiveness here, and this paper will only talk about some of the data. This paper was given only a 63% coverage rate during 2021–11-10. Therefore, the policy itself or promotion of vaccines is already questionable. At the same time, even with the vaccine, the number of the new case did not drop to zero (Fig. 3).

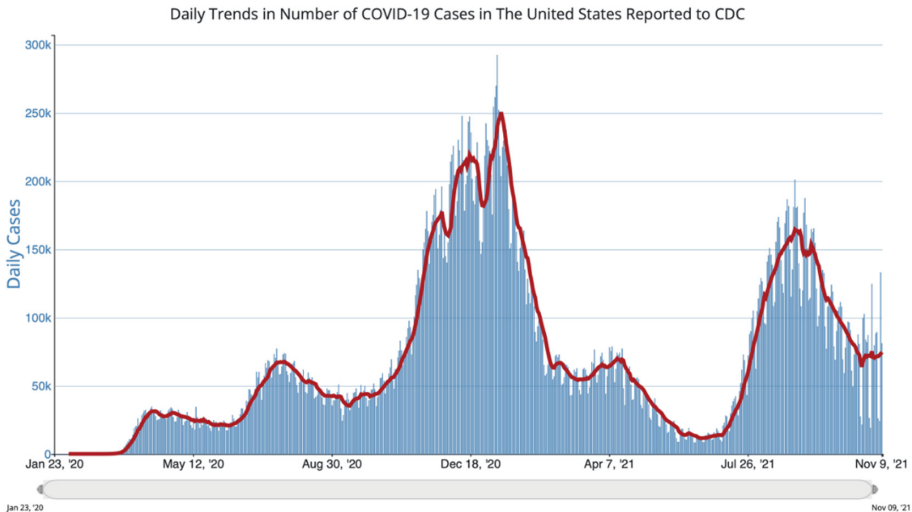


Fig. 3. The number of new cases of Covid19 [12]

During January, the vaccine kicks in and brings down a rate of new cases, but the new case climbs right back up during September when the data is set to end. In this case, this paper can see the effect of vaccines on Covid-19, in general, is not long-lasting enough to affect the new case trend in general. And so, difficult to recover the twisted interest of investors. This might be the reason that Covid-19 affect investor but not the vaccine.

Also, as the data above show, the time factor may play a role in the regression result. This paper separates the period such that the period this paper uses is not accurate, or the way it hit is different. On the other hand, this paper is not written based on the selective result, so this regression is left as-is unless a better time frame comes up.

This is some red flag for investigation in other industries, which is worth another paper. For the machine industry, the result is more in line with assumptions. For CMA, there is a couple of explanation that it does not have any return spread on it. One of the reasons is that the randomness and noise make it insignificant, which means the five-factor model still holds. The other factors combine indicate. The investor thinks it is riskier than the market portfolio; a more minor, high-growth, high-operation profit firm is preferred. The investment style was left out unchanged.

After Covid 19 hit the market, investors preferred to pay higher returns for aggressive firms and fewer operation revue firms. The vaccine offset the shock on investment style but taking growing stock is preferred. Investors assume the machine industry will become riskier. The result is entirely different from than last industry this paper study. Covid-19 does not have much of an effect, but the vaccine does. Also, the effect is interesting as the effect of vaccine and Covid-19 are not the same; Covid-19 cause investor to invest in higher-risk stock and vaccine shift that back to normal, which investor does not care about investing style, which is the original point.

A Canadian study finds out investors are faceless stressed toward buying stock during Covid 19, and more investors increase their investment rather than decrease [13]. The investor also invests less for a saving. This suggests a lot of how the investor may affect by Covid 19. For the vaccine, nothing is coming out yet. A possible explanation is that Covid 19 was not over yet as this paper was written. Most of the country still implies many restrictions on travelling, and the peak of infection was not during the Covid period; it is in the vaccine period.

Such theory can tell a completely different story, which again, is another topic worth looking into is how different react to Covid-19 differently. For example, the difference in response of both industries during Covid-19 and vaccine may be due to their different sensitivity on Covid-19 and vaccine. This paper must check whether there is a tie between time exposure to Covid-19, as the investor slowly shifts their preference instead of significantly dropping.

5 Conclusion

This study was more complex, and assumptions should be checked to study investment preferences and events. There are other considerations for the additional variable. This paper found that Covid-19 and vaccine may shock investor preference, and they may not offset each other. Either investor changes their preference differently because the two events are not weighted the same, or the effect of the vaccine is relatively tiny.

In addition, this paper found that agricultural industries are considered less risky after Covid-19. However, the machine industry reacted differently as investment style was viewed differently and back to normal. Another factor also has a different shift, much the Covid-19 and vaccine overlap. In many cases, there are lots of ways this paper can improve in this paper. The discovery of this paper showcases some of them, including a more extended dataset that should be used, considering other variables such as time and exposure to the event.

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Research on Enforcement Mechanism of Antitrust Law from the Perspective of Comparing Chinese and American Legislation

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Abstract. Since 2021, the State Administration for Market Regulation has shown the characteristics of accelerated pace, increased intensity, and aggravated penalties of law enforcement. It has further concentrated on the implementation of antitrust law enforcement in key industries and fields. However, the lack of quasi-judicial powers and authority of antitrust law enforcement agencies, the relatively light penalties for violations that still cannot adapt to economic development, the lack of transparency of law enforcement, and the lack of specific regulations and boundaries in the forgiveness system in judicial remedy, etc. have caused a great problem in law enforcement and are not conducive to the fair investigation and handling of cases. This article sorts out the problems existing in China's antitrust law enforcement and finds out the US laws and regulations on corresponding matters. From four aspects of the authority of law enforcement agencies, regulations on responsibilities for violations, the degree of law enforcement transparency, and the system of law enforcement remedies, this article carries out a comparative study to explore the perfect path for China's antitrust enforcement mechanism.

Keywords: Antitrust law · Enforcement mechanism · Comparative study · Legislative system

1 Introduction

China and the United States are at different stages of economic development. Their antitrust legislation differs in terms of regulatory strength and regulatory bodies. Different legislative principles and models affect the development of antitrust practices in the two countries. For example, China and the United States have completely different results of the case of Qualcomm, which is mainly because of the differences in the antitrust legislation of the two countries, specifically, the provisions of the law enforcement mechanism. It can be seen that there are obvious differences in the legislative thinking and legislative models between China and the United States.

At present, the current US antitrust law system mainly includes the Sherman Antitrust Act of 1890, Clayton Antitrust Act of 1914, and Federal Trade Commission Act of 1914 [1]. China's law enforcement mainly relies on the Anti-Monopoly Law of China. Although the Anti-Monopoly Law of the People's Republic of China (Draft Amendment)

was reviewed at the 31st Session of the Standing Committee of the 13th National People's Congress on October 19, 2021, the amendment mostly focuses on increasing fines and strengthening the fundamental status of competition policies. There are relatively fewer contents of regulating antitrust law enforcement agencies, and a systematic law enforcement mechanism needs to be further constructed. The organizational form, leadership mechanism, and responsibility distribution system of antitrust law enforcement agencies largely affect the effectiveness of law enforcement in the market economy. Based on the differences in the provisions of relevant law enforcement agencies and authority in the antitrust laws of China and the United States, this article aims to learn successful legislative experience and explores ways to improve the legislative norms of China's antitrust law enforcement system from both theoretical and practical levels.

2 Reasons of Current Legislation Problems

Based on the case of Coca-Cola's acquisition of Huiyuan, the differences in the enforcement mechanism provisions of the antitrust legislation between China and the United States are concentrated in the following aspects.

2.1 Statutory Authority of Law Enforcement Entities

Antitrust law enforcement agencies are administrative agencies in nature, so their powers should be limited to administrative powers. However, in modern society, in addition to administrative powers, many antitrust law enforcement agencies actually have quasi-legislative and quasi-judicial powers.

As the antitrust law is highly professional, the legislature generally only stipulates the law in principle, and authorizes the antitrust law enforcement agencies to formulate specific rules and regulations. This legislative power owned by these law enforcement agencies is known as the quasi-legislative power in academia. In addition, due to the integration and penetration between administrative power and judicial power, administrative agencies have adopted a large number of judicial-like practices in the process of investigating and handling cases. They have certain characteristics of justice, exercise certain judicial functions, and ultimately have considerable judicial effects. This kind of power enjoyed by administrative agencies is called the quasi-judicial power [2].

Currently, China's antitrust law enforcement agencies only enjoy administrative law enforcement powers and quasi-legislative powers, but lack quasi-judicial powers. Law enforcement agencies with quasi-judicial powers have higher and stricter requirements in terms of professionalism, independence, and judicialization of trial procedures, which better protect the rights and interests of the parties and are more conducive to fair investigation and handling of cases.

The quasi-judicial power of US antitrust law enforcement agencies is manifested in that if the committee believes that a violation of the antitrust law does exist, the committee will formally file a lawsuit. The prosecution is in the charge of the Competition Bureau. Then, the administrative judge will hear the case in roughly the same way as the federal courts. After the trial, the administrative judge shall make a preliminary written judgment on the case, and report the judgment, facts, and legal basis to the committee. This has greatly improved the efficiency and fairness of antitrust law enforcement agencies.

2.2 Types of Liability for Violation and Punishment

Currently China has no criminal liability for monopoly crimes. Although the Anti-Monopoly Law has a specific chapter of “Legal Liability”, it only stipulates the corresponding civil and administrative liabilities of the monopolistic actions carried out by market entities. The provision that “Where the monopolistic conduct of an undertaking has caused losses to another person, it shall bear civil liabilities according to law; and if a crime is constituted, criminal liability shall be investigated for in accordance with law” [3] in the draft is deleted. It is only stipulated in Article 52 that “Where, during the review and investigation conducted by the authority for enforcement of the Anti-monopoly Law, a unit or individual refuses to provide relevant materials or information, or provides false materials or information, or conceals, or destroys, or transfers evidence, or refuses to submit to or obstructs investigation in any other manner, the authority for enforcement of the Anti-monopoly Law shall instruct it/him to rectify, and a fine of not more than 20,000 yuan shall be imposed on the individual and not more than 200,000 yuan on the unit; if the circumstances are serious, a fine of not less than 20,000 yuan but not more than 100,000 yuan shall be imposed on the individual and not less than 200,000 yuan but not more than one million yuan on the unit; and if a crime is constituted, criminal liability shall be investigated for in accordance with law”.

The United States has established corresponding criminal liability for serious joint restrictions on competition, for example criminal sanctions for “essentially illegal” monopolistic behaviors such as price fixing, bid rigging, and market division. This is more conducive to the development of the market economy and the protection of legitimate rights and interests of business operators and consumers. US adopts a fine method that associates the penalty amount with the illegal amount, that is, the greater the number of illegal gains, the greater the number of fines. However, China adopts a fixed amount of fines, compared with which, the US regulation is more flexible and has better effects.

The differences in penalties in the current legislation are directly reflected in the antitrust law enforcement practices of the two countries in recent years. For example, in 2013, China issued 353 million yuan in fines to six foreign companies. The six companies including Samsung and LG from South Korea and Chi Mei, AU Optronics, Chunghwa Picture Tubes, and HannStar Display from Taiwan conspired to manipulate LCD panel prices and implemented price monopoly in mainland China. The total amount that has been refunded, confiscated, and fined was up to 353 million yuan [4]. However, the United States has previously imposed antitrust penalties on the above-mentioned six panel manufacturers, with a total fine of US\$1.215 billion, and investigated for criminal responsibility to nine executives in three companies [5]. The fine equaled to RMB 7.642 billion yuan according to the USD-CNY exchange rate of 6.2897 on January 4, 2013. The handling of the case in China at that time was based on the Price Law, which applied fixed penalties. However, the current provisions of the Anti-Monopoly Law still adopt relatively fixed penalties, and the penalty is not bound to corporate sales, so the punishment effect cannot be equal to that under the US legislation.

2.3 Law Enforcement Transparency

Regarding the disclosure of antitrust law enforcement, China's Anti-Monopoly Law stipulates that where after investigation into and verification of the suspected monopolistic conduct, the authority for enforcement of the Anti-monopoly Law concludes that it constitutes a monopolistic conduct, the said authority shall make a decision on how to deal with it in accordance with law and may make the matter known to the public.

However, in practice, the timeliness and degree of disclosure of antitrust law enforcement process and result have failed to meet the requirements of due process. In contrast, the United States adopted the Hart–Scott–Rodino Antitrust Improvements Act to apply the secondary request system to the investigation stage before a major centralized processing, that is, if the investigative agency believes that more detailed information is needed to release a proposed proposal of a possibly fierce competition or to support the initial conclusion that the transaction is illegal believed by the law enforcement agency, additional documents can be issued through a second request. The Federal Trade Commission considers this to be the best indicator that a particular transaction is suitable for consultation and information. In addition, the development of the practice of antitrust case disclosure in the United States also relatively takes the lead. Its antitrust enforcement agencies have disclosed a large amount of information through guidelines, statements, speeches, evidence, and public case declarations, which has facilitated downstream companies and end consumers whose legal rights have been infringed to claim the return of unjust enrichment. It can be seen that the differences in the transparency of law enforcement directly affect the public satisfaction of antitrust law enforcement in China and the United States.

In current decision of full disclosure in China, the antitrust law enforcement agency has only held formal hearings in a few cases such as Coca-Cola's acquisition of Huiyuan and Pfizer's acquisition of Wyeth. Even so, the opinions of all parties, relevant evidence, and cross-examination at the hearing, as well as the parties' defenses were not publicly disclosed and analyzed in detail in the handling decisions of the two cases. In reality, experts suggest that the Ministry of Commerce should disclose the data and details of the review procedures, so that the public can better think about the correctness of the Ministry's decision.

In contrast, the US Congress often holds antitrust hearings, and the Antitrust Panel of the Judiciary Committee of the House of Representatives also publishes reports on investigation details. For example, the U.S. Department of Justice held hearings against Alphabet's Google's antitrust litigation, which is open to the public or the media. On June 20, 2019, the American Antitrust Institute (AAI) held the 20th Annual Policy Conference of "Strengthening Antitrust Law Enforcement". Joseph Simons, Chairman of the US Federal Trade Commission (FTC), awarded Stephen Calkins the 2019 AAI Antitrust Achievement Award and the Jerry S. Cohen Antitrust Scholarship, and David Cicilline, Chairman of the Antitrust Panel delivered a keynote speech [6].

2.4 System Design in Enforcement Remedy

The design of the remedy system in antitrust law enforcement can reflect the rationality and perfection of the country's law enforcement system. As an important system of right

remedy, the leniency system means that cartel members actively provide information and evidence to the antitrust law enforcement agency when the behavior has not been discovered and assist in investigation, thereby obtaining mitigation or exemption from punishment [7].

In practice, Article 46 of the Anti-Monopoly Law of China stipulates in a general way that “If the business manage, on its own initiative, reports to the authority for enforcement of the Anti-monopoly Law about the monopoly agreement reached, and provides material evidence, the said authority may, at its discretion, mitigate, or exempt the undertaking from, punishment. Because it’s too general, its implementation effect does not reach the original intention of the legislator. In 2013, the heated case of ”milk powder monopoly “ ended with six major milk powder companies paying huge fines. However, three of them – Wyeth, Beimgmate, and Meiji – applied the leniency system because they voluntarily admitted illegal facts and were exempted from punishment, which aroused strong public response. Although the original intention of Chinese legislators may not be to universally apply the leniency system to all monopolistic entities, the simple system design does lead to unreasonable handling.

The leniency system of the US antitrust legislation has formed a complete system, including corporate leniency policies and personal leniency policies in terms of subjects, and criminal liability leniency and civil liability leniency in terms of legal liability. It has become a sharp sword for the US law enforcement authority to investigate and deal with monopoly and restrict competition. It effectively maintained the order of market competition. Data shows that since 1997, in the case that the US fined companies that had taken part in international cartel over 2.5 billion USD, at least 90% of them applied for leniency and assisted in investigations. A number of international cartel cases such as the cartel cases of vitamin, graphite electrode, and dynamic random-access memory were solved. Since then, the leniency system of the US antitrust law is well known as the most effective legal tool to deal with international cartels [8].

3 Construction of a Completed Antitrust Legal System in China

Based on the comparative analysis of Chinese and American antitrust legislation articles and practical cases, it can be found that the provisions related to enforcement mechanisms in China’s current antitrust laws and regulations still need to be improved. Although the newly promulgated “Anti-Monopoly Law (Draft Amendment)” has strengthened centralized review in financial, media, and other fields, improved legal liability, and increased the penalty and credit punishment to legal representatives, main responsible persons, and directly responsible personnel of the operators who have had a monopoly agreement. However, it can still become more scientific and rationalized in terms of the authority of the subject of law enforcement and the specific implementation of law enforcement. From the perspective of comprehensively constructing China’s antitrust law enforcement system, the revision of current regulations can be discussed from the following perspectives.

3.1 Clarify the Legal Status and Scope of Authority of the Subject of Antitrust Law Enforcement

First of all, on the basis of the US legislative model, the status of the antitrust law enforcement subject should be clarified in the Anti-Monopoly Law. It should be given quasi-legislative power, quasi-judicial power, and administrative power to have a legal basis for its more comprehensive work. Secondly, it is possible to further clarify the type of authority of the antitrust law enforcement subject through the implementation of detailed rules. With an enumerative legislation, the specific action that can be implemented by the subject will be clarified. In addition, when conditions are favorable, it is possible to adopt the method of legislation with a list to stipulate the statutory action of the law enforcement subject in the form of an attachment. Finally, in the process of establishing the quasi-judicial power of the antitrust agency, several adjudication teams can be set up according to different industries, allowing them to make independent decisions in accordance with judicial procedures.

3.2 Distinguish the Liabilities and Punishment Methods of Different Attributes

In terms of administrative liability, currently, the calculation of fines in China's antitrust law enforcement are relatively vague, which leads to problems such as poor enforcement effects. Considering the US legislation and practice, on the one hand, China can adopt floating fines related to turnover on the basis of flexibly adapting corresponding regulations to classify enterprises according to their turnover. Enterprises of different sizes shall apply different fine standards, so that the fine can be calculated based on the balance of multiple factors.

In terms of criminal liability, anti-monopoly legislation should criminalize actions such as fixing prices, dividing markets, and colluding bidding, and set severe criminal liabilities. These "essentially illegal" behaviors not only have serious social harm, but are also ethically blameworthy. Therefore, it is not enough to pursue their civil or administrative liabilities, and criminal sanctions must be imposed on them [9]. The criminal liability of the "monopoly crime" should be severe enough to deter potential offenders in order to crack down on current offenders, deter potential offenders, and protect the welfare of consumers and society.

3.3 Rely on the Internet to Improve the Transparency of the Law Enforcement Process and Results

In theory, the disclosure of law enforcement activities can be divided into three stages, namely, the disclosure of the regulation before the event, the disclosure of the enforcement actions during the event, and the disclosure of the results after the event. On this basis, first of all, an antitrust law enforcement platform should be established and relevant antitrust legislation texts should be made public, so as to provide expectations for operators' business behaviors. Second, the review information should be disclosed in a timely manner, and the scope of information disclosure should be appropriately expanded, such as the specific reasons and details of the review decision and the specific criteria for fines, etc. The evidence of cartel crimes is made public, so that consumers, commercial organizations, lawyers, and others can understand the harmfulness

of monopoly and the nature of the crime, change the views of enterprises and citizens on main cartels, and fill the information gap between citizens and antitrust authorities. On the other hand, they can also encourage operators to adjust their behavior and actively avoid monopolistic behavior. Third, the social impact after the completion of antitrust law enforcement should be emphasized and disclosed. For example, within a certain period of time after enforcement, subjects who have been violated by previous monopolistic behaviors should be investigated to learn about their satisfaction with the results of the law enforcement and make it public to the society. It can provide good feedback for antitrust law enforcement, and at the same time introduce social forces to supervise law enforcement activities. Finally, the speed and quality of disclosure should be improved and hearings should be held to normalize information disclosure.

3.4 Improve Legislative Technology and Build an Antitrust Law Enforcement Remedy System

In the process of advancing the overall construction of the antitrust law enforcement system, in addition to the provisions of law enforcement itself, the regulation of remedy mechanisms is equally important. Presently, China should focus on improving the remedy system.

First, an anonymous consultation system can be established. Before applying for remedy, the applicant can anonymously consult the authority through certain methods, which can be face-to-face consultation, or through phone calls, emails, etc. The content of the consultation can be the conditions required to apply for remedy, including the time of application, the evidence needed, etc., or possible consequences after remedy. Second, the application time should be further clarified. China does not stipulate the specific time when the applicant can file an application for remedy in Anti-Monopoly Law. It can be learnt from the United States that the applicant can apply before or after the investigation begins [10]. Third, the responsibility system needs to be improved. There should be clear regulations of the scope of responsibility reduction and exemption in the remedy system. Fourth, the standard of remedy should be improved. A combination of full exemption and partial exemption for stepped reduction and exemption can be adopted. Specifically, it can be learnt from the US. Whether before or after the investigation, the first applicant can get full exemption if meeting the requirement. If you meet the conditions, you can get a full forgiveness. The second applicant will be granted 30%–50% exemption, and the third and subsequent applicants will be given exemption of no more than 30% and no less than 10%. This kind of stepped reduction and exemption regulations can inspire law enforcement objects to apply the system reasonably, so as to maximize the effect of the system.

4 Conclusion

In the thirteenth year after the promulgation of the Anti-Monopoly Law and the fourth year after the Chinese antitrust law enforcement agency having achieved the “triple play”, China is strengthening the antitrust management after the release of Anti-Monopoly Law of China (Draft Amendment). Under the current background, it is possible to clarify

the powers of law enforcement agencies, establish criminal responsibilities and increase penalties, establish and improve an open platform for antitrust law enforcement, improve the application of the remedy system, and carry out corresponding institutional reforms to ensure the fairness and effectiveness of law enforcement and the legal rights and interests of the parties and related interested parties. It will further explore China's antitrust mechanism, strengthen the law enforcement capabilities of antitrust law enforcement agencies, promote the improvement of antitrust law enforcement, protect fair competition, and promote the healthy development of the socialist market economy.

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An Evaluation of the Sharing Economy Market for Umbrellas in Urban China

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Abstract. In 2017, several umbrella-sharing platforms were started but most failed to grow and thus closed operations. In this paper we analyze the problems of the traditional umbrella market and the new umbrella-sharing market, proposing an alternative business model, which features delivery rider, online platform with a large number of sticky users, and express cabinet and thus focuses on umbrella-delivery service to improve user experience. Based on several studies, this work finds that the designed umbrella sharing economy model has some market possibilities, if some key designs that users care about are implemented. This research contributes to an improved understanding of the sharing economy more broadly.

Keywords: Sharing umbrella economy · Market analysis · Delivery service

1 Introduction

More people are living and commuting within urban areas using public transportation as well as walking. This condition increases the need for individuals to carry around or have access to umbrellas. Particularly in regions of heavy rainfall, such as in the southeast of China, there is decreased predictability of weather patterns. Such unpredictability results in numerous incidents in which commuters do not have access to their previously purchased umbrellas, and alternatively an increased number of incidents in which commuters must carry around the umbrellas but do not actually need them. These problems relate to deficiencies in the existing ownership model of umbrellas.

Given the rise in the sharing economy business model as a means for addressing problems associated with the ownership model in other markets (e.g., bikes, cars, homes), this work looks to investigate the potential market for an umbrella-focused sharing economy business model, which is different from the models put forward by some existing umbrella-sharing startups.

This work systematically examines the desirability, feasibility, and viability associated with an umbrella-focused sharing economy business model. From conducted surveys, interviews, and simulation tests of potential customers in aimed market segment, this paper concludes that customers do indeed experience problems associated with the traditional ownership model of umbrellas. This paper contributes to a greater understanding of the opportunities for the umbrella-sharing economy business.

2 Literature Review

In 2020, rainfall is mainly distributed in most areas of the south region, with less rainfall in the northwest, northeast and southwest regions, and the same level of rainfall area presents the characteristics of banded distribution as shown in Fig. 1 [1]. In recent 5 years, the effective precipitation days in the Yangtze River Delta and Pearl River Delta in the subtropical monsoon climate region are 60 to 80 days, which is twice as many as other key regions, with one effective precipitation day in every 5 to 6 days on average as shown in Fig. 2 [2].

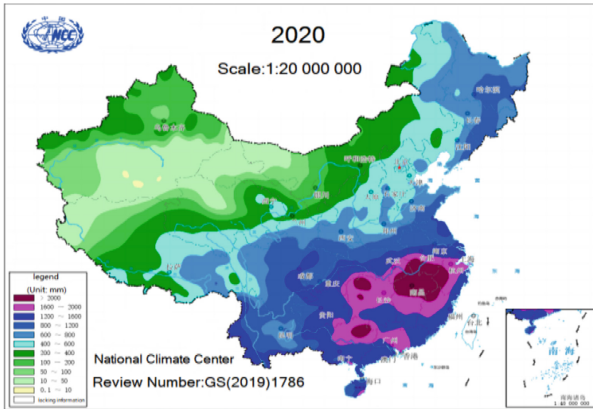


Fig. 1. National precipitation distribution map in China [1]

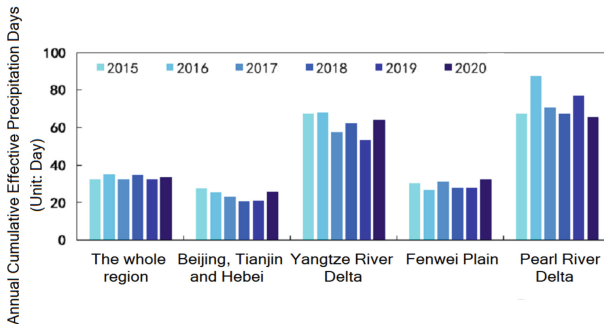


Fig. 2. Annual cumulative effective precipitation days (daily precipitation ≥ 5 mm) in China and key regions from 2015 to 2020 [2]

However, a survey of 203 people, most of whom are college students, shows that 72.41% of them do not always carry an umbrella as shown in Fig. 3 [3].

In summary, the current ownership-based business model of simply making and selling umbrellas does not fully address the customers ‘need to be able to reach their destination when it rains.

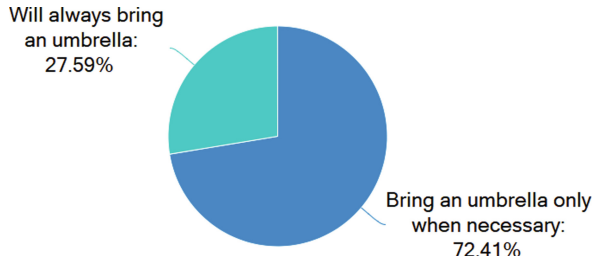


Fig. 3. A graph of a questionnaire about umbrella-using behavior [3]

To address the challenges with this current approach, some enterprises have explored alternative business models and sales channels associated with umbrella usage. For instance, kinds of umbrellas with QR code appeared in and around traffic stations. E-umbrella Sharing Corporation, Magic Umbrella Corporation, Umbrella Network Technology, and other enterprises have entered the market. Two types of models are put forward by these startups. In the first type, umbrellas are stored in self-service terminals for umbrella-rental. In the second type, locked umbrellas are hung randomly on the road guard rails and customers need to scan the QR code, pay the deposit through cellphone, and open the lock on the handle. Enterprises running the second model have not been accepted by the market and the government. For example, in 2017, 50,000 shared umbrellas hung on the road guard rails were removed from the rails for violating Hangzhou City's Urban Appearance and Environmental Hygiene Management Regulations [4].

At present, the best developing enterprise with active users is Tiansan Umbrella Company with self-service terminals for umbrella-rental. The consumer fees associated with this model involve a 39-yuan deposit and 2-yuan daily service charge. Liang Rui, director of operations at Tiansan Umbrella Company, said it was hard to make a profit with a 24-h service charge of 2 yuan [5].

According to Du's investigation of the umbrella sharing economy, the author found that two significant problems that companies in this market face regarding the durability of the umbrellas and the limited incentives for users to take care of those umbrellas [6].

Despite these challenges, there may remain opportunities to explore this market through a thorough consideration of practicability, versatility, legitimacy, initiative, individuation, and market segmentation [7]. In conclusion, the existing literature found that the traditional umbrella market has industry shortcomings, and some existing umbrella sharing companies also have great shortcomings in terms of legitimacy. However, most recent literature has neither put forward new models to solve the existing problem nor discussed ideas and paths for the better development of the shared umbrella industry.

3 Research and Method

A set of important hypotheses related to the desirability, feasibility, and viability of an alternative business model were tested to explore the opportunity for a shared economy market for umbrellas in urban China,

3.1 Study 1 (Questionary)

Hypothesis. Customers currently face problems with using traditional umbrellas.

Methodology. A standard questionnaire was designed and a questionnaire survey of 135 people, who were randomly selected from the urban areas in China, was conducted in the study. This study examined umbrella-related issues faced by customers who use umbrellas in traditional ways.

Result. 29.1% of questionnaire participants indicated that the weight of umbrellas would reduce their willingness to carry them. 2. 48.8% of users would continue to use an umbrella when it was not very badly broken. 3. 47.8% of users would replace an umbrella within six months. 6. Quality and brand were the main factors that most of the respondents considered when buying an umbrella. In terms of usage time and damage of umbrellas, the percentage of users who often encountered the problem of umbrella handle damage was 41.9%, the percentage of users who often encountered the problem of umbrella holder breakage was 34.8%, the percentage of users who often encountered the problem of umbrella cap lost was 41.9%, and the percentage of users who often encountered the problem of umbrella lanyard lost was 46.4%.

According to the above data, it can be concluded that more than 30% of customers who currently use umbrellas do face problems. When using umbrellas in traditional ways, customers may face problems such as broken umbrellas, heavy umbrellas, and frequent replacement.

3.2 Study 2 (Interview)

Hypothesis. The demands for a temporary umbrella service are most likely to arise in individuals who commute to work by way of public transportation.

Methodology. Specific interviewees were selected for this interview. In our continuous observation of a subway exit from November 1 to November 5, 2021, The numbers of people waiting for the rain to stop at this subway exit in three conditions of sudden rain were 2, 3, 2 respectively. Three of them were interviewed.

Result. The interviewees expressed the following three demands for umbrellas and daily commute:

Functional Jobs. Customers want to always get to the destination safely and smoothly.

Social Jobs. If I haven't take an umbrella with me in advance, many people will pass by me and I may look bad. If many people order umbrellas online and have them delivered to their Own hands, customers who think the process is compelling may desire to try them with the crowd.

Emotional Jobs. Customer don't feel good when they have to wait for the rain to stop. They want to seek for peace of mind when they haven't taken an umbrella in advance.

The absence of an umbrella in the bag when it rains is related to a problem about customers' demand for travel jobs. Some customers are eager to solve the problems.

The problem that citizens haven't taken an umbrella with themselves in advance in rainy days will damage people's attempt to finish the journey and keep a decent job. Anxiety may arise because of this problem. At present, traditional umbrellas in the umbrella market are not all the same, which may lead to different satisfaction degree of customers with umbrellas. At the same time, customers' demands are not satisfied when they find that they have not taken an umbrella in rainy condition. This case may put forward new requirements on the distribution channels of umbrellas.

3.3 Study 3 (Questionary)

Hypothesis. Customers have strong preferences related to the features of umbrellas.

Methodology. A standard questionnaire was designed and a survey of 112 people who live in second-tier cities in China and in areas covered by metro lines were done. The final results of the survey were that 67 of the respondents were male and 45 were female, with an age distribution of 20 to 70 years old, all living in second tier and first-tier cities in China with dense metro lines.

Result. Among the respondents, 41.9% of users generally buy umbrellas from small supermarkets and street stalls. 73.9% of customers generally buy umbrellas at the price of 10 to 50 yuan. Black and green umbrellas were favored by 69.2% of respondents, unpatterned and landscape patterns were favored by 76.9%, and straight thick and cylindrical handles were favored by 75.1% of respondents.

There is indeed a correlation between customer buying behavior and the characteristics of umbrellas.

3.4 Study 4

Hypothesis. Customers are interested in using an umbrella sharing service.

Methodology. *Part 1 (Questionary).* A survey of 13 regular subway riders, who were not in advance aware of that they could choose to get a delivery service for an umbrella, was conducted. Questions were asked one by one to make sure that the questionnaire was effective. The respondents, seven men and six women, ranged in age from 20 to 70 and all lived in China's second tier and first-tier cities with dense subway lines.

According to the feedback of 13 interviewees, when it rains occasionally, they do not bring an umbrella. In this case, they choose to take a didi, take a rickshaw, buy an umbrella nearby, ask family or friends to pick up, wait for the rain to stop, or run to the destination in the rain as shown in Fig. 4.

When we got their answers, we added an option: A platform (e.g., Meituan, Eleme) has an umbrella delivery service. Thirteen people were asked to report their choices when they found it suddenly raining at the entrance to a subway station without an umbrella.

Choices of the questionnaire recipient

When you are leaving the station and it happens to rain, but you don't have an umbrella with you, what would you choose to solve the problem you are facing? [Multiple choice]

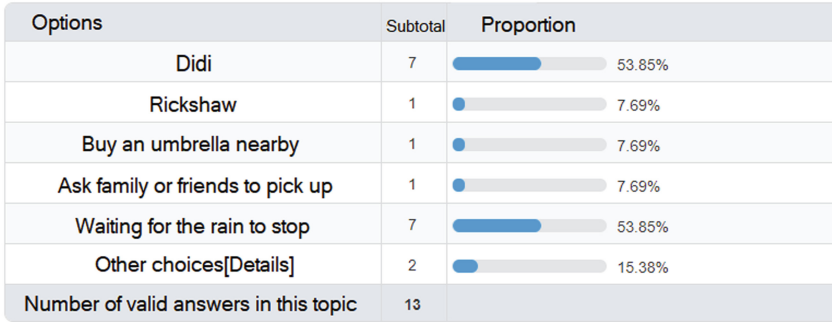


Fig. 4. Customers’ choice when it rains without an umbrella

Would you consider choosing an umbrella delivery service if it was available in a platform(e.g., Meituan, Eleme) and the delivery time was less than 5 minutes? [Single-choice question]

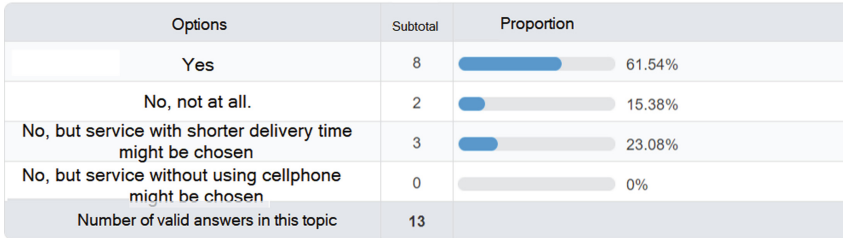


Fig. 5. Customer’s reaction when delivery service appears

61.54% respondents (8 people) indicated that they would like to try umbrella sharing delivery service as shown in Fig. 5.

Part 2 (Table Score). To ensure the credibility of our hypothesis, we conducted a further survey on 8 customers who chose the first option in the questionnaire (namely the “yes” option) by way of scoring in a table, as shown in Fig. 6, from an industry strategy model [8].

They were given a form printed on A4 paper with no other information than the form. The scenario in the form was that the respondent was faced with four choices when riding the subway without an umbrella, and all he had to do was to measure and score the four choices. The horizontal coordinates are Umbrella shaing, DiDi, Rickshaw, Retail store nearby, and the vertical coordinates are Exposure, Fixed cost, Service options, Price, Inventory, Pro-enviroment, Acquirement time. This study performed an arithmetic mean operation on the scores of the eight customers.

Result. Sharing umbrella delivery service has certain competitive advantages, and some customers will try sharing umbrella delivery service.

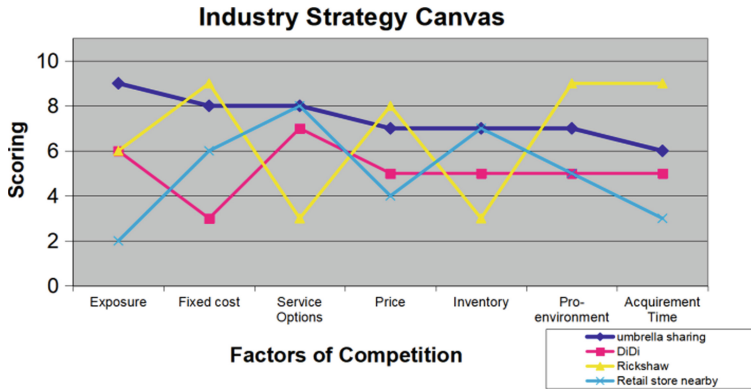


Fig. 6. Industry strategy canvas

3.5 Study 5 (Interview)

Hypothesis. The demand for shared umbrellas is price-elastic.

Methodology. We conducted a follow-up interview with 13 frequent subway users from Study 4. This study designed an investigation on the intended price of sharing umbrellas with delivery service and interviewees were asked about the degree of acceptance of different price-areas of shared umbrellas with delivery service. After getting the feedback of respondents on the four conditions of high price, high price, low price, and low price of selective sharing umbrellas, we analyzed the data.

Result. In the topic of “Expensive”, 7–9 got 1 vote, 10–12 got 8 votes, 13–15 got 3 votes, and 19–21 got 1 vote.

In the topic of “Too Expensive”, 7–9 got 1 vote, 10–12 got 2 votes, 13–15 got 4 votes, 16–18 got 2 votes, 19–21 got 2 votes, 22–24 got 1 vote, and 28–30 got 1 vote.

In the topic of “Cheap”, 1–3 got 4 votes, 4–6 got 3 votes, 7–9 got 3 votes, 10–12 got 2 votes, and 13–15 got 1 vote.

In the topic of “Too Cheap”, 1–3 got 8 votes, 4–6 got 2 votes, 10–12 got 1 vote, and 13–15 got 2 votes.

We graphically depict the user’s perception of price on the graph shown in Fig. 7, through a price test model [9].

From the intersection of the four curves, this study concludes that when the selective sharing umbrella has not been put into the market, the lowest price that existing customers can accept is 7 yuan, and the highest price that existing customers can accept is 12 yuan.

3.6 Study 6 (Interview)

Hypothesis. Customers are willing to pay for shared umbrellas.

Sharing economy business models will generate relatively large cash flows.

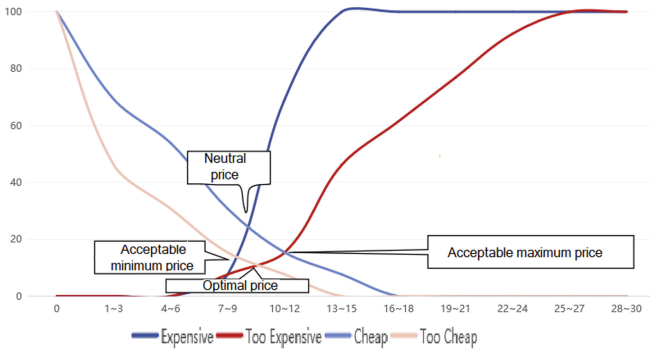


Fig. 7. Price test chart

Methodology. Step 1. First of all, this study proposed three new service modes, and then selected 10 seed users as interviewees. This study conducted the whole investigation process from their choices about traditional umbrellas and three shared umbrella service modes.

To meet the needs of different segments of customers, we improve the selectivity of services, and the quality of delivery services.

The first mode. Lifetime subscription and stock umbrellas. The first type of customer pays 260 RMB to become a lifelong subscriber, enjoying daily weather information service and priority umbrella delivery service. Without on-site payment, the customer can obtain six umbrellas in stock. When the customer places an order online to receive umbrella service, rider of the platform are regulated to wait for a longer time at the delivery site without premium charge.

The second mode. Monthly membership fee paid in advance and umbrellas at cost for each order. When a customer becomes a monthly member on an online platform (e.g., Meituan, Eleme), they receive several 6 RMB coupons, and this study assumed that they could use these coupons for sharing umbrella.

The third mode. Sharing umbrellas at full price. Customers without membership will pay full price for each umbrella.

Step 2. We found 10 seed users, all of whom always commute by way of subway and don't have a habit to carry their umbrellas around. They, all of whom can't wait to get our product and give us constructive feedback on it, are enthusiastic followers of our product.

This study used the model proposed by Neil Patel for calculation. In the study, "s" denotes "expenditure of any umbrella in each purchase", and "c" denotes "the frequency of any umbrella purchase every week" [10].

We asked questions about their daily expenditure on traditional umbrellas, got the approximate "s" and "c", and then calculated the "Average LTV" based on the estimated corresponding values of t, p, r, i.

Step 3. Then this study studied on sharing umbrellas. In order to analyze the actual cash flow of the project more effectively, this study obtained predicted data form selected seed customers through simulation tests and calculated a projected revenue amount.

This study used a simulated scenario approach, including showing pictures of the rain scenario and clearly describing the three types of services to help interviewees have an immersive perception of the rain scenario and be able to make estimates and predictions close to the real scenario state.

Our assumption is that every time they encounter the problem of finding themselves at the subway exit without an umbrella in the rain, they all choose our delivery service 100% of the time.

For the shared umbrella situation, we asked these 10 seed users about their choices.

The first model was chosen by 2 customers. The values of Number of Visits per Week were 0.11 and 0.12, respectively.

The second model was chosen by 3 customers. The values of Number of Visits per Week are 0.13, 0.15, and 0.16 respectively.

The values of Number of Visits per Week are 0.12, 0.14, 0.08, 0.15, 0.06 for 5 customers in the third mode.

In the first mode, s_1 is fixed at 12 (RMB) based on the share fee of 6 umbrellas in stock in the subscription fee. In the second mode, this study assumes that when a customer buys an umbrella, the coupon that the customer gets for paying the subscription fee is not used up and customers will definitely use the coupon. s_2 is 11 (RMB). In the third model, s_3 is a fixed amount of 12 (RMB).

Set The approximate number of weeks in a year(w) to 52

Set The Average Customer Lifespan(t) to 30(years)

Set Profit Margin per Customer(p) to 0.123.

Set Customer Retention Rate(r) to 70%.

Set The Rate of Discount(i) to 8%.

w = The approximate number of weeks in a year

s = Average Customer Expenditures per Visit

c = Number of Visits per Week

a = Average Customer Value per Week

t = The Average Customer Lifespan

r = Customer Retention Rate

p = Profit Margin per Customer

m = Average Gross Margin per Customer Lifespan

i = The Rate of Discount

$$a = 0.2 * s_1 * c_1 + 0.3 * s_2 * c_2 + 0.5 * s_3 * c_3 \tag{1}$$

$$m = \text{simple LTV} * p \tag{2}$$

$$\text{Simple LTV} = 52 * a * t \tag{3}$$

$$\text{Custom LTV} = t(52 * a * p) \tag{4}$$

$$\text{Traditional LTV} = m[r/(1 + i - r)] \tag{5}$$

$$\text{Average LTV} = (\text{Traditional LTV} + \text{Custom LTV} + \text{Simple LTV})/3 \tag{6}$$

Result. Average LTV of traditional umbrella = 1580, Average LTV of umbrella sharing = 996 RMB. The models characterized by shared umbrellas with delivery service can generate relatively large cash flows from one user.

4 Conclusion

In this work we proposed a new economic model of umbrella sharing. Our umbrella sharing model was designed with two main parts, inflow part and outflow part, as a consequence of our research which takes into account the needs of some customers to buy umbrellas and the needs of some customers to rent umbrellas.

4.1 Inflow

Users place orders on an online platform (e.g., Meituan, Eleme) to buy umbrellas and the riders send the umbrellas to users at the subway exit.

4.2 Outflow

If some customers choose to recycle umbrellas and get cash back, they need to put their umbrellas into the express cabinet, and the umbrellas will be delivered to the recycle center through the express system. Then, the umbrellas will flow into the market after the maintenance procedure and will be bought or shared by the next customer as shown in Fig. 8.

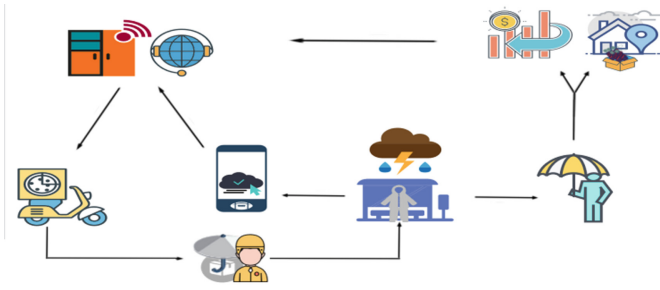


Fig. 8. Selectively sharing umbrella business flow chart

If customers don't choose to send their umbrellas back, they keep owning the umbrellas.

To solve the problem with wet umbrella surface after usage, we designed a new umbrella with an outlook as shown in Fig. 9.

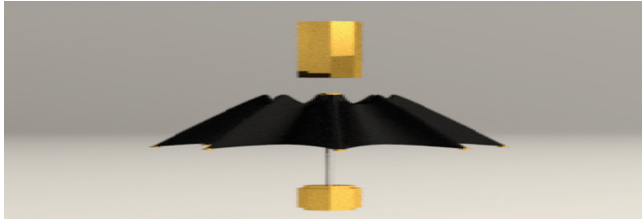


Fig. 9. A view of the designed umbrella in C4D

4.3 Our Pricing Mechanism

The cost of the umbrella is 10 yuan, the delivery cost is 2 yuan, and the total price is 12 yuan. When the customer chooses to send back the umbrella through the express cabinet, there are two types of cashbacks. The first, if the rental period is within a month and the umbrella is intact, they get cashback for 5 (RMB). The second, in other cases, they get cashback for 1 to 3 (RMB).

The above 6 studies offer evidence that the model we design can solve customers' problems, be accepted by customers, and generate enough income. Also, our work is of important reference significance for innovations in sharing economy market for other commodities.

However, the results of our work were limited by the insufficient number of samples we selected, and our model is only feasible in urban areas with service of riders and subways.

Some questions remain for require future research. Will customers in urban China gradually pay more money for shared umbrella services? How many customers will get in the habit of using umbrella sharing services instead of carrying their own umbrellas? Will the umbrella-sharing market grow beyond a large scale?

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Determination of Value β in the Capital Asset Pricing Model and Application to Corporate Rate of Return

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Abstract. This paper provides a comprehensive analysis of the feasibility of applying the Capital Asset Pricing Model (CAPM) to the valuation of the corporate rate of return in the US market. The CAPM provides a theoretical basis for the fundamental value of financial assets, with a focus on exploring the quantitative relationship between returns and risks of risky assets. This paper makes mathematical and empirical analyses on the measurement of risk-free payment coefficient, risk premium coefficient and the beta coefficient of enterprise risk degree, in order to provide theoretical support for the rational application of CAPM in the American securities market.

Keywords: APM · β coefficient · Risk-free · Payoff rate · Risk premium

1 Introduction

Sharp (1964), Liner (1965) and Mossion (1966) independently proposed the capital asset pricing model (CAPM) based on rational expectations and mean-variance theory, respectively, which laid the theoretical framework for studying capital market prices [1]. After continuous revision and development, CAPM has become an important tool for firms to make asset decisions. There are more theoretical methods for determining the discount rate, and the more common one in developed countries is to apply the capital asset pricing model for its determination.

In the CAPM, the return on capital is equal to the risk-free rate of return plus the degree of risk of the firm (β coefficient) and the product of the risk premium. It is calculated as:

$$R_i = R_f + \beta \times (R_m - R_f) \quad (1)$$

where R_i —the rate of return on capital of the enterprise. R_f —the risk-free rate of return. R_m —the average market rate of return. β —Firm riskiness coefficient. From the basic model, it is clear that the application of the capital asset pricing model is influenced by three main factors, the risk-free rate (R_f), the measurement of the risk premium estimation ($R_m - R_f$), and the measurement of the degree of corporate risk β .

2 Estimation β General Approach to Values

The beta coefficient is a risk factor that measures the sensitivity of changes in the return of a single stock to changes in the return of a market portfolio. The beta of a market portfolio is 1. If the beta of a stock is greater than 1, it means that the market risk of the stock is higher than the market portfolio risk, and vice versa, it is less than the market risk.

The beta of a portfolio is the portfolio’s individual stock β value of the portfolio as a weighted average. That is

$$\beta_p = \sum_{i=1}^n x_j \beta_j \tag{2}$$

Which x_j represents the stock j ’s weights in the portfolio, and β_j is the stock j ’s β coefficient.

The most common estimations of β are definition-based estimation, exponential model-based estimation, and CAPM model-based estimation.

2.1 Definition-Based Estimation Method

The coefficient β can be defined by the following equation:

$$\beta = \frac{\text{cov}(r_j, R_M)}{\text{var}(R_M)} \tag{3}$$

where $\text{cov}(r_j, R_M)$ represents the covariance of the return of stock j with the return of the market portfolio M , and $\text{var}(R_M)$ represents the variance of the market portfolio returns. However, since the returns on j and M are constantly changing, estimating the above equation β requires the assumption that returns remain relatively constant over a small period of time, deriving a small time of β value, and then adding the obtained values of β for each small time period and then summing them to obtain the β value for a given time period. It is often calculated using the following equation.

$$\beta = \sum_{t=1}^T (r_{jt} - \bar{r}_j)(R_{Mt} - \bar{R}_M) / \sum_{t=1}^T (R_{Mt} - \bar{R}_M)^2 \tag{4}$$

where r_{jt} denotes the return of stock j at time t (e.g., hours, days, weeks), and R_{Mt} denotes the return of M at time t , and T represents a certain time period. When using this formula, data on stock and market portfolio returns over a longer period of time are required.

2.2 Index-Based Model Estimation Method

An exponential model, also called a market model, is a method of analyzing stock returns using a single factor, which can be expressed as:

$$r_j = \alpha_j + \beta_{jt} R_{Mt} + \varepsilon_{jt} \quad \varepsilon_{jt} \sim N(0, \sigma^2) \tag{5}$$

The mean and variance of each security are recorded on a day-by-day basis, and these data are represented on a mean-variance coordinate plot that is roughly fitted to a conservative line, with the gradient of the line being the β_{jt} value.

3 Measurement of (R_f) the Risk-Free Rate of Return

The risk-free rate of return (R_f) refers to the percentage of return obtained by social investors investing in a financial instrument with high credit rankings and unchanging returns. Such financial instruments involve all types of deposits in banks, financial bonds, treasury bonds, and new financial instruments with the same credit rankings.

Another important point is that the risk-free rate of return is the value of capital when there is no risk of default on the principal and the expected income is guaranteed and is mainly influenced by average profitability, supply and demand for capital and government regulation. In countries with developed bond markets, such as the United States, three different views are considered important in the selection of the risk-free rate.

First Viewpoint: Using short-term Treasury rates as R_f , generally picking the three-month U.S. Treasury rate.

Second Viewpoint: Computation of the cost of equity for the beginning year by incorporating the historic risk premium produce on spot short-term bonds issued by the government versus the capital forum. Furthermore, the use of forwarding rate in the calculation to assess the risk-free rate for the forward period, which is considered as the cost of equity for the next periods.

Third Viewpoint: Use the commercial long-term Treasury rate as R_f and the historical equity market risk-return computed from the long-term Treasury rate as an assessment of the market return risk.

The shared three views are reasonable; the first view sees the Capital Asset Pricing Model as an only one-period risk-return framework, with spot temporary Treasury rates being rational anticipation of temporary interest rates for next periods. The second view emphasizes mainly the advantage of forwarding rates in forecasting the interest rates in the future, and the third view sees long-term Treasury bonds as having the same maturity as the asset being valued [2].

In professional practice, the three methods calculate the same result when the periodic arrangement of interest rates is similar to the historic connection between long-term and short-term rates and β is close to them. When the period arrangement diverges from the historical data, or when β is not closer to 1, the outcomes computed through these processes are not the same. In contrast, if the curve slopes rising to a greater extent, the rate which is discounted for the long-term is greater that may become undervaluation. If the curve slopes upward to a lower degree or even appears to slope downward, the opposite conclusion is reached.

Figure 1 illustrates the trend of the yield movement of the U.S. ten-year Treasury bond from 2019.10 to 2021.9. The U.S. ten-year Treasury yield is a very important indicator in the financial markets and can be considered a measure of all asset prices. It is equivalent to the cost of funds in U.S. dollars and therefore has a certain precedence effect. The ten-year U.S. bond yield has been the reference, benchmark rate of risky asset yields because it is generally believed that investors' demand for 10-year U.S. bonds reflects their allocation needs to low-risk or safe assets.

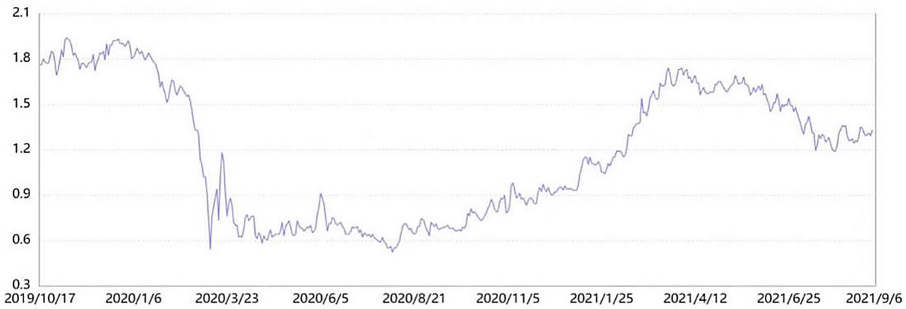


Fig. 1. The interest rate on ten-year US Treasury bonds

4 Estimation of the Risk Premium

The risk premium is how a person's personal tolerance for risk affects whether he or she will take the risk for a higher payoff, or just accept the income that has already been determined and forgo the higher payoff that might be obtained by taking the risk, given the different levels of risk and knowing that high risk is highly rewarding and low risk is less rewarding. The difference between the payoff of a risky investment instrument and the risk-free payoff is usually referred to as the "risk premium".

The formula $(R_m - R_f)$ is called the market risk premium. It is attached to the R_f , as a result of taking the average market risk required to obtain compensation, it reflects the market as a whole on the average degree of risk "tolerance" [3].

4.1 Introduction and Analysis of the Main Methods of Market Risk Premium (ERP)

Basic Calculation Formulae Used. Market risk premium = fundamental premium in mature stock markets + country risk premium (Aswath Damodaran 2010). Mature stock markets have rational investors and well-regulated market rules, stock data that are sufficiently large and well-diversified, and reliable historical data that are sufficiently long. In practical application, the US stock market is generally considered to be a mature market.

Two Measurement Methods. Two different approaches are generally used to measure risk premiums: the first is a vertical analogy that refers to the past is assumed to remain into the long-term and the level of past risk premiums computed using historic information is a prediction of the future; another approach is a horizontal analogy that means the level of risk premiums in competitive markets is appropriately adjusted to derive the level of market risk premiums to be calculated [4].

Data on Mature Markets in the United States. The valuation statistics reveal the use of the historic premium method to calculate the market risk is in line with common international practice, and the market data required for the historical premium method can be sourced from established international market data.

It is now generally accepted that US market data is a good choice for calculating the mature market risk premium, usually using the S&P 500, which has relatively comprehensive coverage of sectors and a long history, and the country risk premium adjustment usually takes the risk indicator of the country’s debt credit rating Fitch, Standard & Poor’s, and Moody’s are ranking organizations do country debt credit ratings, for example, Damodaran online provides The data is based on Moody’s rating data.

4.2 Research Methodology and Data

Modeling. To investigate the factors affecting the risk premium for U.S. equities, we use a traditional two-step regression. In the first step, a time-series regression based on a multi-factor linear model (6).

$$r_{it} - r_{ft} = \alpha_i + \sum_{j=1}^k \beta_{ij}f_{jt} + \varepsilon_{it} \quad t = 1, 2, \dots, T; \quad i = 1, 2, \dots, N \quad (6)$$

Among them, r_{it} is the yield of group i in time t ; r_{ft} is the interest rate, which is risk-free in time t ; f_{jt} is the risk premium of risk element j in time t (assuming there are K risk elements), which can be economic variables at the macro level and fundamental factors reflecting the characteristics of the company at the micro level; β_{ij} is the load or sensitivity of the portfolio i to risk factor j ; α_i is the excess return term; random perturbation term is $\varepsilon_{it} \sim \text{IID}(0, \delta_i^2) \forall i$.

The second step is based on the cross-sectional regression of (7) [3].

$$\bar{r}_i - \bar{r}_f = \lambda_0 + \sum_{j=1}^k \beta_{ij}\lambda_j + e_i \quad i = 1, 2, \dots, N \quad (7)$$

\bar{r}_i is the average yield of portfolio i throughout the sample term. \bar{r}_f is usual during the risk-free interest rate sample period³. Here β_{ij} is the estimate in the first step. λ_0 is the excess gain. Since it is the cross-section data, we expect e_i to be zero, but which has heterovariance and non-independence [5, 6].

Selection of Factors. The elements that impact the risk premium of a firm’s stock besides market risk are mainly divided into two categories one is macro factors reflecting economic conditions and the other is cross-sectional factors of firm characteristics. The role of investor psychology and political contingencies on stock market anomalies has been suggested, but investor psychological factors are reflected in market factors, while contingencies such as wars and scandals do not occur frequently. Therefore factors reflecting investor psychology as well as political events are not generally constructed separately.

Consider first the construction of the first category of factors, namely macro factors. Chen, Roll and Ross (1986) propose a model based on five macro factors [7]. These factors are the success percentage of production in the industries, the unanticipated percentage of inflation, the predictable rate of change in inflation, the credit risk premium

(calculated by the change in monthly earnings on corporate bonds and long-term Treasury and the term premium calculated by the change in earnings on long- and short-term Treasury bonds).

The second category that affects security returns is cross-sectional factors, i.e., factors that reflect the fundamentals of firm characteristics. Firm fundamentals factors refer to firm characteristics such as market capitalization, leverage and P/E ratio. French and Fama (1993) three-factor framework indicates that in addition to market returns, the size of the organisation and book-to-market fraction have dominant explanatory effects on returns of stocks [8]; Fama and French and Lakonishok, Andrei (1994) also determine the effect of earnings stock price (Earning/Price) and cashflow stock price ratio (Cashflow/Price) on stock risk ratio (Earning/Price) and Cashflow stock price ratio (Cashflow/Price) have a strong explanatory effect on equity risk premium.

In summary, this paper considers the following fundamental factors: earnings-to-stock ratio, firm size, book-to-market ratio, invested capital ratio, cash flow-to-stock ratio, and cash asset-to-capital ratio [9].

The third category of factors is more intuitive and includes mainly market returns, market volatility, market turnover, market trading volume etc. In this paper, we choose the traditional market yield or market premium factor.

5 An Empirical Test of CAPM in the US Market

This paper focuses on testing whether two assumptions of the CAPM model are valid in the US market. One, it is a linear relationship between the excess earnings of the equity portfolio and the coefficient of Beta. Two, the excess return of the equity portfolio is only related to systematic risks such as economic cyclicality risk, policy risk, purchasing power risk, interest rate risk, and the risk of the exchange rate, but not to unsystematic risks such as the firm's management, financial condition, market sales, and major investments.

5.1 Data Collection and Processing

Market Portfolio and Data Collection. In the presence of risk-free assets, it follows from the law of quantitative fund separation that the optimal demand for risky assets is the cut-point portfolio and the difference arises only from the quantity demanded. When the market reaches equilibrium, aggregate demand equals aggregate supply, at which point the market portfolio is the tangent portfolio. As shown in Fig. 2, geometrically, the intercept period moving over the line of the portfolio in midpoint is exactly the risk-free return R_f and we can get the highest return at point m. Roll (1977) points out that the one real assumption of the Capital Asset Pricing Model is that the portfolio of the market is proficient that should theoretically involve all resources in the different international economies and systems, but it is not possible in the case of data collection, so we need to use an index instead of the market portfolio. Using Sina Finance and mac stock software like databases, 600 stocks in the NYSE are collected, and 30 stocks are used as a portfolio, which contains all components of the U.S. capital market, and a

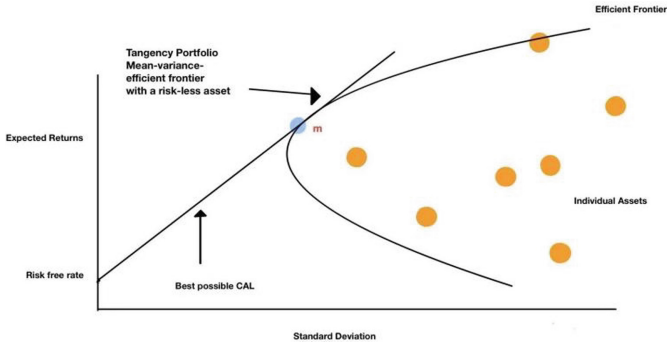


Fig. 2. Market efficient portfolio

value-weighted index is calculated using all equity as weights so that the CAPM market portfolio requirements are met.

Risk-Free Rate of Return. By analyzing the R_f in the third part of this paper, the annualized interest rate of the ten-year U.S. Treasury bond is considered as the R_f in this paper. The annualized interest rate of the ten-year U.S. Treasury bond in 2020 was found to be 1.343% in investing.com.

Market Returns. According to Wall Street Journal, the Dow Jones Industrial Average is 7.2% in 2020, which is the overall performance of the entire U.S. stock market.

5.2 Test for Linear Relationship

Based on the exponential model estimation method, β values were calculated for each firm.

$$r_j = \alpha_j + \beta_{jt}R_{Mt} + \varepsilon_{jt}\varepsilon_{jt} \sim N(0, \sigma^2) \tag{8}$$

The values of variance and mean of each security are recorded on a day-by-day basis, and these data are represented on a mean-variance coordinate plot that is roughly fitted to a straight line, with the slope of the line being the β_{jt} value.

Then using $\beta_p = \sum_{i=1}^{30} x_j\beta_j$ The risk factors of each of the 20 stock portfolios are calculated β_p , where x_j represents the weights in the portfolio of the stock j , and β_j is the stock j 's β coefficient. The CAPM model is simplified to a general expression as follows:

$$R_j = \omega_0 + \omega_1\beta_j + \varepsilon_j \tag{9}$$

where R_j denotes the corporate return on capital of the j th stock portfolio, and β_j denotes the risk factor of the j th stock portfolio, and the calculated R_j and β_j are substituted and the resulting regression results are shown in Table 1.

In the model, both coefficients ω_0 and ω_1 have significant p-values less than 0.05, indicating that the model can explain relatively well the relationship with the return on

Table 1. Regression outcome

	Coefficients	Standard error	t stat	P-value
ω_0	0.01387	4.86183E-17	2.85443443	0.00634791
ω_1	0.05857	4.2281E-18	1.3853E+16	0

capital and risk coefficients of 20 groups of stock portfolios and β values. The constant term of the regression equation ω_0 is 0.01387, which is close to the risk-free rate of 1.343%, indicating the stocks of each portfolio’s stocks are well diversified. Also, ω_1 is 0.5857 and positive, indicating that there is a significant positive relationship between excess return and systematic risk in the U.S. stock market, which is also consistent with investors’ high-risk, high-return psychology. In summary, the first point of the CAPM model’s hypothesis is basically met.

5.3 Cross-Sectional Inspection

The second assumption of the model is that the return on capital is related to systematic risk only. Therefore, the article introduces an unsystematic risk term δ and a quadratic term of the risk coefficient β^2 , to test whether these two terms affect the return on capital of the equity portfolio, yielding the following model after the change.

$$R_j = \omega_0 + \omega_1\beta_j + \omega_2\beta^2 + \omega_3\delta_j + \varepsilon_j \tag{10}$$

Table 2. Multiple regression result

Model	Non-standardized coefficient		t stat	P-value	
	Coefficients	Standard error			
1	ω_0	-0.001	0.001	-1.473	0.148
	ω_1	5.857	0.000	105,383.602	0.000
	ω_2	-1.327E-006	0.000	-1.365	0.179
	ω_3	0.000	0.000	1.302	0.199

From the regression results in Table 2, it can be seen that only ω_1 passed the p-value test and the coefficient ω_2 and coefficient ω_3 , according to the regression results, converge to zero. So it can be assumed that the return on capital of the 20-group stock portfolio is related to the risk coefficient β value and the relationships with the unsystematic risk term δ and the quadratic term of the risk coefficient β^2 are uncorrelated. In summary, the second hypothesis of the CAPM model is largely met.

6 Conclusion

The article first introduces the theoretical basis and model equations of the capital asset pricing model and then selects the U.S. stock market as the research object to test whether

the model is suitable for the share market of the United States. The study outcomes or findings represent that the risk coefficient of the share market of the United States has a positive relationship with the return on capital, and the risk coefficient has covered different elements of factors that have a high impact on the earnings on capital in the stock market, and the change of the excess return is not correlated with any other elements. These two points are very consistent with the general theory of the CAPM.

Capital Asset Pricing Model is the widely used technique or procedure to identify the cost of capital for an organization of its investment project, and the value in CAPM represents the sensitivity of the return of a company (investment project) to systematic risk, which is the parameter that must be estimated when using CAPM for securities investment or project investment. Therefore, this paper is of great significance for enterprises or investors to determine the values of unlisted companies and investment projects and thus make scientific investment decisions.

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Mean-Variance Model and Its Modifications in the Chinese Securities Exchange Market

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Abstract. Based on the classic mean-variance model, this paper makes a retrospective analysis of the efficiency and improvements of the model in China's securities market. According to the characteristics in the Chinese market, this paper evaluates several papers about mean-variance model, including the improvement of quadratic programming, integer programming, interval number and short and long selling respectively. Mean-variance models improved by Chinese scholars have proved their effectiveness in corresponding empirical studies. Improvements of mean-variance model have positive influence to enriching investors' ideas and providing referential value to the further development of China's securities market.

Keywords: Mean-variance model · Quadratic programming · Interval number · Integer programming · Long and short selling

1 Introduction

Harry Markowitz put forward the portfolio theory in 1952, and won the Nobel Prize in Economics in 1990 [1]. This theory includes the mean-variance model and the effective frontier analysis of portfolio, which is the beginning of quantitative financial research. In the mean-variance model, the mean value represents the expected average rate of return, and the variance represents the degree of the return deviation from the expected value. The basic idea of this model is to maximize the benefits under a certain risk, or to minimize the risk under a certain return.

$$\text{Max } \lambda w^T e - (1 - \lambda) w^T V w \quad (1)$$

$$\text{s.t. } w^T = 1 \quad (2)$$

$$\lambda \in \mathbb{R} \quad (3)$$

where w is weight vector, e is vector of expected rate of return, and V is matrix of covariance.

In summary, the solution set of the model is the effective boundary of investment portfolio. However, the establishment of this model needs to meet a series of strict

assumptions. For example, the yield of securities obeys a normal distribution, the investment assets are infinitely divisible, and rational people's assumptions about investors and the market are reasonable, etc. Therefore, the practical application of this model is limited by many factors. As far as China's securities market is concerned, Chinese scholars have also studied the performance of the mean-variance model in China's securities market. For example, short selling is not allowed in the market, stock trading has the lowest trading unit and so on. Many of them continue to improve the model on the original basis, making it more practical for Chinese investors.

2 Literature Review

Based on the Markowitz mean-variance model, Xu and He introduced the concept of interval numbers into the mathematical programming, formed the uncertainty optimization model to the condition that the market did not allow short selling, and put forward the interval quadratic programming model of investment portfolios [2]. Due to the real securities trading, the return is often a range rather than a certain value. Therefore, Xu and He used the interval number to represent a kind of uncertainty, and this article uses the interval number to represent the range of the expected return rate of the securities during the holding period [2]. By using the interval number sorting method (interval order relation, interval possibility and interval acceptability), two mathematical transformation model of interval nonlinear optimization of portfolios are given, so that the uncertain portfolio model is transformed into the deterministic portfolio quadratic programming model for solving, and the three solution are compared with traditional methods (the objectives of the interval quadratic programming problem of portfolio obtained by these four methods are compared with the risk value).

At the same time, Xu and He also put forward an idea for the optimization of the model [2]. That is, the transaction cost can be taken into account in the portfolio of securities investment with interval numbers. The solution of interval quadratic programming model is further improved. The development of these directions have certain practical significance and development space for studying the portfolio problem under uncertain environment.

Although the short selling mechanism plays an important role in the securities market, it has not been introduced in China. Xu et al. proposed that in real economic activities, investors can only get the expected returns [3]. Therefore, interval numbers are used to represent the expected returns, and this kind of problem is transformed into an interval programming problem. And they constructed the interval nonlinear programming model with negative investment ratio coefficient. Then, through the transformation of objective function based on the interval order relation, the transformation of uncertainty constraint of the interval probability and the transformation of uncertainty constraint of the interval acceptability, the deterministic single-objective quadratic programming model of portfolio is obtained.

Similarly, the example verifies that the covariance matrix of three securities yields is used to obtain the expected return range. Finally, they compared the target risk values obtained by different methods and chosen a satisfactory investment scheme. It is found that the result obtained by the method based on the acceptability of the interval with

the constraint condition is better. "Investors can weigh the risks they can bear with the actual investment portfolio return rate obtained, and then choose a portfolio scheme that satisfies investors."

On the basis of Xu's research, Wang et al. aimed at the investment portfolio problem in an uncertain environment and described the securities' yield, risk loss rate and liquidity (handover rate) with interval numbers, and established a new type of securities with transaction costs-the quadratic programming model of portfolio interval [2, 3]. In order to solve this model, Wang et al. proposed an improved deterministic conversion method of interval acceptability [4]. By introducing the optimization level α and the acceptability level η , the uncertainty quadratic programming was transformed into a deterministic programming.

Wang et al. uses the data in the cited literature as a numerical example, assuming that investors want to allocate assets to three kinds of securities (Oriental Group, SAIC Group, Minmetals Development), collecting the monthly closing prices and turnover rates of the corresponding securities from April 2005 to March 2009, and calculating the expected yield range, variance and covariance range and turnover rate range corresponding to the three kinds of securities, and assuming that the transaction cost ratio corresponding to the three kinds of securities is 0.0002, assuming that the acceptable range of investors' expected yield is [0.0015,0.002], and the corresponding acceptable range of liquidity is [0.40,0.01] (The upper and lower bounds of expected yield and liquidity here correspond to the investors' optimism and pessimism respectively) [4]. The empirical test results of the newly established interval quadratic programming model are compared with the test results of the previous similar model in the same group of data, and the new model has better performance in accuracy.

Through the research, Wang et al. found that with a fixed value of η , the greater the objective function optimization level α selected by investors, the greater the investment risk for investors [4]. With a fixed value of α , the greater the acceptable level of constraint conditions given by investors η , that is, investors' acceptance of the expected return rate and turnover rate will increase, and the risk that investors will have to bear will continue to increase. On the contrary, the smaller.

Yu and Li combined some actual conditions in the Chinese securities market, such as considering the degree of risk appetite, short selling is not allowed, transaction cost restrictions, minimum transaction volume restrictions, etc., and proposed some changes to the mean-variance model. In the subsequent empirical analysis, 15 stocks in different industries in Shanghai Stock Exchange were selected as investment options, and the improved model was used to find the optimal solution [5]. The results show that the model and algorithm are effective.

In the empirical analysis, the sample data comes from 15 stocks in different industries, and the earnings of the eight quarters from April 30th, 2010 to April 30th, 2012 are taken as the actual earnings. The conclusion the optimal portfolio obtained by the improved model is not compared with other portfolios, but the effectiveness of the improved model is discussed.

In China's stock exchange market, the trading rules require that the minimum unit of stock purchase is a batch (100 shares per batch), and each purchase should be an integer multiple of a batch. As M model has a series of assumptions, it is assumed that

the share of assets can be divided indefinitely, which is very inconsistent with actual transactions. Chen and Wang introduced the minimum transaction unit, extended the model to a quadratic integer programming problem, improved the branch-and-bound algorithm, and designed an effective algorithm to solve the model by combining the algorithm of quadratic programming.

In the empirical analysis, Chen and Wang assumed that an investor had 1 million yuan in assets and decided to invest in ten stocks [6]. He selected the daily closing data of these ten stocks for the whole year of 2009 and got the relationship chart between the expected rate of return and the risk, which proved the effectiveness of the proposed model.

Starting from the direction of strategy selection, this paper presents an analytical solution based approach to solve the portfolio optimization problem with short selling restrictions. And through empirical analysis and comparison of the performance of each investment strategy (mean-variance, minimum risk portfolio, “plate market value weighting, individual stock market value weighting, simple equal weight”), the five asset portfolios constructed by it outperformed the market in terms of revenue and risk during the period, which proves that the mean-variance portfolio has considerable reference significance for the asset management business in the domestic market. The conclusion of this article also mentions the current deficiencies: different estimation methods of parameters may lead to completely different results, and randomly generated asset markers cannot fully represent the market.

In the empirical analysis, the sample length is three years (2015.01–2018.01), and five securities are randomly selected from different industries to construct an asset portfolio [7]. It is concluded that the maximum withdrawal amount of the constructed mean-variance portfolio and the smallest risk portfolio is only half of the market risk, indicating that the investment risk has been clearly controlled after allocation.

Zhang Peng et al. proposed a mean-variance portfolio model of restricted short selling, in which the ratio of funds obtained from short selling to own capital is a certain value and the transaction volume of assets has an upper bound limit; Then, the model is transformed into a convex quadratic programming problem by variable substitution, and the rotation algorithm of inequality set is applied to solve the problem. In the example stage, the data quoted from the literature (six securities) are used for reference, and assuming that the investment proportion of each asset in the investment portfolio does not exceed 0.6 and the lowest acceptable return rate for investors is 0.08, the optimal investment proportion, expected return rate and standard deviation of the mean-variance investment portfolio are calculated for different ratios of borrowed funds to total funds.

Based on the results obtained from the optimized model, the author proposes that when there is restricted short selling, the expected return rate of the investment portfolio will also increase but the variance will not necessarily increase with the increasing proportion of borrowed funds and total funds. Therefore, the expansion of the ratio of borrowed funds to initial funds helps to expand the investment opportunity space.

Because investment is a continuous and multi-stage process in the actual financial market, Zhang et al. proposed a multi-stage mean-variance portfolio model aiming at

maximizing the final wealth and considering non-negative constraints [9]. In the algorithm of the model, Zhang and Zheng use the embedded method to embed the original model into the auxiliary model, and transform the inseparable objective function into separable [9]. Then, the discrete approximation iteration method is adopted for calculation.

In the calculation example, Zhang and Zheng select 6 stocks from the Shanghai Stock Exchange 50 and take its quarterly end-of-quarter yield from January 2006 to March 2008 as the sample data [9]. The validity of the algorithm is proved.

Without considering transaction costs and taxes and assuming that capital is infinitely divisible, Wu et al. proposed an investment portfolio model with a certain amount of borrowed funds and a unit risk return as the objective function [10]. The economic meaning of this model is how investors allocate various assets to minimize the VaR of the portfolio under the premise of satisfying the constraints. In the solution of the model, the penalty function processing mechanism is first used to transform the model into an unconstrained problem, and then the second-order hybrid particle swarm optimization algorithm is used to solve the problem.

In the aspect of empirical analysis, Wu borrows the data from the references, and assumes that the investment proportion of each asset does not exceed 0.6, and the ratio of borrowed funds to total funds is 0.5, and obtains the optimal investment strategy under different confidence levels for the unit risk-return maximization model of restricted short selling [10]. It is also found that for the same confidence level, the higher the lower bound of the expected return rate, the higher the investors' returns and risks will be. When restricted short selling is considered, there is a non-linear relationship between the optimal investment ratio of each asset and the expected return rate. The maximum unit risk return portfolio model with restricted short selling does not meet the two-fund separation theorem.

3 Discussion

3.1 Interval Quadratic Programming of Mean-Variance Model

These three articles are all about the interval quadratic programming of the M-V model [2–4]. The main idea is that in the real world, investors conduct securities investment portfolios in an uncertain environment, which is an uncertainty decision-making issue. Moreover, in actual economic activities, investors can only get the range (interval number) of expected returns based on the information provided. Therefore, the authors of these articles cited interval numbers into the model to form an uncertainty optimization model.

Xu et al. assumed that the average return rate and risk loss rate of the investment portfolio fluctuate within a certain interval, introduced the interval number sorting method (interval order relationship, possibility and acceptability), and transformed it into a deterministic secondary problem to solve [2, 3]. Moreover, the validity of the interval quadratic programming model is verified under the restrictions of short selling and no short selling respectively.

On the basis of Xu, Wang et al. introduced transaction costs and liquidity as new constraints in the mean variance model of the interval quadratic programming to establish

a new securities investment portfolio model with transaction costs [2–4]. And in the same way, the uncertainty programming is transformed into a deterministic optimization problem to be solved.

It can be seen from these three papers that in terms of the interval quadratic programming model, the M model has a relatively high degree of fitting, and it can be fully accepted to convert the expected return, VaR, and liquidity into interval numbers, and then solve the problem, develop a securities investment portfolio [2–4]. Among them, the third paper is an improvement on the basis of the first two, which introduces the condition that transaction costs are linear functions. It is closer to the actual situation of constructing investment portfolios. However, in real life, transaction costs also have different forms, which are likely to affect the portfolio of securities. Therefore, further constructing and solving a portfolio model with complex transaction costs will have far-reaching guiding significance for real investment.

3.2 Mean-Variance Model Under Minimum Trading Volume Restrictions

Since the original mean-variance model assumes that every asset is infinitely divisible without considering the transaction costs. It is inconsistent with the rules of China's securities trading market, which greatly reduces its practicability. In view of this situation, Yu and Li put forward an improvement scheme for mean variance model, namely, by increasing the restrictions step by step, it is not allowed to consider the portfolio model of transaction cost restrictions, minimum trading volume restrictions and short selling [5]. In the empirical part, Yu selected 15 component stocks of different industries in the Shanghai Stock Exchange 50 Index as investment choices, and obtained the optimal solution with the improved mean variance model, which verified the effectiveness of the model.

Chen et al. improved the investment proportion of assets in M model to the investment quantity of assets, constructed a quadratic integer programming model and designed an algorithm to solve the model without considering risk-free investment and short selling [6]. In the empirical part, Chen et al. assume that a certain amount of assets will be put into a portfolio consisting of ten stocks [6]. By solving the model constructed in this paper, the effective margin of the portfolio is obtained, which proves the effectiveness of the algorithm.

In the research direction of the minimum trading unit restriction, the M model has a high degree of agreement. The authors of the two articles introduce the practical minimum trading unit restriction into the original M model in different ways, and study the corresponding solutions to make the improved model more valuable in the securities market of our country. In the current improvement of M model, scholars mainly focus on the solution of the improved model. However, a successful model can not be separated from a large number of empirical calculations. Therefore, future research can focus on a larger scope/longer time dimension to verify the effectiveness of the improved model. At the same time, it can also compare and choose the models with different improvement ideas of predecessors.

3.3 Long and Short Position in Mean-Variance Model

Many scholars have discussed whether short-selling system should be introduced into China's securities market. Therefore, for investment portfolio theory, what kind of performance it can have under different constraints conditions is also concerned by scholars and investors. The earlier literature mainly focused on discussing the feasibility and reliability of portfolio theory in China's securities market when short-selling is not applicable, and adjusted the mean-variance model accordingly. In recent years, with the development of the market, the call for introducing short selling mechanism is getting louder and louder. Therefore, many researchers focus on the theoretical model of mean variance under the conditions of short selling or short selling to a certain extent, and have made a lot of progress, including the feasibility of the model under these conditions and the influence of short selling system on the model results. Zhou et al. optimized the mean-variance model under the condition of short-selling restrictions in China's securities market, and proposed a method based on analytical solutions to obtain an effective frontier analytical solution [7]. The empirical analysis found that the absolute return and excess return obtained by the optimized mean-variance model are higher than other traditional models, which shows that the model has certain practical significance for the Chinese securities market with short selling restrictions.

Considering the continuity and multi-stage nature of the investment behavior, Zhang et al. proposed a multi-stage mean-variance model for terminal wealth maximization under short-selling restrictions. However, in the empirical calculation examples of this model, the actual factors such as transaction costs and transaction units are not considered, and there is also a lack of multi-stage examples to further illustrate its effectiveness. The multistage mean-variance model is worth further study.

Zhang et al. proposed a mean-variance portfolio model of restricted short-selling, and obtained the optimal investment ratio, expected rate of return and standard deviation of the portfolio under the constraints of different short-selling quotas [8, 9]. It is found that, under market conditions of allowing short selling again, the increase of yield is not necessarily accompanied by the increase in variance, which also illustrates the positive significance of the short-selling system to the securities market.

Similarly, Wu et al. put forward the portfolio model of maximizing the unit risk-return of restricted short selling [10]. Through empirical analysis, it is helpful to improve market efficiency and reduce risks.

In summary, the mean-variance model has high application value and reference significance for the investment portfolio problems with different short selling restrictions, and it has an important guiding role for the further improvement of China's securities market.

4 Conclusion

Through a lot of studies, it can be found that although the original mean-variance model has strict assumptions and its practical application has been limited. According to different market backgrounds, scholars put forward different improvements to the model in different directions by imposing different constraints on the model, and proved the effectiveness of the improved model in empirical studies. It can be seen that the mean-variance

model has a great room for optimization under different constraints. Among them, many scholars have also put forward more effective algorithms to improve the model, so as to obtain the corresponding effective risk-return boundary, and to determine the expected investment ratio of investors. Chinese scholars put forward the restrictions in line with the market background based on the background that short selling is not allowed in the market and the restrictions of the minimum trading unit in the securities market. On the other hand, some scholars have proposed using interval numbers to represent some parameters in the model to enrich investors' investment ideas.

In addition to its application value, by observing the performance of the mean-variance model when short selling is allowed, scholars have found that this model has important guiding significance for the further improvement of the Chinese securities market. At the same time, scholars also put forward the current situation of the model is still limited and the prospect of optimizing it.

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The Effectiveness Between Influencer Marketing and Traditional Advertising in the Cosmetics & Skin Care Industry

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Abstract. Gen Z, China's rising consumer force, yet there is few research on influencer marketing and traditional advertising on Gen Z in mainland China. This work analyses the benefits between emerging influencer marketing and traditional counterparts and indicates that influencer marketing often costs less and has a better performance in reaching numerous consumer groups. Nevertheless, the mistakes of influencers' choice will lead to the failure of marketing campaign. By contrast, traditional advertising can reach a larger number of consumer groups, and high-quality advertisements are more likely to help leave distinct brand images. Taken together, influencing marketing does better in persuading stage, whereas traditional advertising has more advantages in informing stage and reminding stage.

Keywords: Influencer marketing · Traditional advertising · Generation Z · Persuading stage

1 Introduction

In recent years, the composition of consumers and consumption patterns have undergone great changes. Meanwhile, China's consumer power is rapidly moving towards a younger direction. In China, Gen Z is the largest group, which occupies nearly 260 million people [1], and they are gradually becoming the leader of domestic trends and new consumption drivers, the rise of Generation Z will bring great impetus to the innovation of marketing methods. Additionally, Gen Z are more familiar with online celebrity marketing (including e-commerce live streaming, short video planting, private domain traffic, etc.), whereas marketers pay less attention to the brand as a whole. On the other hand, compared with traditional advertising, consumers now rely more on the power of word-of-mouth, so in a segment of the field more professional experts or Netflix, even

those with hands-on experience of product use are more likely to obtain the trust of consumers and become influencers. Furthermore, the popularity of digital platforms and channels has bridged the gap between influencers and consumers, as well as between brands and consumers, which effectively avoids the embarrassing situation that brands are isolated from consumers and exist alone. Hence, seemingly and favorable brand image can be latently delivered to the potential customer. Especially during the COVID-19 pandemic, influencer marketing, has met an unprecedented proliferation, along with the development of online shopping. In this context, relying on traditional marketing, influencer marketing is flourishing.

Influencer marketing in China market can be divided into two categories: advertising and livestreaming. The former includes text and text and short video, which means that commercial content can be fully integrated into the daily posts of social media influencers, while consumers can directly comment and interact with influencers and brands. For the latter, thanks to the authenticity and interactivity of live broadcast, consumers are more likely to perceive and produce purchase behaviors. In terms of methodology, focus groups were conducted to gather data from aged 18–26, 4 females and 1 male per group. The focus group tends to comprehend the attitude of interviewees on both influencer marketing and traditional advertising. This paper, targets at the Chinese cosmetics market, objectively analyzes the influencer marketing and traditional marketing methods through specific cases, and depicts the efficiency between influencer marketing and traditional advertising and how influencer marketing becomes so popular in different ages, especially in Gen Z. Incidentally, the study aims to examine not only if there is a bond between influencer marketing and traditional advertising, but the effectiveness of two strategies on promotion objectives. Finally, in conclusion section, this work summarizes the findings and outlines directions for further research.

1.1 Methodology

The qualitative data were collected from 8 participants who are aged 18–26 in different regions in China; thus, this is the sample befitting Gen Z. The participants were 75% female and 25% male. The median age is 25. The responses were generally gained under a comfortable and relaxed atmosphere, such as coffee hour, by asking participants a set of questions. All questions were open-ended, and the participants were not given any pertinent information to answer the question. All the interviewees were not being told that the purpose of study is to test the effectiveness of influencer marketing and traditional advertising until the end of the interview. After obtaining their agreements of publishing, the responses of participants were published anonymously.

1.2 Literature Review

Social media connects millennials through online platforms, making them act and communicate similarly, reducing perceived limits [2]. Besides, the market scale of influencers has expanded in recent years, and Gen Z is affected by social media. Relevant studies reveal the advantages of influencer marketing from different angles. However, except for the general benefits and limitations of influencer marketing and traditional advertising

explained separately, inadequate research studies the synergy of the two on millennials in specific industries and areas, such as cosmetics in China.

2 Comparison Between Traditional Advertising and Influencer Marketing

From the communication perspective, Influencer marketing could be described as native advertising [3], which earns both paid and earned media characteristics while traditional advertising is paid one. The former has implemented content designer as an influencer but not a company [4]. This paper found valuable points that influencer marketing's credibility, investment effectiveness, and engagement make it more popular than traditional advertising.

2.1 Influencing Factors of Effectiveness of Influencer Marketing

First, the credibility of customers, influencers are more credible than famous people for the informative value of generated content, attractiveness, trustworthiness, and similarity to themselves [5]. Moreover, social influence and argument quality also count [6]. According to Lou, Tan, and Chen [7], detailed disclosures also gain consumers' trust.

Second, the match. Brand image, celebrity congruence, and the company's objectives are significant in the effectiveness of the company's campaign [8]. In other words, the match is critical. Some studies add that influencers should have a personal post, particularly when the match is a little incongruent [3].

Third, the engagement. Various characteristics of influencers' content sometimes determine which media platform to post on and generate engagement due to people's different motivations to use social media platforms [4]. Other scholars study more details on liking and commenting influence engagement [7], and persuasive and communicative emoji also count [9].

2.2 Influencer Marketing in Cosmetics

Some scholars, such as McCormick [10], think influencers have no impact on millennials' purchase choice, while some point out the trust relationship instead of influencer popularity drives millennials' interest and buying intention [11]. Despite their different states, the research regions are western countries. Therefore, some research which takes region factors are taken into account, which runs in China, and find if there would be any difference.

It would seem that there is a need to figure out how do the two different ways of promotion affect millennials' purchase decision-making in different stages that based on AIDA model and the influencer marketing in cosmetics of China.

2.3 Influencer Marketing vs. Traditional Advertising

Arguments suggest influencer marketing can engage with target audience more easily than traditional advertising, and it is also more credible and cost-effective. Based on

forementioned statement, in the AIDA model that has three corresponding promotion objective: informing, persuading and reminding, influencer marketing has better performance in persuading stage in general cases. Consequently, it is hypothesized that influencer marketing makes more contributes to persuading stage.

H1: Influencer marketing dose better in persuading stage.

Arguments suggesting traditional advertising tends to be paid media more, this promotion method shows advertising through television, billboard, magazine, and broadcast, so that people can get in touch with it more often because of those channels' characteristics such as common use in daily life. According to above statement, traditional advertising still plays an significant role in promotion, especially in informing and reminding based on AIDA model. Therefore, this paper argues that traditional marketing is more effective in informing and reminding stages.

H2: Traditional advertising dose better in informing and reminding stages.

2.4 Discussion

This study examined how information from influencers affects Gen Z's behavior in purchasing decision-making of cosmetics and skincare products in the Chinese market. The study analyzes at three different stages: informing, persuading and reminding.

Influencer Marketing Does Better in Persuading Stage. Influencer marketing is more conducive to reaching consumers, particular groups. Explicitly speaking, influencers on the platform all operate their own private traffic pools, and fans in these traffic pools are often attracted by multiple factors such as their professional knowledge, expertise and personality. Therefore, these fans usually have a large number of common characteristics, which can help marketers reach consumers more accurately. For illustration, on Dou Yin, a Chinese short video platform, talent is divided into beauty, food, clothing and other regions, and the algorithm will push relevant videos or open screen ads based on these specific categories.

Furthermore, influencer marketing is more cost-effective. A strong case for this is that the funds spent by companies on influencer marketing are increasing rapidly. Analysis from a 2017 study by the Influencer Marketing Center showed that companies had increased their influencer marketing budgets by 67 percent, which is a strong proof that marketers and companies believe influencer marketing has a huge impact. On October 21, 2021, official data released by TMall.com (Alibaba) showed that the sales volume of the live broadcast rooms of China's top Internet celebrities Li Jiaqi and Viya reached 10.6 billion yuan and 8.2 billion yuan respectively.

In addition, influencer marketing tends to offer more objective viewpoints. That is to say, influencer marketing is usually the user's personal use of the experience, so they can more persuasively explain the conditions under which a particular product is suitable. In the process of promotion, influencers can hide their business info in their daily life blogs. As far as traditional marketing is concerned, advertisements pay more attention to the promotion and introduction of superior points of products, but do not mention disadvantages and some restrictions. Hence, based on the above characteristics, online celebrity marketing is better at promoting consumers' final purchase behavior.

When buying cosmetics and skincare products, according to the data, most of the participants would buy cosmetics or skincare products from influencers' recommendations or advertisements. Some of them commented that "I will definitely buy it when they successfully pursue me because they seem trustful," "I take the initiative to search the products I want in influencers' video clips", "it's interesting to watch them and get direct interaction", and "I bought so many products from influencer livestreaming because it's cheap and valuable." Those support that influencer information have relatively high credibility, enjoyment and good value, or preference. In the AIDA model [12], enjoyment relates to the promotional tasks of getting attention and holding interest. Preference affects the task of arousing desire; moreover, credibility develops the task of obtaining action. Preference and credibility are most influential in Gen Z's purchasing behavior; what's more, both of them are associated with the persuading stage. Thus, influencer marketing plays a great role at persuading stage. In contrast, the participants comment on traditional advertising that "I tried once and it is not favorable. I feel they lie to me. I won't try again because it gave me a bad experience.", "I feel traditional advertisement is much more trustworthy", and "traditional advertisement is not in my favor". Combining those comments, which present median credibility and lower preference. According to the model tasks, traditional advertising has relatively weak performance at persuading stage.

Traditional Advertising Does Better in Informing and Reminding Stage. While influencer marketing may have more precise target audiences, traditional advertising has a wider-ranging effect than influencer marketing. In terms of traditional advertising, the ubiquitous distribution on different platforms allows them to reach more audiences than influencer marketing. Since traditional advertising has more rate of exposure to customers than influencer promotions, that could be delivered to customers through various approaches in their daily life, such as TV advertising, newspaper advertising, shopping mall brochure, etc. Consequentially, traditional advertising has more chance on rising the product or brand awareness.

Nowadays, the fast update on video or blog platforms limits the duration and frequency of appearance of influencer promotion. It causes that influencer promotion faces the risk of neglect or oblivion. In contrast, however, well-designed, creative traditional advertising is able to be repeatedly broadcast for a long-lasting period of time. On the other hand, traditional advertising is not exclusively valuable for growing companies, it is also cost-effective for mature, well-recognized brands/products to broadcast traditional advertising. There is no necessitate for them to either rise brand awareness or motivation of purchase since they already have a decent number of loyal customers. The intention of advertising, in other words, promotion strategy, is to maintain brand reputation and develop customer loyalty. In some circumstances, influencer marketing may have the risk of drawing backlash and hurt the brand image. On September 24, 2021, Rolls-Royce in China published a new promotion vlog on Weibo, one of the most popular social platforms in China. In this promotion vlog, Rolls-Royce invites an influencer couple to test drive a Cullinan, the sports utility vehicle of Rolls-Royce. In counterproductive, the vlog receives oceans of complaints from Rolls-Royce's customers. Overwhelmingly, citizens are blaming the company for simply failing to conduct proper due diligence and therefore bringing this fiasco upon itself [13]. The majority of Rolls-Royce customers bluntly

argued that the invitation dwindled the high-end identity of Rolls-Royce. After falling into the scandal three weeks later, Rolls Royce issued an apology and removed the vlog. Based on the aforementioned statement, in the AIDA model, traditional advertising has better performance on informing and reminding stages in general cases.

Further Research. This study analyzes the effectiveness between influencer marketing and traditional advertising in cosmetics and skin care industry in China within Gen Z. However, additional questions remain. Future research should inquiry that some issues: impulse purchases, counterfeit products, government regulations and marketing revolution. After impulsive buying, would it cause waste problem? Would the occurrences of counterfeit products cause less credibility? During thriving of influencer marketing, would it limit by government regulations? Would influencer marketing replace digital marketing? Addressing these questions in future research will analyze deeply in influencer marketing through the back of the operation.

3 Conclusion

This paper argues that the compared with traditional advertisements, influencer marketing has more benefits in persuading stage for three main reasons, which include the more accurate reach, the higher ROI and the more persuasive points. These three advantages are the fundamental reasons why generation Z is more likely to accept and trust influencer marketing. By contrast, traditional marketing does better in both reforming and reminding stages, and these are rooted in the essential characteristics of traditional advertising. People rightly remember good creative advertising and repeat them again and again in their mind and always have an emotional connection to them. Furthermore, traditional advertising permeates every corner in people's daily life through all kinds of channels and so that to contribute to the inevitable contact with them.

In conclusion, both of these two different marketing methods play a synergistic role in the purchasing decision process among customers and they maybe also influenced by the macro-control policies of the Chinese government and the invisible hand of market.

Acknowledgements. Weiyang Ren and Benyu Liu are both first authors.

Appendix: Study Participants

Participant #1 (Make-up Artist, Female, 26 Years Old)

Usually I buy a cosmetics or skin care product because of my needs, my interest and how suitable to me. The video clips of influencers are interesting and a good phenomenon because they try first and explain to audiences; thus, I will definitely buy it when they successfully pursue me because they seem trustful. No matter these are famous or niche brands. However, I think traditional ads are not useful and feel nothing to me. I won't buy products which are promoted by official advertisements because I tried once and it

is not favorable; hence, I feel such ads lie to consumers. Every time I see such ads, I skip because it gave me bad experiences.

Participant #2 (Make-up Artist, Female, 25 Years Old)

I usually decide to buy cosmetics and skin care products when I almost run out them. Because I am a make-up girl, I am always in a professional perspective to choose products: ingredients. Influencer marketing is awesome. KOLs always present ingredients of products share their experience. It is good because I tend to take initiative to search some products in Tik Tok or The Red Book (a platform for sharing pictures and recommending items) to see eWOM and there is always something I want. However, I don't think traditional ads working for me and I usually have autonomy to purchase. I prefer influencers marketing because they are more sincere than traditional advertising.

Participants #3 (Beauty Industry Worker, Female, 25 Years Old)

When I watch influencers' video clips or live streaming, I make purchase decisions due to my interests, suitability and freshness. I like to buy cosmetics goods best fit for me so I prefer to look at the ingredients of products; however, if it is not qualified, I won't be pursued. However, personally, I think that traditional advertising only works for celebrities' worshippers, not for normal consumers. Even though I don't believe that influencers' videos attract me, I think traditional ads are worse and out of date

Participants #4 (Student, Female, 21 Years Old)

I have many favorite Internet celebrities, but few of my favorite advertisements. I like Internet celebrities because they know more about what we want to watch; Furthermore, most of them have their own areas of focus, but advertising doesn't. And advertisements always make me feel bad. They always come in the form of interruptions, just like when you're watching a video and you get angry when an AD suddenly comes on. But on the contrary, it's interesting to see what influencers do and you can interact with them directly. You always follow some influencers and even take the initiative to search for some product reviews. That is amazing.

Participants #5 (Product Director, Male, 30 Years Old)

I think network red marketing is a good way of marketing, especially network red live with goods. It helps companies quickly shorten marketing cycles and helps us get first-hand consumer information. Yes, I mean we don't need another distribution channel, we just need the docking platform. However, there is a problem of how to increase the long tail effect of influencer marketing, that is, how to get consumers to buy again.

***Participants #6 (College Student, Female, 20 Years Old)**

I asked her whether she bought products from the recommendation of influencers. She told me she usually watched some live streaming from influencers on the Tik Tok platform. Due to the Covid-19 crisis, she got a lot of spare time, which caused the increasing frequency of watching the live streaming. And these live streaming usually pushed products gear commercials to customers. She got into this at that time. I asked her why she bought so many products from live streaming. She thought their products were cheap and valuable. Since they usually offer some promotion to attract customers. Jiaqi Li, one

of the most influential e-commerce KOL in China who set up live streaming on Tik Tok, influenced her most. The traditional advertisement is not in her favor.

Participant #7 (Designer, Female, 24 Years Old)

She seldom bought products from the recommendation of influencers. Due to her occupation, she knows how influencers influence people to consume and their way of promotion. From a subjective point of view, she doesn't believe these influencers. She thought their reputation did not determine the quality of the product. On the contrary, she felt the traditional advertisement was much more trustworthy.

Participant #8 (Unemployed, Male, 24 Years Old)

I have bought some skin care products as a gift for my wife through livestreaming e-commerce. And the style of the live-streaming e-commerce is quite waggish. So sometimes I watch the livestream and bought some products for fun.

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The Impact of Monetary Incentives on COVID-19 Vaccination Rates in California

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Abstract. Today the COVID-19 epidemic is still having a serious impact on people's lives and many governments have started promoting COVID-19 vaccine incentives to motivate more people to get vaccinated and reduce infection rates. This study investigated the effect of the 'Vax for the Win' vaccine incentive implemented in California from May 27 to July 21, 2021, on COVID-19 vaccination rates. A synthetic control method was used to assess the effect of the California vaccine incentive, with data from California counties from April 1 to July 21, 2021. California served as the experimental group and 'synthetic California' served as the control group. The results showed that since the implementation of the incentive on May 27, COVID-19 vaccination rates in California have increased compared to 'synthetic California', which suggests a positive treatment effect and that the incentive has somewhat contributed to COVID-19 vaccination rates.

Keywords: Monetary incentives · COVID-19 vaccination rates · Synthetic control · California

1 Introduction

During the COVID-19 epidemic, to encourage vaccinations and reduce the risk of transmitting the disease, COVID-19 vaccine incentives were introduced in many districts in the United States. For example, a \$5 million lottery incentive in Ohio; an incentive program to issue state bonds in West Virginia; free museum visits for those who came for vaccinations in New York libraries, etc. Incentive policy is one of the common interventions in society, which intends to make and implement policies so as to mobilize the motivation of the target of policy implementation and make the work effective.

From a microeconomic perspective, COVID-19 vaccination is a type of merit good. Its consumption brings about positive externalities such as health protection for not only

H. Tang, A. Zhou, J. Zhang and Y. Zhu—Contributed equally to this work and should be considered co-first authors.

the vaccinated individuals but also the others around them. As merit good, it can often be under-consumed which can incur a loss in social welfare. Consequently, to maximise the consumption of the vaccine, the government intervenes via subsidies or other monetary incentives [1–5].

Moreover, research named Impact of Vax-a-Million Lottery on COVID-19 Vaccination Rates in Ohio [6] provides thinking of synthetic control. It means the combination of characteristics, such as gender, new cases, poverty, race, and education, in various states can be used to construct a synthetic group. This research found that the initial immunization rate increased by 0.98% to 47.41%, compared to 46.43% in synthetic Ohio. Because of the monetary incentive, this equates to 114553 more people. It is clear from that comparing the synthetic group with the surveyed group allows for a more accurate analysis, and therefore, synthetic control thinking became the basis of our study.

However, some previous studies also contradict the positive effects of incentives on the consumption of COVID-19 vaccines in certain areas in the US. In this research, primarily focusing on California - one of the most popular and well-known states. In California, COVID-19 vaccines were first introduced on January 4, 2021, midst the COVID-19 pandemic outbreak. Although California experienced a peak in vaccine consumption in March 2021, vaccination rates continued to decline over time. Consequently, to encourage consumption, California Governor Gavin Newsom announced one of the nation's most lavish vaccine incentive programs - Vax for the Win - with a total of \$116.5 million in monetary incentives. The policy commences on May 27 and ends on July 21, 2021. It entails for each of the 2 million people who receive vaccinations beginning May 27, 2021, will automatically be eligible for a \$50 cash card or supermarket gift card; from June 4 to June 11, a total of 30 winners will be drawn for a prize of \$50,000; and on June 15, the date of the California relaunch, 10 prizes of \$1.5 million each will be awarded.

This study aims to measure the effect of California's vaccination monetary incentive programs on COVID-19 vaccination rates focusing on a county level, through the analysis and comparison between the pre- and post-incentive vaccination rates in California. Furthermore, using a difference-in-difference model (DID), to quantify the sensitivity of COVID-19 vaccination rates to these monetary incentive programs in different income counties from an income perspective.

2 Method

A Synthetic control method [7] is selected to evaluate the effects of the monetary incentives on the vaccination rates in California. Although it is impossible to find the best control region of California, a weighted synthesis of different states enabled to the construct a better "synthetic control region". Then, comparisons are made between California and the "synthetic California".

The usage of explanatory variables to construct the synthetic control was similar to the previous research done by Neil K.R Sehgal in Ohio, including age, race/ethnicity, education, poverty and new cases. Same as the previous research, changes in vaccination rates were also used as an indicator of the incentives' impact.

The United States Census Bureau [8] was queried for all demographic data and the Centers for Disease Control and Prevention was sourced for all initial COVID-19 vaccination rates [9] and new cases [10] administered by 25 other states and date from April 1st to July 21st. There were 25 states because though initially the other 49 states and the District of Columbia were in the potential control pool, 24 states were excluded for implementing other monetary incentives for vaccination rates before July 18 (the deadline to enter vaccine incentives). To better approximate the effects of the monetary incentives and avoid the influence of loss of data in some states at weekends, a weekly data frequency was used, and data was re-calculated. The synthetic control was constructed using case rates and vaccine data from 8 weeks before the incentives were announced (April 1st through May 26th, 2021), and 8 weeks after the incentives were announced (May 27th through July 21st, 2021) to analyze the impact of the incentives on vaccination coverage.

The weights chosen for the states in the synthetic control were intended to minimize the root mean square prediction error of 0.083359), as well as treatment effects shown in Fig. 2. The findings were put through three sensitivity tests to see how reliable they were. Firstly, MSPE was estimated both before and after the incentives were implemented. Secondly, an in-time placebo test shifted the incentive announcement to four weeks prior to the incentives from week 4 - April 22nd to April 28th, 2021, with the final assessment taking place on the announcement day - May 27th, 2021. Finally, a leave-one-out test eliminated each of the chosen control states one by one.

Stata16 was used for all of the analyses.

3 Results

Table 1. State weights in synthetic california

C0_No	Unit_Weight	C0_No	Unit_Weight
AK	0	RI	0.12
AZ	0	SC	0
DC	0.158	SD	0
FL	0	TN	0
GA	0.093	TX	0
IA	0	UT	0
KS	0	VA	0.062
MS	0.01	VT	0
MT	0	WI	0
ND	0	WV	0
NE	0	WY	0
NH	0.074		
OK	0		
PA	0.484		

Table 2. Characteristics of California and synthetic California prior to the monetary incentives announcement

Variables	Treated	Synthetic
Persons 65 years and over percent	14.8	16.9975
White alone non-Hispanic percent	36.5	66.9714
Bachelor’s degree or higher percent	33.9	36.8191
Persons in poverty percent	11.8	11.8239
Vaccines(1)	33.34	33.38129
Vaccines(4)	46.56	46.59459
Vaccines(8)	55.06	55.21451
Newcases(1)	2384	2355.051
Newcases(4)	1918.43	1942.851
Newcases(8)	1059.57	679.5476

As shown in Table 1, most states had a weight of 0, while only seven states had positive weights, the District of Columbia (0.158), Georgia (0.093), Mississippi (0.01), New Hampshire (0.074), Pennsylvania (0.484), Rhode Island (0.12) and Virginia (0.062), and the weighted average of the actual vaccination rates in these seven states was used as a substitute indicator for the synthetic California.

See Table 2, the predictor variables for both California and synthetic California are very similar before the incentives are announced, so synthetic California can replicate California’s demographic characteristics and economic characteristics, etc., very well.

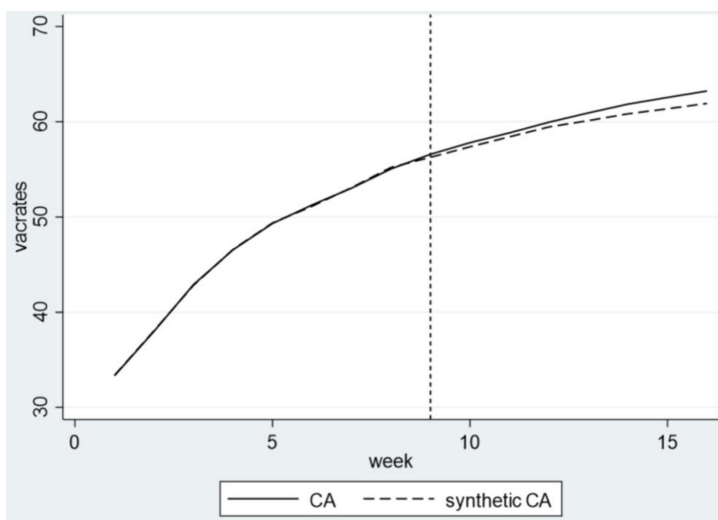


Fig. 1. Percentage of population that received first COVID-19 vaccine dose in California and synthetic California from week 1 to week 16 (April 1st, 2021, to July 21st 2021. COVID-19 = coronavirus disease 2019)

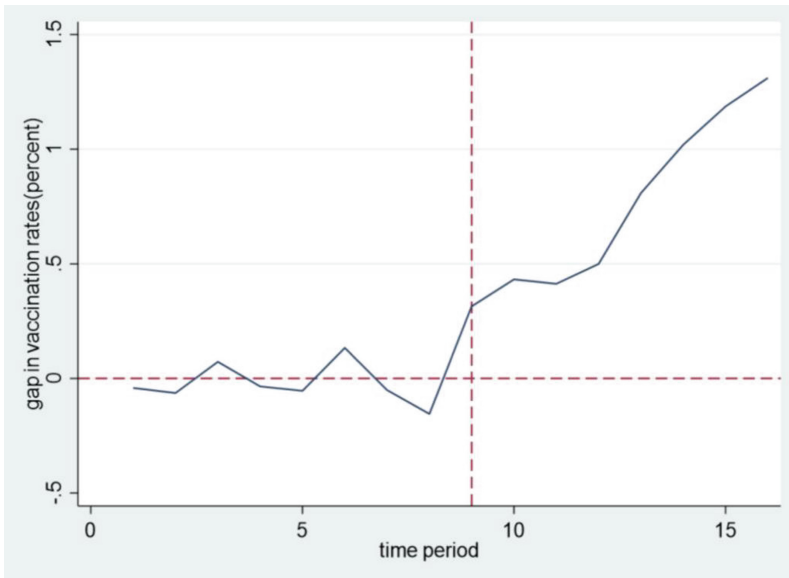


Fig. 2. Gap in the percentage of the population that received the first COVID-19 vaccine dose between California and synthetic California (Treatment effects), from week 1 to week 16 (April 1st, 2021, to July 21st 2021. COVID-19 = Coronavirus Disease 2019)

Referring to Fig. 1, there is a common upward trend in vaccination rates for both groups before the incentives were announced. COVID-19 vaccination rates continued to increase in both groups after the incentives were announced.

Figure 2 shows more visually the gap in the percentage of the population vaccinated with the first dose of COVID-19 vaccine (treatment effect) between California and synthetic California during that time period. Prior to the announcement of the incentives, the COVID-19 vaccination rate in synthetic California was essentially indistinguishable from experimental California. The gap in COVID-19 vaccination rates between experimental and synthetic California widened gradually after the incentive was announced. Eight weeks after the incentive was announced, this difference had widened to more than 1.3%, suggesting that there was a treatment effect which led to this difference.

4 Discussion

First of all, this study applies only to California. Because each state is different, such an incentive program may have a different impact in each unique state. In addition to that, this study also has limitations. External factors that may influence COVID-19 vaccination rates but are not easily quantifiable were not considered in the analysis. For example, the impact of exposure to the media, the potential negative long-term effects of incentives, etc. Political orientation also plays an integral role in people's decision-making preferences.

It should be noted that although the incentive contributed to some extent to the increase in COVID-19 vaccination rates in experimental California, this contribution

was not very significant. This result may be related to people's income, with high- and low-income groups differing in their sensitivity to the monetary incentives, which means low-income groups tending to be more sensitive to the monetary incentives, yet having insufficient impact on high income groups.

5 Conclusion

Preventing the spread of the COVID-19 epidemic remains an important topic today, and vaccination is currently the most effective means of prevention. This study gives an analysis and response on how to increase vaccination rates in the current COVID-19 epidemic and whether monetary incentives are effective.

The study has validity. The time period of this study was expanded, and the gender variable was excluded because when the population size is large enough, the percentage of males and females is the same (50%). Not only that, but such smaller non-lottery incentives in other states were taken into account, and those states were also excluded from the potential control group.

In the case of California, the monetary incentives show some positive effects. The data show an improvement in first-dose immunizations in California compared to the well-matched synthetic California.

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Analysis of Stock Price Forecasting Using Deep Learning Models

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Abstract. In the stock market, forecasting stock price is a common form of investment nowadays. However, stock prices are affected by many factors. For stocks, macro factors such as national monetary policies, the degree of industry boom, as well as other micro factors such as relevant events occurring in the companies associated with the stock, can have an impact on the stock price. Therefore, how to achieve accurate stock prediction by statistical means is a meaningful and challenging problem. We analyzed the difficulties of stock market forecasting and found that volatility and vulnerability to external factors are the most difficult aspects in stock price forecasting. We further discussed the advantages and disadvantages of using different machine learning models for stock price movement forecasting. In order to make the prediction more accurate, we adopted two commonly used deep learning models, LSTM and GRU, to predict the stock price of APPLE Inc. In addition, the occurrence of overfitting and how to minimize the impact on the results are discussed. Finally, we determined the performance of different models in stock price forecasting.

Keywords: Stock price prediction · Deep learning and neural networks

1 Introduction

The stock market is one of the most popular fields that many investors pay attention to. Investors hope to obtain as much as possible benefits by predicting stock prices. Therefore, how to achieve an accurate forecast of the stock market trend is a hot research problem in the financial field. However, the stock market is dynamic, nonlinear, extremely unstable and unpredictable, which makes stock price movements very difficult to predict [1]. Simultaneously, the price of the stock market is affected by various factors, such as policies and regulations, international conditions, macroeconomics, natural weather, etc. [2]. In the past few decades, many scholars and researchers in the fields of finance and statistics have worked on the forecasting of stocks movement. However, stock prices still can not be predicted very accurately. For short-term forecasting, the fluctuation of stock prices in the short term has a great relationship with market sentiment and is highly volatile. Therefore, various short-term stock price forecasting methods are actually probabilistic forecasts and it is extremely difficult to predict this volatility. As for the long-term stock price, the stock price is more determined by the market value of

the company behind the stock and the relevant government policies. In fact, stock price trend prediction is essentially a time series forecasting problem [3]. In the early days, researchers focused on traditional statistical models for predicting stock movements, such as linear regression, SVR, and K-nearest neighbors (KNN), artificial neural network (ANN), etc. [4]. Over the recent years, as the development of deep neural networks, a growing number of deep models have been applied to stock prediction tasks, and they have shown quite excellent prediction effects, such as CNN and RNN. In addition, natural language processing (NLP) methods have been vigorously developed recently, leading to the invention of more and more network structures for time series prediction, such as LSTM and GRU. This article will discuss LSTM and GRU which are commonly used in NLP problems, and their potential in stock price prediction.

2 Previous Work

In the field of stock price prediction, linear regression is one of the basic regression algorithms [5]. The principle of LR is to collect a huge amount of historical data and train the model. Then, the future price is predicted. The linear regression model is simple and is very efficient for smaller volumes of data and simplified relationships. In addition, the linear regression model is very understandable and its results are well interpretable, which facilitates decision analysis. However, linear regression also has some weaknesses that make it impossible to accurately predict stock prices. For example, the model is limited to a linear space and can not be applied to nonlinear data [5]. In addition, it is unable to express highly complex data such as stock price changes. Therefore, data with nonlinear and high-dimensional features can be processed through SVR (support vector regression) [6]. By using different kernel functions, SVR can better solve prediction problems with high-dimensional features and various nonlinear regression problems. However, it is not applicable to the case of large samples [6]. There is no universal standard for the selection of kernel functions for nonlinear problems, so the difficulty of choosing a suitable kernel function is also one of the problems faced by SVR [7]. Inspired by the biological nervous system, researchers simulate and model the human brain neuron network, which is called the Artificial Neural Network (ANN) [8]. ANN is a computational model with a connected node layer, and it has a hierarchical structure which is similar to of neural networks in the brain [9]. Since the activation function can choose different nonlinear functions, ANN can theoretically fit any nonlinear function [9]. In addition to predictive models, clustering models can be applied to stock price prediction [8]. The clustering model is the process of dividing the sample into multiple classes composed of similar features. After clustering, we can use statistical models to estimate, analyze or predict separately in each class more accurately. The main clustering models used are k-nearest neighbor (KNN) and Support Vector Machine (SVM). KNN is simple and fast. It is efficient when dealing with large amounts of data. Moreover, it does not require parameter estimation and is insensitive to outliers, so it can be used for both classification and regression [10]. However, KNN also has its own shortcomings. For example, it is required to give the number of classes to be divided in advance [5]. Like SVR, SVM also faces the same problem of kernel function selection.

In addition to the traditional models mentioned above, some simple deep neural network models have also been applied to stock price prediction, such as Convolutional

Neural Network (CNN) and Recurrent Neural Network (RNN). CNN is a network structure used extensively in the area of computer vision. It can handle image data well through different size kernel which detects various pattern in different receptive field [11]. However, this model also has certain problems. We can not judge what features are extracted by each convolutional layer, especially for those deep layers, which means that the physical meaning of this model is not clear. Therefore, the interpretive work of deep convolutional networks is also the key to research on deep neural networks [12]. RNN is a model widely used in the field of natural language processing, where the input data is a time series. The unit of RNN receives input not only from the output of the previous moment but also from their own state information, which is cyclically transferred in the network [13]. RNN can explicitly learning and using contextual information in sequence forecasting, and has the capability to study and perform complex data transformations over an extended period of time. However, since the output of a RNN at a given moment is the joint result of itself and all previous outputs, this leads to the appearance of gradient dispersion [14]. To solve this problem, the researchers proposed Long Short-Term Memory (LSTM) which realizes the memory of the original cell state through the forgetting gate and prevents the disappearance of the gradient [15]. In the next part, we will discuss LSTM and GRU which are the two commonly used time series processing models in the field of stock forecasting.

3 Deep Learning Models in Stock Price Forecasting

Long and short term memory is a very popular RNN architecture. RNN networks are able to handle certain short term time series data, but it is not a good choice for long term time series. However, LSTM adds cell state to store memory information. Therefore, LSTM can better store long-time information. In addition, the LSTM is introducing input gates, forgetting gates and output gates for controlling and processing timing information [1]. Input gates are gating devices used to control how many input values are in and out or whether they are allowed in and out. Forgetting gates are gating devices that control how much historical state flow in the RNN is allowed into the next moment after that moment. And output gates are gating devices used to control how much state values are visible to the outside at the next moment [16].

Simultaneously, LSTM solves the problem of gradient disappearance existing in RNN by its own complex structure. The gradient vanishing problem of RNN is primarily caused by the circular multiplication of the weight matrix in the circular architecture of RNN, while LSTM solves the problem of gradient disappearance caused by the gradual reduction of information in the process of gradient reverse transmission by introducing three gated devices [14]. LSTM has obtained state-of-the-art results in a diversity of sequence processing tasks, including speech recognition, machine translation, and fault diagnosis [1]. In general, LSTM controls the proportion of long-term memory and short-term memory well through gating, and further improves the extraction of each input and the consequence of the hidden layer at the former moment. However, due to its too many parameters and slow training, people make further modifications on its basis, and obtain models that have both performance and complexity such as GRU.

GRU is a more effective improvement of the LSTM model, which has a simpler structure compared to the LSTM network and is also effective. It shows more significant

effects in some scenarios. In addition, GRU is transformed on the basis of LSTM, so GRU can also solve problems such as long-term memory and gradients in back propagation [2]. Both LSTM and GRU ensure that important features can be preserved during long-term propagation through all kinds of gate features. In the LSTM model, the input gate, forgetting gate, and output gate respectively control the input value, memory value and output value. The cell state runs through all LSTM units to store long-term information. In the GRU model, there are only two gates: the update gate and the reset gate, which lack the cell state. The update gate is for controlling how much information from the earlier state is carried over to the present state [13]. The greater the value of the update gate, the larger the amount of information carried over from the prior state. The reset gate mainly determines how much of the past information needs to be forgotten [13]. The narrower the reset gate, the lower the amount of information written from the previous state. The input and output structure of GRU is not different from ordinary RNN. Moreover, GRU has one fewer gate function than LSTM, thus the parameter number is also lower than that of LSTM. Therefore, the training time of GRU is quicker than that of LSTM. At the same time, it can also achieve functions equivalent to LSTM.

The data required for this article is from Yahoo Finance and includes the daily average share price of Apple Inc from January 3, 2011 to August 17, 2017. In the experimental phase, the collected data is classified into training and test sets in the ratio of 75% and 25%. In addition, in order to get better performance, the model needs to learn as many as possible the general patterns of all samples from the training set so that it can make correct judgments when new samples are encountered. However, overfitting occurs when the model is too powerful and learns the characteristics of noise as general characteristics that all samples will have. The opposite of overfitting is under-fitting, which occurs because the model is not complex enough and does not have enough learning ability. Under-fitting is relatively easy to overcome, such as increasing the number of training epochs in neural network learning or performing data augmentation. However, overfitting is a more problematic issue. In this problem, we have tested different numbers of LSTM and GRU units and found that one LSTM or GRU unit is sufficient to learn the features behind the data. Also, in order to fully compare the effects of LSTM and GRU units, we used only one LSTM unit or one GRU unit to predict the trend of the average price of Apple's stock. We conducted several epochs of training and finally determined that the stock price trend could be sufficiently learned and not over-fitted at five epochs of training. Finally, we used MSE as the loss function for model training. For the obtained test set results, we adopted RMSE and MAPE as the evaluation criteria for predictive performance. Compared with the more commonly used RMSE, MAPE pays more attention to measuring the relative size of deviation, and it is also a statistical indicator commonly used to measure the accuracy of prediction. After sufficient training, we analyzed the prediction results of the test set. Both LSTM and GRU show relatively high prediction accuracy from the first day of the test set to approximately day 1550. However, as time progressed, GRU showed more accurate predictions at longer times (as shown in Figs. 1 and 2).

We compared the prediction performance of both LSTM and GRU in terms of RMSE and MAPE, which were 2.1973 ± 0.42104762 and 1.2684 ± 0.236104068 for LSTM and 1.4814 ± 0.036108754 and 0.8590 ± 0.024962902 for GRU, respectively. For the

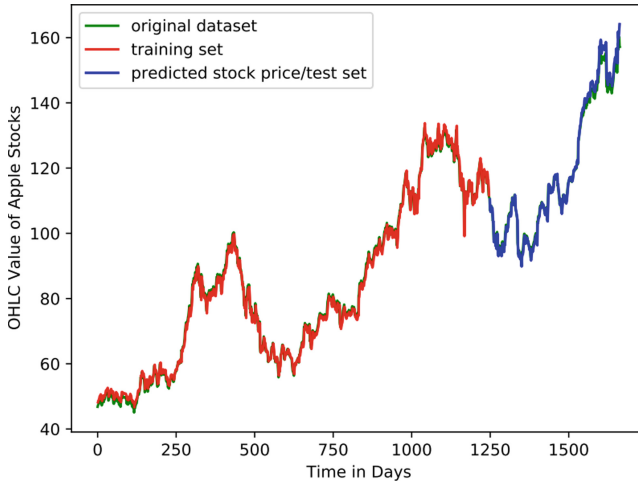


Fig. 1. Predictions by LSTM

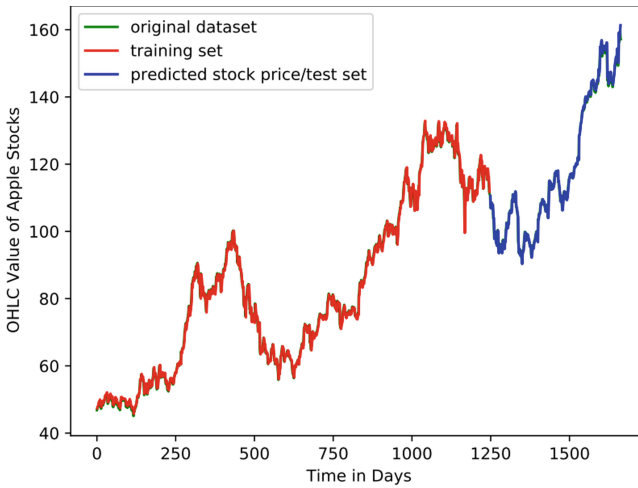


Fig. 2. Predictions by GRU

data of this experiment, the prediction value of GRU was closer to the true value, and its performance in stock price better performance on prediction.

4 Conclusion

Nowadays, both financial investors and the general public want to gain more profit by entering low and coming out high in the stock market. Therefore, accurate forecasting of stock price movements has become a common concern for many people. However, it is very difficult to predict stock prices accurately because they are dynamic and non-linear, which are influenced by various factors. This paper surveyed some traditional time series forecasting methods while discussing the application of deep learning models in financial field. In this paper, a single LSTM unit or a single GRU unit is applied to forecast the daily average stock price of Apple Inc. Stock from January 3, 2011 to August 17, 2017. After deriving the data, we discuss the performance of LSTM and GRU in this experiment. Of course, the results of this experiment do not necessarily indicate that GRU is superior to LSTM. Since LSTM has an independent cell state, at the same time, the update gate can be unaffected by old information and independently control how much new information is input. Therefore, from the perspective of the model, the LSTM with more complex parameters is more reliable for complex tasks such as video classification and language translation [6].

There are some limitations in this study, as there is a certain contingency because it only uses the stock price of a single company to carry out the prediction experiment. Therefore, the prediction performance of LSTM and GRU can not be determined by a single experiment. In addition, there is still a lot of work to be done for the accuracy of stock price forecast results. For example, the process of feature selection should be more complete and more precise in order to find an accurate model for prediction. We believe deep learning model will be widely used in financial fields in the future.

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How Populism Impacts the Prevention of COVID-19 in the United States?

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Abstract. COVID-19 is a major infectious disease sweeping the world, and the United States is one of the most seriously affected countries. In this process, what is the main impact of populism on American leaders and people to guard against COVID-19? This paper mainly focuses on the medical prevention of COVID-19 and pure populism, and lacks joint research. Meanwhile, as the epidemic situation is still developing, there are still innovations in related research. This paper will further improve the research on preventing COVID-19, combine it with populist analysis, and explore the impact of populism on preventing COVID-19 in the United States. In terms of research methods, this article focuses on the media's propaganda on the situation of COVID-19 and its prevention and control measures, the specific policies and measures adopted by the Trump administration in relation to COVID-19 and the Republican Party's disregard. In conclusion, the populist government in the United States did not pay enough attention to COVID-19 from the very beginning but regarded it as a tool to get people's support and play its political role. However, with the severe development of the epidemic, these behaviors led to the seriousness of COVID-19 in the United States. In addition, from the party point of view, Republicans' relatively negative attitude and behavior of epidemic prevention have delayed the effective time of epidemic control.

Keywords: COVID-19 · Populism · The United States · Republicans · Trump

1 Introduction

COVID-19 is a major infectious disease that has swept the world and continues to this day. It is a serious challenge for all mankind. COVID-19 on March 11, 2020 was considered to be the global pandemic. On the official website of WHO, COVID-19, as a kind of pneumonia, its prevention means are to reduce direct transmission, aerosol transmission and contact transmission with others through social distance and wearing masks. As one of the most serious countries in COVID-19, how did the United States play its role in the early prevention and control of COVID-19? What is the main impact of populism on American leaders and people's defense against COVID-19? To explore these problems, the article will combine the media propaganda, specific policy actions and consequences of COVID-19 in the early days of the outbreak of the US with populism theory analysis. Thus, we can better understand what causes populism to affect prevention in COVID-19,

and how it affects prevention in COVID-19 within the framework of the United States. Because COVID-19 is still an ongoing project, this research has some novelty.

2 Literature Review

At present, the research on this issue focuses more on the structured understanding of the concept of populism and the possible scope of its definition. For example, Jenne, Hawkins and Silva described the specific role of populism in the interstate framework [1]. Scholar Mudde further explored populism in theory [1]. His populist centralization tendency and views on social issues are also very important in this study. Other scholars, such as Eatwell and Stanley, have a unified understanding of the concept and uniformly named the concept proposed by Mudde as “national Populism”. In terms of the scope of its use, due to the flexibility of the concept of populism, the scholar Mols Jenne, Hawkins and Silva linked it with the leaders who inspired the movement and explored the relationship between populist leaders and the people [1–3]. Similarly, Michael also proposed how leaders use populism as a political means and how voters and non-voters will be affected when facing the president’s speech with this means [4].

In addition, some authors have focused on the global spread of COVID-19, and whether the global populist leadership has promoted the spread of the epidemic. McKee et al., studied this issue and believed that the political demands of populist leaders indirectly hindered the prevention and control of the epidemic [5]. In this study, they focused on several aspects that may promote the spread of the epidemic. First, populist leaders will pay more attention to the party responsible for the outbreak rather than how to solve the problem [5]. Populist leaders strongly associate their image with ordinary people, as if they had nothing to do with the elite [5]. These politicians appeal to backward groups in society, seize their discontent, and develop a narrative that blames their misfortunes on the actions of others [5]. In addition, populist leaders deny evidence and despise the institutions and elites that produce it, as well as the scientific laws they discover and promote and their consequences [5]. Although the rapid spread of the epidemic was obvious from the very beginning, populist politicians denied the potential impact of the epidemic on the country [5]. McKee et al., found that populist leaders seem to be undermining the effective response to COVID-19 [5].

Unfortunately, most scholars focus on the performance and influence of leaders, which is not closely integrated with the framework of the great populism, but closely to whether the global populist leadership promoted the spread of COVID-19. McKee et al., in the case analysis of the United States, are more inclined to the analysis of facts [5]. Generally speaking, the combination of populism theory and COVID-19’s prevention and control achievements is not close enough. Besides, this relationship is the starting point for exploring the influence of populism on prevention in COVID-19. This paper will further improve this research and integrate these applications into the background of COVID-19 prevention and discuss their impact.

3 The Effect of Populism in COVID-19 in the United States

From the very beginning, American populist government did not pay enough attention to COVID-19, but regarded it as a tool to gain nationalist support and play a political

role. However, with the serious development of the epidemic, COVID-19's early political propaganda did not pay attention to the prevention and control of COVID-19, which led to the seriousness of COVID-19. In addition, from the party point of view, Republicans showed relatively negative attitudes and behaviors of epidemic prevention in the overall prevention and control of COVID-19.

In the prevention and treatment of COVID-19, the Populist Party in the United States exerts influence on the public in three parts. One is the media's propaganda on the situation of COVID-19 and its prevention and control measures for parties and leaders. The other is the Trump administration's specific policies measures related to prevention and control in COVID-19. Then there is the difference between the attitude and behavior of the Democratic Party and the Republican Party in dealing with COVID-19, which highlights Republican's disregard for COVID-19. In the first aspect, the information published by populist leaders through the media has a great impact on the public's personal behavior during this period. Secondly, leaders' personal attitude towards COVID-19 and the neglect of professional knowledge in this stage of the media also make the public more confused and contempt for the COVID-19. For the second aspect, especially when the epidemic continues to deteriorate, the populist parties headed by Trump politicize the epidemic, and turned the health-related contents such as prevention and control into political support they can get. This has led to serious distortions of epidemic prevention and control. This phenomenon is particularly prominent in the third part when comparing the behaviors of Democrats and Republicans.

3.1 Media Impact

The Trump administration made full use of the media to spread its view on COVID-19, which has a negative impact on the epidemic prevention and control. With the rise of mass media and new communication technologies, people have more and more ways to express their opinions and output them to the outside world. This means a lot to celebrities, including populist celebrities and politicians. In this way, these politicians can not only influence people's political attitudes, but also have a deeper impact on people's health and other behaviors [6]. The identity of well-known figures combined with modern media can be transformed into potential role models to play their role in society [6]. As Abdulaev & Shomron mentioned, celebrities are not only a social symbol, but also carry ideological value. According to "Inter-group Identity Model", people who have more in common with the role model are more affected by the role model [6]. This commonality is usually related to identity characteristics [6]. The American nationalist identity advocated by populist parties makes the characteristics of common identity more prominent. The shaping of this role is well integrated with the identity of celebrity politicians, making it easier for such celebrity politicians to influence the public [6]. At the beginning of the epidemic, Trump's populist government first evaded responsibility, blamed the epidemic on "others" and denied its potential impact on the country [5]. During this period, Trump's remarks about defining the epidemic situation as "Wuhan virus, Chinese virus" were strongly output through the media [5].

Usually, the public's perception of new things will be affected by the information they can access. In this process, the speeches and statements of mainstream media and political leaders have a far-reaching impact on the shaping of public cognition

[5, 6]. In the United States, the media are relatively divided into Democratic media and Republican media. This power sharing of media represents the power sharing in American politics [6]. Therefore, the president only criticized the “fake” media and encouraging his followers to avoid consuming this news [6]. But Trump has never really ignored, abandoned or destroyed this way of disseminating personal opinions through the media. For the medias inclined to their own political party, leaders will strongly support them [6]. At the same time, from the perspective of how media information can encourage the public to abide by it to a greater extent, Oliver’s research proves that media information can play an important role in encouraging individuals to participate in the health practice of COVID-19 [7]. During the first outbreak of COVID-19, the World Health Organization (WHO) declared the epidemic as an emergencies within a few weeks because of its high infectivity. Wearing masks, as a powerful means to stop this disease, has become popular in many countries [8]. However, under Trump’s populist government, this method has been hindered in the United States. This is because both the latest epidemic situation and experts’ suggestions on the prevention and control of COVID-19 need to be disseminated through certain media or implemented by the government, so that the public can get information and implement the suggestions. When leaders themselves fail to comply with or violate relevant health regulations, it will have a negative impact on the public, because the president, as a famous politician, has been given public influence [5]. Especially among the most enthusiastic supporters of the president, they listened to the president’s guidelines on the use of masks [8]. However, during this period, Trump publicly expressed optimism about the control and future development of the new crown in the United States [9].

3.2 Trump’s Populist Government Behavior

Take prevention and control in COVID-19 as an example. At the White House press conference on April 3, 2020, Trump announced that the Centers for Disease Control and Prevention (CDC) advised people to wear masks in public places, but stressed that it was voluntary and he would not wear masks. [8, 10]. During this period, the differences between the President and CDC, WHO, other public health institutions and scientists on prevention in COVID-19 also had a great influence in the United States [8]. Leaders, especially democratically elected leaders, can influence people to take some specific behaviors, and even change people’s beliefs and preferences at some times [8]. Therefore, when the president expressed inconsistent attitudes towards relevant preventive actions, and when he was unable to wear masks in public and when he violated relevant epidemic prevention suggestions, the information obtained by the public also played a role in their impact.

Some scholars believe that the inconsistent information of the Trump administration led to the greater spread of the virus [8]. In June of the same year, at a White House press conference, vice president Pence also claimed that the United States had better controlled the epidemic situation and had slowed down the growth curve [11]. In fact, however, the places with the highest number of newly confirmed cases in a single day appeared in several places on the same day [11]. The statistics of the White House coronavirus task force also showed that the speed of virus transmission was increasing, especially in the densely populated areas of southern states [11]. At the same time, Trump’s campaign did

not abide by social distance and did not wear masks [11]. In addition, another spokesman at the press conference said that “whether to wear a mask or not seems to have become a political statement”, but Pence did not answer these questions positively [11]. Instead, Pence emphasized “the freedom of speech and the right to peacefully assemble” [8]. When the behavior of wearing masks has developed to this stage, the behavior of wearing masks and the COVID-19 incident are no longer single events related to public health, and the political attribute behind them have become very obvious. It was not until July 2020 that Trump publicly wore masks, and he was vague about when to use it [12]. This made the American people miss the best opportunity to prevent the epidemic, and the key scientific information related to COVID-19 was concealed by politically motivated information.

The political intention of the Trump administration to stop COVID-19 was seen from the very beginning. Combined with the populist theory, we can see the Trump administration’s practice of COVID-19 Administration. First of all, on the horizon, when Trump mentioned the “Chinese virus” and “Wuhan virus”, there was a populist tension among countries. At the same time, the populist government also creates a populist narrative by taking advantage of COVID-19’s dissatisfaction that affected the normal income and life of the people at the bottom of society. In the world view of populism, an abandoned environment is created by a distant and ruthless elite. That is to say, the COVID-19 was also designed by other countries. Moreover, the elites of relevant scientific institutions can not be trusted. In this case, a strong leader will become the savior of his people [5].

When the Trump administration no longer regards COVID-19 as a simple public health problem, but focuses on shirking responsibility instead of actively controlling the epidemic situation, the populist government has a clearer intention to take the new crown pneumonia as a political tool. Meanwhile, in the vertical distribution of populism within the country, from the masses to the elite and in the process of the so-called populist leaders represented by public opinion, the Trump government first denied the seriousness of the epidemic by diverting the attention of the masses. Then, regardless of the facts, reduce its harmfulness, and make it conform to the common people’s desire for the early end of the epidemic. Populist government shows the same emotional tendency as the masses and gains the legitimacy of governance by expressing and reflecting its position as the representative of the masses’ public opinion. Populism’s “brainwashing” and the personal worship of leaders by using supporters. The right to judge COVID-19’s attitude and how to take preventive measures has been given to the president, the spokesman of populism, rather than the people themselves [1].

Populist Republican parties try to show that all their motives are consistent with the masses. However, when the power is implemented, especially when the administrative power is relatively concentrated in the hands of a leader, the people obey and support the populist leaders at the expense of lack of their own judgment, hoping to achieve the expected results, such as the leaders’ commitment to end the epidemic quickly. As a result, the people are manipulated by politicians who understand their mentality, thus making them lose their judgment on the situation and prevention of COVID-19. In terms of health, the reality of life and unrealistic but beautiful leaders’ words, choose the latter [5].

However, this populist political intention comes at the expense of people's health. Missing the critical period of epidemic prevention has resulted in high infection rate, numerous deaths and severe cases, which effectively reflects the influence of populism on prevention and treatment in COVID-19.

3.3 Attitudes and Behavior of Republicans

In addition, from the point of view of party members, the Republican Party and Democratic Party have different attitudes towards COVID-19 in terms of overall prevention and control. Based on the study of Gadarian et al. [13], in the months before the outbreak of the COVID-19 epidemic, partisanship played a central role in the formation of personal response. For the prevention and control of COVID-19, the political behavior of the country is far more important than preventing epidemic situation and protecting life and health. Facing the severe COVID-19 problem, individuals began to try to find reliable measures to protect their own safety. At this time, due to the instinct of self-protection, people would trust medical experts more than leaders.

However, because President Trump openly disagreed with the public health experts' understanding of the severity of the coronavirus epidemic and what policies could effectively control their view, COVID-19 and its preventive measures show that supporters are divided. By mid-March, 2020, the great differences between the two parties in dealing with the epidemic reflected how the two parties viewed the epidemic itself, whether to treat the epidemic as a simple health problem or as a political tool. In response to the epidemic, Republicans were less likely than Democrats to follow the recommendations of authoritative institutions and were less worried about the epidemic [13]. However, they are more likely to support policies of restricting cross-border trade and mobility as a response to the epidemic [13]. In contrast, the response of the Democrats is to change personal health behaviors and support the policy of socialized testing and treatment costs [13]. Therefore, in the first month of COVID-19 outbreak in the United States, partisanship is the best predictor of differences in behaviors, attitudes and preferences [13].

According to the classification of parties, in the United States at the beginning of COVID-19, the behavior and attitude of Democratic Party and Republican Party to prevention and control are different. First of all, there are differences among parties in the use of masks. 92% of Democrats said they often wear masks, while only 76% of Republicans said they often wear masks [7]. American partisanship reflects a more basic tendency towards public health information and epidemic response. Party bias can predict social distance, and partisan differences in social distance can in turn predict the subsequent infection rate [12]. Secondly, Kassas & Nayga in the face of the rapid spread of COVID-19, the United States, like many other countries, have provided a guide to social alienation, trying to create more time for the treatment of the epidemic [14]. These policies are usually formulated at the state level [14]. By the beginning of April 2020, almost all States in the United States have implemented social alienation measures and issued orders to stay at home [14]. However, the results of the study can be different depending on the political parties. In the early stage of the influenza pandemic, Republicans in the United States are more active in protesting the government blockade, and Democrats are more inclined to maintain social distance and stay at home [14].

In addition, there are obvious differences between the two sides in the chronological order of preventing epidemic-related behaviors. Cevasco et al. pointed out that under the appeal of CDC and WHO in March 2020, the United States declared a national emergency [10]. The Democrats' response to stopping the epidemic is earlier than that of Republicans [10]. Taking the epidemic prevention of higher education institutions as an example, the Democratic governor announced the initiatives of online learning and telecommuting earlier than the Republican governor, so that people could move out of their school buildings earlier [10]. In addition, the universities of the Democratic governor closed earlier than those of the Republican governor [10]. In the House of Representatives, the democratic constituencies acted earlier than the Republican constituency [10]. Congressional districts represented by Democrats closed earlier than Republicans [10]. The different views and behaviors of the two parties (mainly members of Republican Party) on the epidemic situation have had a negative impact on the implementation of the relevant policies to prevent COVID-19 from gaining time, and the attitude of resistance to each step has had a negative impact on the overall prevention and control.

4 Conclusion

In the early stage of COVID-19 control in the United States, the populist government carried out political propaganda of COVID-19. Its lack of understanding of the seriousness of public health problems and its lack of attention to prevention and control measures in COVID-19 led to public confusion and indifference to COVID-19, which aggravated the severity of the epidemic in the United States. However, with the continuous deterioration of the epidemic situation, the populists (Republican Party) further politicized the epidemic situation, and turned the contents that were originally closely related to health, such as prevention and control, into political support that they can get, which led to serious distortion of epidemic prevention and control. In addition, the different attitudes and behaviors of the two parties in the comprehensive prevention and control of COVID-19, especially the relative negative attitude and behavior of Republicans as the ruling party, also prolonged the development time of the COVID-19 in the United States and hindered the control of the situation.

Secondly, in the whole prevention and control in the early stage of COVID-19, the United States tends to instrumentalize the ideology of populism. But this behavior is not the first time in the United States. In American history, populism has been used as a tool to achieve political goals, as well as the adjustment of national security policy after 9/11, the assassination of Saddam Hussein and so on. These actions also use populism as a tool to arouse American people's dissatisfaction with the Islamic world and enable the government to rationalize its attacks on the Islamic world. Therefore, there is still much room for further exploration and improvement in the instrumentalization of populism in the United States. This paper mainly focuses on how the population impacts the prevention of COVID-19 in the United States, and exploration in this regard is still insufficient. In addition, due to constraints, the related research can be further improved in the future.

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Comparison of Xiaomi Smart Home and Huawei HarmonyOS Business Ecosystem

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Abstract. Smart home ecology has gradually come into view. For the major platforms also launched their own smart home's ecology, and this study is based on Huawei and Xiaomi's smart home comparison. Huawei HarmonyOS is a recently emerged ecology, which supports various brands of home appliances and their interconnection. Xiaomi Smart Home, on the other hand, has been conducting IoT research for a long time, and its main focus is on interconnecting its own brands and platforms. In these two cases, the main purpose of the study is to find out which of Huawei's open ecology and Xiaomi's closed ecology will be beneficial in the smart home field. The results show that in the long-term Huawei may be more advantageous, but in the short term it will need to be strictly in the right hands. As for Xiaomi, the development is extremely strong in the short term, but in the long term on its own brand but lack of strong competitiveness.

Keywords: Open ecology · Closed ecology · Smart home · HarmonyOS · Xiaomi smart home

1 Introduction

Nowadays, smart home ecosystem, which means managing services and systems within and outside the home over the network, has gradually come to the mass market and many companies want to get a share of this market, and mobile brands are no exception [1]. Therefore, this paper will focus on the ecosystem created by Huawei and Xiaomi in the smart home space by means of a case study. Through their data, the obvious difference between the two can be analyzed is that Huawei has created an open ecosystem, while Xiaomi is a closed one.

Earlier this year, Huawei released a new set of smart home solutions, HarmonyOS; in April, it launched a new whole house smart solution, "1 + 2 + N"; and now, with the latest upgrade of HarmonyOS operating system, each step shows Huawei's determination to act as an "enabler" in the smart home space.

Another company that started with cell phones is Xiaomi. At this stage, the Xiaomi eco-chain has basically covered all hardware areas of the smart home, which makes

Xiaomi's core position unshakable. Covering the market with massive hardware connections has allowed Xiaomi to have built a strong smart home ecosystem. Xiaomi's model is extremely difficult to copy and requires a lot of time to accumulate, so it is difficult for the current smart ecosystem companies to surpass Xiaomi in terms of hardware.

So for now, it's hard to tell which company is doing better, leading us to the question. Which is better for smart home ecology, open ecosystem or closed ecosystem?

2 Literature Review

2.1 Comparative Factors of IoT Platform and Smart Home Ecological Development

The development of the smart home ecosystem dates back to the 20th century when electricity entered the home, and as we enter the 5G era, the smart home becomes a key component of the IoT ecosystem. The IoT is an ecosystem based on the federation of services and programs across platforms, systems and domains. Bridging the Interoperability Gap in the Internet of Things (BIG IoT) is the cornerstone of the IoT ecosystem and helps enable technical interoperability in the IoT. Here is an example of an IoT ecosystem user, an IoT application that automatically predicts and accesses the next platform that the user will visit. When the app predicts that the user is leaving his residence, it will access the next smart mobile platform that will help the user book a cab to his workplace. At the same time, the app will access another smart home platform and turn off the air conditioning and lights in the user's home after he leaves or get the hot water in the bathtub ready before he returns. The multiple uses of the vast amount of data tallied in the Internet of Things will bring enormous benefits. In September 2003, the Housing Learning and Improvement Network provided a definition of a smart home through a license from DTI and Intertek. The article states "a home that incorporates a communications network that connects key appliances and services. That's the definition of a smart home in this article". This is also the definition of a smart home in this article.

The smart home system is the primary IoT system in the home. There are two main ecologies, one is more open with Huawei HarmonyOS as an example, and the other is more closed with Xiaomi smart home system as an example. The difference between the two ecologies is mainly reflected in the support or not for third-party platforms or systems, or the degree of compatibility with third-party systems. Huawei's globalization is concretely manifested by the platform as an intermediary, separating the industry of science and technology innovation and the application of innovation results, and building an up-and-down coupled ecosystem globally. One article argues that one of the main problems facing an open ecosystem like the HarmonyOS system is how to unify standards across applications or individuals in the system. The article emphasizes that "unifying standards" is particularly difficult in the smart home space. The author of the article believes that the core experience of smart home still lies in interconnection and deeper functional communication between different devices in the future. And in the future development of open platform, the automation cooperation between device and device, platform and platform will be the main difficulty. Xiaomi is implementing the core strategy of mobile * AIoT, which is a relatively closed smart home ecosystem, that

is, if you want to use the system over there, you have to set all the smart industry platforms to Xiaomi platform and cannot communicate across platforms. This has greatly boosted Xiaomi’s active user base and helped Xiaomi develop overseas markets. The future direction of Xiaomi’s IoT ecosystem is to further dig deeper into the market, strengthen the synergy between IoT products and cell phones in the brand channel, and seize the IoT market space outside China.

2.2 The Research Framework

Table 1 shows a conceptual model diagram of the study comparing open and closed ecosystems, and three points are found to compare the open and closed ecology on the smart home platform impact status. The horizontal direction is the supplier of the platform, which is the partner. Contrast study Xiaomi and Huawei’s rules in selecting partners, number and type. User activity, on the other hand, is a discussion of the selection of users on both ecologies, for both the present and the will. Finally, the profitability, which has immediate profitability and which has greater potential.

Table 1. The research framework [2]

	Supplier	User activation	Profit
Opened ecosystem	More/More	Low/More	Low/High
Closed ecosystem	Less/Maybe more	High/Maybe low	High/Low
<i>Short-term/Long-term</i>			

2.3 Data Sources and User Stories

From this framework, we can draw the results of the study: the structure of the business ecosystem contains partners of suppliers, users’ activation and profit. The partners of suppliers can be found in official websites, annual reports, news in financial media. These details do not appear in the material, and the information is accurate enough to support the thesis.

It is clear from the figures in the annual reports and the short-term development plans discussed by the board and management those profits are difficult to falsify. In contrast, user activation requires not only data, but also an understanding of the stage of development of platform governance, not just the word of the vendor, but also the development cycle summarized by academics.

User’ opinions and stories are also a key part of the equation. A business that is unhappy with its users is not successful. Large-scale questionnaires conducted by users who pay close attention to the product are difficult to collect opinions. Respondents are also often too lazy to give their opinions. Therefore, we collected stories from users who have achieved a high level of acceptance on social media, which is representative and objective.

3 Analysis

3.1 Basic Platform Architecture of Xiaomi

The IoT will be continuously strengthened through the layout of the enterprise cultivation model of the ecological chain and the adjustment of the internal strategic structure. Since 2013, Xiaomi has been deploying IoT in advance. 2017, Xiaomi officially launched the IoT developer platform and opened it to the public; in 2019, it officially launched the “Mobile + Aiot” dual-engine strategy, and a series of organizational changes are also strengthening AI capabilities and AIOT strategy [3].

Criteria, Design and Branding. Xiaomi’s “Mobile + Aiot” dual-engine strategy for IoT-related revenue; based on the developer platform, the number of Xiaomi device connections continues to grow. Xiaomi’s IoT and consumer products business is on the rise, with revenue of 62.1 billion yuan (30.2%) in 2019, up 41.7% from 2018. more, xiaomi has launched the iot developer platform, an open iot platform for consumer smart hardware manufacturers and developers. it provides hardware and software services such as connected modules, cloud platform, app remote control, data cloud storage, ota, and user accounts. at the same time, it opens up enterprise resources such as device interconnection, xiaomi user base, xiaomi love control, and Xiaomi Crowdfunding/Unique mall [4].

Non-core Companies: Suppliers. In the supply chain model, xiaomi uses hunger marketing to shorten the supply chain, relies on professional contract factories for contracting, reduces intermediate agents and distribution links, and connects producers and users directly.

Xiaomi, on the other hand, has built a network with hunger marketing thinking, using money as a bond to bundle a large number of hardware suppliers after gaining scale, which in turn has created a cost advantage over other competitors.

Looking at Xiaomi’s supply chain layout, the trend of supplier decentralization and shift to the mainland has emerged. According to incomplete statistics, there are hundreds of domestic suppliers allied with Xiaomi, including 12 listed companies, providing different chips, structural parts and other cell phone accessories for Xiaomi. Currently, Xiaomi’s overall supply chain is centered in Taiwan and the mainland, with assembly plants Foxconn and mobile chip maker MediaTek, which supplies panels and develops driver IC programs for AU, camera lens factory Diagraph, and others [5].

User Stories. A blogger who lives in a 70 m² room has installed xiaomi smart home productivity products in her home and here is her experience.

“You might want to look into it. I now live in a two-room apartment of about 70 square meters. So basically, there’s no linkage required. In terms of lighting, it’s basically within the range of my eyes and my daily activities, so there’s basically no need for human sensing to turn off the lights and so on, and most of the operations are done in an interactive way. Currently, I have mainly air purifiers, humidifiers, robotic floor sweepers, desk lamps, smart switches, etc. in my house. For lighting, I bought sensor lights because I think it is more practical than smart lights. For indoor environment control related to keep the house in a constant comfortable state. With smart, why not!”

3.2 The Basic Ecological Architecture of Huawei Harmony Platform

Huawei uses 1 machine + 2 network + N system as the core of its smart home business. Next, we will analyze Huawei’s IoT ecosystem from its perspective.

Core: In-house. Huawei’s brand development goal is to build a smart world where everything is connected, which means huawei will develop vertically in the smart home sector with iot technology.

As Fig. 1 shows that Huawei launched the IoT system Hilink in 2015. in 2019, Huawei officially released Harmony and HarmonyOS as open source. in 2020, Huawei launched HarmonyOS, a distributed operating system for five scenarios. in 2021, Huawei CEO Yu Chengdong said at Huawei’s new product launch that Huawei Hlink and Harmony merged and upgraded to HarmonyOS Connect”. Through this empowering ecology, it provides consumers with a whole house connected smart living experience [6].

For consumers, Huawei’s consumer business continues to adhere to “1 + 8 + N”, where 1 represents cell phones; 8 represents 8 of Huawei’s own devices; and N is responsible for representing pan-IoT devices, such as washing machines and TVs [6]. For IoT developers, Huawei efficiently supports developers to complete product development, testing, certification and product release based on its open operating system and IoT chip capabilities. In terms of partners, Huawei widely integrates all kinds of partners. It has proposed four major initiatives to support partner profitability, simplify policies, enhance partner capabilities, and build a partner ecology to actively build an open, cooperative, and win-win diversified ecosystem.

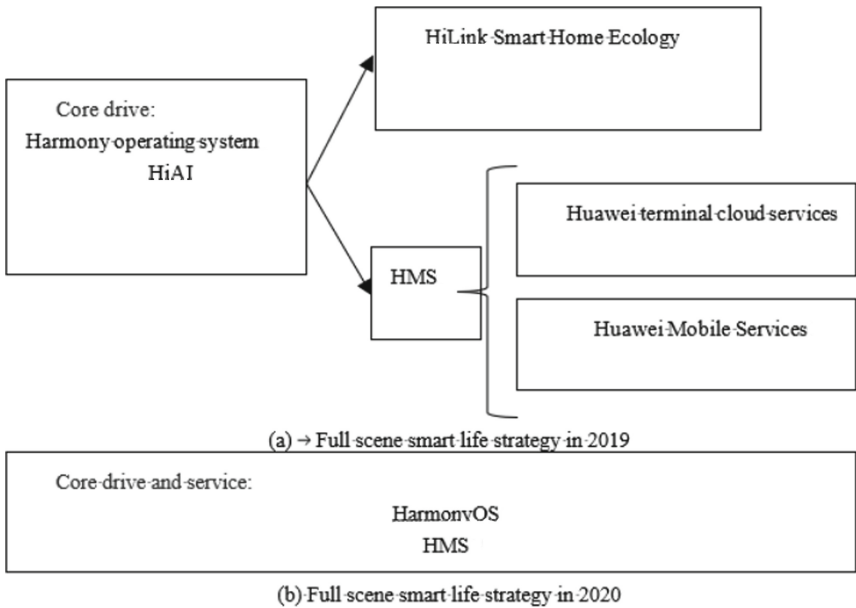


Fig. 1. Huawei smart ecosystem framework

Non-core: Partners and Suppliers. Huawei’s cooperation with ecological partners will implement the strategic policy of “four unifications”: unified brand, unified experience, unified solution, and unified platform. Huawei’s hardware and software suppliers need to have the ability to build business continuity systems so as to achieve high quality and meet customer requirements and expectations for results. Secondly, suppliers need to cooperate deeply with huawei to achieve visibility of demand forecast, purchase order, and supplier inventory through it system to ensure fast delivery of demand and fast response of supply capacity.

User Case. First, harmonyos smart home can be interconnected not only with its own products, but also with those of other electronics companies. long before harmonyos appeared, huawei hilink platform has accumulated more than 50 million users, access to more than 100 categories, covering more than 1,000 models, and the total number of iot-connected devices shipped exceeded 150 million. huawei whole-house intelligence also provides consumers with a variety of ways to interact. under huawei harmonyos, users do not need to download and install applications, and the phone can become the “control center” and “first contact” of the smart home, easily realizing the control of multiple devices. finally huawei changed the whole house intelligence to 1 machine + 2 networks + n system.

As, Fig. 2 shows that it is one whole house intelligence host with HarmonyOS central control system. Two networks, one for home IoT and one for home Internet. n-system refers to the rich and scalable Harmony Smart Link ecology, which currently covers 8 sets of intelligent control systems for lighting, environment, water, security, etc. [6].

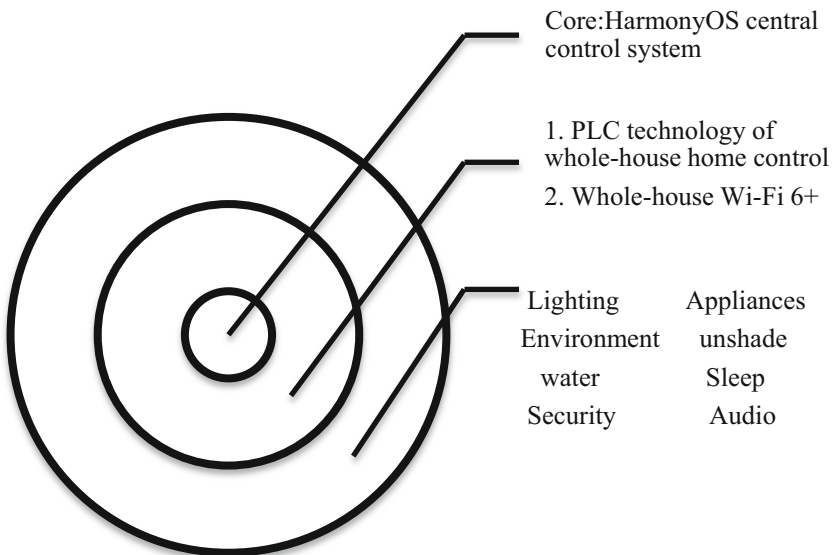


Fig. 2. 1 + 2 + N smart home ecosystem

4 Case Analysis

4.1 Xiaomi Ecological Mechanism

“Invest + Incubate” eco-chain enterprises, giving them multiple resource support to jointly cultivate new products and expand new users [7]. Xiaomi provides multiple resource support to its eco-chain partners, including: brand (Mijia and Xiaomi), supply chain capability (cost control), channels (Xiaomi/Mijia Mall), funding, product definition, ID design, and quality requirements. By the end of March 2020, Xiaomi has invested in more than 300 eco-chain companies focusing on more than 100 smart hardware and lifestyle products. In the early stage, more companies should be selected for incubation to jointly cultivate new products and support the growth of the companies [7]. In the later stage, more mature companies should be selected to promote product innovation. In the future, Xiaomi will continue to strengthen its AI technology, develop its home appliance business and expand its B2B business.

4.2 Huawei Ecological Mechanism

Huawei’s business model has evolved in all aspects. In terms of ecological capacity building, Huawei has always implemented and practiced the ecological strategy of “co-creation, sharing and win-win”. In terms of talent cultivation, Huawei has signed cooperation with the Ministry of Education and 72 double-class universities. In terms of prosperous regional ecological construction, 22 eco-innovation centers have been established across the country. In the consumer sector, Huawei’s mobile service ecology has become the third largest mobile application ecology in the world. Huawei has also gained opportunities from the multilateral trading system. Internally, Huawei has had 20 years to focus on the globalization of electronics. At the same time, global trade and services have huge potential, and as long as they are based on multilateral rules, open markets and non-discrimination, they can enjoy a fair chance in the services trade process. The epidemic is an external factor, and only a multilateral solution will enable the new crown epidemic to triumph and promote economic recovery. Huawei can build a healthy ecosystem and share the benefits of the market with its industry peers.

4.3 Platform Governance

For hardware partners, using the Xiaomi IoT platform, hardware can be networked and intelligent, with very low investment in technology development. In addition, smart hardware merchants have the opportunity to be listed in Xiaomi’s multiple sales channels, and also receive multi-dimensional support such as operational promotion resources, funding, and technology. More importantly, Xiaomi provides extensive rights protection for the IoT platform [8].

Huawei has designed and implemented a set of internal control systems based on its organizational structure and operation model. First, Huawei is committed to promoting and maintaining the company’s culture of integrity. Second, Huawei has set up a dedicated risk management department to regularly assess risks and identify, manage, and monitor all global business processes. Third, the company has established multi-faceted

information communication channels and formal internal information transfer channels. Finally, while creating business value for customers, Huawei values stakeholder requirements.

5 Discussion

Due to space limitations, the article only delves into the benefits of open platforms, but we must not forget their drawbacks. One of the major problems faced by open ecosystems such as the HarmonyOS system is how to unify the standards of each application or individual in the system [9]. The “unified standard” is especially difficult in the smart home. Also, when Huawei creates a cross-platform, cross-domain ecosystem, this could lead to interoperability issues or prevent the emergence of a large number of other active ecosystems [10]. The author of the article believes that the core experience of smart home is still only in the networked communication, and in the future, more in-depth functional communication between different devices. But in the open platform, people can’t guarantee that different manufacturers will fully communicate with each other about information involving user data or potentially affecting user safety. In other words, in the future development of open platform, the automation cooperation between device and device, platform and platform will become the main difficulty.

At the same time, open operation of the open platform in the early stage, it may be difficult to obtain considerable revenue in the short term because of the need to ensure the uniformity of applications and devices within various systems. The security of the open platform also needs to be further improved.

6 Conclusion

In general, Huawei and Xiaomi, who also entered the IoT field with cell phones as the entry point, seem to have good development in the field of smart home ecosystem and have formed both open and closed ecosystems in the construction of smart home ecosystem.

First, Huawei has the advantage of greater import and product quality, while Xiaomi has the advantage of first-mover and connected devices. Huawei’s IoT platform concept “Huawei Smart = Huawei + Partners” can ensure high-quality cooperation and the best user experience. Xiaomi, on the other hand, has built a closed system in all aspects such as product definition/user experience/sales/human resources. In this closed system, Xiaomi has achieved strong control over products/channels/users/value distribution. In this case, anyone who enters Xiaomi’s ecology must abide by Xiaomi’s rules. The closed system is one of the powerful explanations for Xiaomi’s explosion in the smart hardware sector.

More open ecosystems are needed in the future, and the Internet of Everything should be open. However, there is a fatal risk of an open ecosystem, and that is the systemic hazard of uncertainty in innovation. With no control over the direction and pace of innovation, it is highly likely that participants in open systems will bring disruptive and destructive forces. In addition, the security of information involving user data or information that may affect users is not guaranteed between different vendors.

This suggests that for the smart home, there are advantages and disadvantages to both open and closed ecosystems. The study cannot be generalized and needs to be considered in the long and short term. Instead, Huawei and Xiaomi should face the risks and challenges and carry out their own unique responses.

Acknowledgement. The degree of contribution is in order.

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Discrete-Time Model Pricing of American Option Early Exercise Premia

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Abstract. The characteristics of the early exercise of American options are full of research implications, and it is interesting to define the premia for the early exercise of different American options. In this paper, the option value is calculated via the risk-neutral measure, which define the payoff of an option at a certain time period through a discrete model called binomial tree and then discount the payoff by risk-neutral method to determine the option value. This paper first considered the conditions for early exercise of American options at the nodes, and then find out the law of premiums by taking the slope of the premium function.

Keywords: Pricing American option · Option premium · Risk-neutral measure · Discrete model · Binomial tree

1 Introduction

The option value computation is based classic paper by Cox et al. [1]. Therefore, the option with a certain maturity time T and strike price K is a contract, which can give option holder the right to buy or sell one share of underlying asset [2]. The difference between American and European options, as defined by Ravi [3], is that options can be exercised before a given future, but European options can only be exercised at the expiration date to decide whether to exercise.

Option pricing theory has a long and illustrious history. Based on the earliest proposals of Sharpe [4], all later studies are based on discrete-time methods. Besides, based on the binomial tree approach and the put-call parity, the risk-free rate is limited to a specific range.

In the next section, first, defining the premium for American options is the primary objective. Secondly, the main objective of the next section is to discuss the cases in which each parameter needs to be satisfied when the American option is exercised early in the one step and two step binomial tree cases. Finally, the premium is plotted as an image via python, and then the relationship between the inflection points and the exercise condition is determined to verify and generalize the conclusion.

1.1 Basic Knowledge

The option price measure used in the latter is risk-neutral pricing. Based on Birge and Zhang’s [5] derivation of risk-neutral pricing and Ruf’s [2] arbitrage calculation based on risk-free bonds and risky stocks, the pricing formula for a one-step option is as follows:

$$V_0 = \frac{1}{R} E^Q[F(S_1)] = \frac{1}{R} (qF(S_0u) + (1 - q)F(S_0d)) \text{ where } q = \frac{R - d}{u - d}. \quad (1)$$

Q is called the risk neutral or martingale probability measure. The formula for a two-part binary tree is just nested once in a binary tree, and the detailed formula will be given later.

In order to make the derivation more rigorous, the following three assumptions will be true by default in the calculation: (1) $d < R < u$ (2) $R > 1$ (3) $ud = 1$.

Assumption (1) is to ensure that arbitrage opportunities arise. If $R \leq d < u$, at the beginning of the period, the arbitrage strategy is to borrow S_0 cash from the bank at an interest rate of R and buy one share of stock, with the payoff equal to 0. After one period, the arbitrage strategy is to pay back S_0R cash to the bank and buy one share of stock, with the payoff equal to $S_1 - S_0R \geq 0$. In this case, there is an arbitrage opportunity between the option and the stock. However, the same method can be used to prove that $R \geq u$.

Assumption (2) is because most countries or organizations in the world have benchmark interest rates that are greater than zero. Among countries, only Japan and Switzerland have negative central bank benchmark rates of -0.1 and -0.75 respectively from East Money [6]. Therefore, the interest rates in the subsequent section will be discussed assuming a positive interest rate scenario.

Assumption (3) assumes that the later calculations are in an idealized environment. Hence, individuals are allowed to sell short any security and receive full use of the proceeds as defined Cox et al. [1]. If $ud = 1$, The basic need the mean and standard deviation σ of continuously compounded rate be nonfinite when n , the number of periods goes to infinite. Then Cox et al. [1] in the paper show that:

$$\begin{aligned} u &= e^{\sigma\sqrt{\frac{T}{n}}} \\ d &= e^{-\sigma\sqrt{\frac{T}{n}}} \\ u &= \frac{1}{d} \end{aligned} \quad (2)$$

(Limiting conditions used in Cox research)

2 Computations of the Early Exercise Decision Boundaries of American Option and Images of the Premium in Different Cases

2.1 One-Step Binomial Tree Calculation of the Decision Boundaries

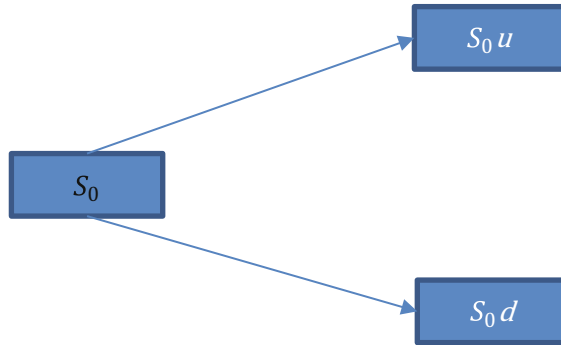


Fig. 1. Two-steps binomial tree (call option)

Figure 1 shows the price change caused by a binomial tree for the stock price. After one period, the stock price S_0 becomes S_0u with probability q and S_0d with probability $1-q$.

In a one-step binomial tree, the American option only needs to consider whether to exercise early at the beginning of the period. The value of the initial immediate exercise option: $v^a = F(S_0) = (S_0 - K)^+$. And the premium is defined as: $p = v^a - v^e$.

The value of options waiting to be exercised at expiration:

$$p = F(S) - \frac{1}{R}(q * F(S_0u) + (1 - q) * F(S_0d)).$$

where : $F(S) = (S - K)^+$ for call (3)
 $F(S) = (K - S)^+$ for put

The Decision Boundaries of American Call Option. Summary of the Conclusion on Whether to Exercise the Option Ahead of Time:

One-step American put options will never exercise early in any ranges of K .

The initial early exercise requires the following equation to be satisfied, which is based on Formula (3):

$$(S_0 - K)^+ > \left(\frac{R - d}{u - d} * (S_0u - K)^+ + \frac{u - R}{u - d} * (S_0 * d - K)^+\right) * \frac{1}{R}$$
 (4)

The above equation changes for four different ranges of values of K .

For $K < S_0d$: the inequality does not hold

$$(S_0 - K) > \left(\frac{R-d}{u-d} * (S_0 * u - K) + \frac{u-R}{u-d} * (S_0 * d - K) \right) * \frac{1}{R}$$

$$\frac{-KR(u-d)}{u-d} > \frac{-K(u-d)}{u-d}$$

$$R < 1,$$

Since : $d < R < u$.

For $S_0d < K < S_0u$: the inequality does not hold

$$(S_0 - K) > \left(\frac{R-d}{u-d} * (S_0 * u - K) \right) * \frac{1}{R}.$$

$$\frac{S_0d}{K} > 1 + \frac{(u-d)(R-1)}{u-R}$$

Since : $S_0d < K$.

For $S_0 < K < S_0u$ and $S_0u < K$:

Looking at both sides of the equation it is intuitive to conclude that the equation does not hold. In summary, in the case of American call options priced with a one-step binomial tree and satisfying the prerequisite assumptions, the option holder will not exercise the option early. It also means that the premium of the American call option is equal to zero under this premise.

The Decision Boundaries of American Puts Option. Summary of the Conclusion on Whether to Exercise the Option Ahead of Time:

One-step American call options will only exercise early when $K > \frac{S_0u*(R-d)}{(R-1)(u-d)+R-d}$.

The initial early exercise requires the following equation to be satisfied, which is based on the Formula (3):

$$(K - S_0)^+ > \left(\frac{R-d}{u-d} * (K - S_0u)^+ + \frac{u-R}{u-d} * (K - S_0 * d)^+ \right) * \frac{1}{R}. \tag{7}$$

I) For $S_0u < K$: the option holder will usually exercise the option early

$$(K - S_0) > \left(\frac{R-d}{u-d} * (K - S_0u) + \frac{u-R}{u-d} * (K - S_0 * d) \right) * \frac{1}{R}$$

$$\frac{RK(u-d)}{u-d} > \frac{K(u-d)}{u-d}$$

$$R > 1.$$

II) For $S_0 < K < S_0u$: When the below inequality is satisfied, the option holder will exercise the option early

$$(K - S_0) > \left(\frac{u-R}{u-d} * (K - S_0 * d) \right) * \frac{1}{R}$$

$$\frac{S_0u}{K} < \frac{(R-1)(u-d)}{R-d} + 1$$

$$K > \frac{S_0u*(R-d)}{(R-1)(u-d)+R-d}.$$

III) For $S_0d < K < S_0u$ and $K < S_0d$: In both cases the equation does not hold.

Very intuitively, the American put option is only this possible to exercise if K is greater than S_0 . In both cases, therefore, the option will not be exercised early.

2.2 Two-Steps Binomial Tree Calculation of the Decision Boundary of American Option

The Decision Boundaries of American Call Option.

$$\begin{aligned}
 v^a &= \max [q * \max(qF(S_0u) + (1 - q)F(S_0), F(S_0u)) \\
 &+ (1 - q) * \max((qF(S_0) + (1 - q)F(S_0d^2)), F(S_0d)), F(S_0)], \\
 \text{where : } &F(S) = (S - K)^+ \text{ for call} \\
 &F(S) = (K - S)^+ \text{ for put} \\
 &\max(a, b) = b \text{ when } b > a \\
 &\max(a, b) = a \text{ when } a > b.
 \end{aligned} \tag{10}$$

Summary of the conclusion on whether to exercise the option ahead of time:

Two-step American Call options will never exercise early in any ranges of K and node u, d, 0.

The initial early exercise requires the following equation to be satisfied, which based on Formula (10):

$$\begin{aligned}
 \text{node u : } &(S_0u - K)^+ > (\frac{R-d}{u-d} * (S_0u^2 - K)^+ + \frac{u-R}{u-d} * (S_0ud - K)^+) * \frac{1}{R}. \\
 \text{node d : } &(S_0d - K)^+ > (\frac{R-d}{u-d} * (S_0ud - K)^+ + \frac{u-R}{u-d} * (S_0d^2 - K)^+) * \frac{1}{R}. \\
 \text{node 0 : } &(S_0 - K)^+ > (\frac{R-d}{u-d} * V_u + \frac{u-R}{u-d} * V_d) * \frac{1}{R}.
 \end{aligned} \tag{11}$$

The above equation changes for six different ranges of values of K:

I) For $K < S_0d^2$: the option holder will not exercise the option early.

At node u:

$$\begin{aligned}
 v_u^e &= [(S_0u^2 - K) * \frac{R-d}{u-d} + (S_0ud - K) * \frac{u-R}{u-d}] * \frac{1}{R} \\
 &= \frac{[(R-d)(S_0u^2 - K) + (u-R)(S_0ud - K)]}{(u-d)R} \\
 &= S_0u - \frac{K}{R}.
 \end{aligned} \tag{12}$$

Compare the value of v_u^a and v_u^e , since $R > 1$, then get the follows:

$$S_0u - K < S_0u - \frac{K}{R}. \tag{13}$$

Which means $v_u^e < v_u^w$.

At node d:

$$\begin{aligned}
 v_d^w &= [(S_0ud - K) * \frac{R-d}{u-d} + (S_0d^2 - K) * \frac{u-R}{u-d}] * \frac{1}{R} \\
 &= \frac{[(R-d)(S_0ud - K) + (u-R)(S_0d^2 - K)]}{(u-d)R} \\
 &= S_0d - \frac{K}{R}.
 \end{aligned} \tag{14}$$

Compare the value of v_d^w and v_d^e , since $R > 1$, then get the follows:

$$S_0d - K < S_0d - \frac{K}{R}. \tag{15}$$

Which means $v_d^e < v_d^w$.

At node 0:

$$v_0 = [(S_0u - \frac{K}{R}) * \frac{R-d}{u-d} + (S_0d - \frac{K}{R}) * \frac{u-R}{u-d}] * \frac{1}{R}. \tag{16}$$

Assume $v_0^e > v_0^w$, then get:

$$\begin{aligned} (S_0 - K) &> [(S_0u - \frac{K}{R}) * \frac{R-d}{u-d} + (S_0d - \frac{K}{R}) * \frac{u-R}{u-d}] * \frac{1}{R} \\ S_0(uR^2 - dR^2 + dR^2 - uR^2) &> K(d - u + uR^2 - dR^2) \\ 0 &> K(d - u + uR^2 - dR^2). \end{aligned} \tag{17}$$

Since $R > 1, K > 0, K(d - u + uR^2 - dR^2) > 0$, the inequality does not hold.

II) For $S_0d^2 < K < S_0d$, the option holder will not exercise the option early.

At node u , it's similar to situation I). Therefore, the option will not exercise early at node u .

At node d :

$$v_d^e = [(S_0ud - K)^+ * \frac{R-d}{u-d} + (S_0d^2 - K)^+ * \frac{u-R}{u-d}] * \frac{1}{R}. \tag{18}$$

Since $S_0d^2 < K, ud = 1$, then get:

$$v_d^e = \frac{1}{R} * (S_0 - K) * \frac{R-d}{u-d}. \tag{19}$$

Compare the value of v_d^e and v_d^a , assume $v_d^a > v_d^e$:

$$\begin{aligned} S_0d - K &> \frac{1}{R} * (S_0 - K) * \frac{R-d}{u-d} \\ S_0(d - d^2R) &> K(R(u-d-1) + d). \end{aligned} \tag{20}$$

Since $1 - dR > 1 - du = 0$, then get:

$$\begin{aligned} \frac{S_0d^2}{K} &> \frac{R(u-d-1)+d}{u-R} \\ \frac{S_0d^2}{K} &> \frac{(R-1)(u-d)}{u-R} + 1. \end{aligned} \tag{21}$$

Since $u - d > 0, R - 1 > 0, u - R > 0$, then $\frac{(R-1)(u-d)}{u-R} + 1 > 1$, which means $v_d^e < v_d^w$.

At node 0, assume: $v_0^a > v_0^e$. Then get the following:

$$\begin{aligned} S_0 - k &> [(\frac{1}{R}q(q(S_0u - K) + (1 - q)(S_0 - K)) + \frac{1}{R}q(1 - q)(s_0 - k))] * \frac{1}{R} \\ \frac{K}{S_0} &> \frac{q^2u^2 - q^2 + 2q - R^2 - q^2}{2q - R^2 - q^2}. \end{aligned} \tag{22}$$

Since $q^2u^2 > q^2$, the right-hand side of the inequality is greater than 1. And according to the condition, the left side of the inequality is less than 1. The inequality does not hold. Therefore, the option holder will not exercise early at node 0.

IV) For $S_0 < K < S_0u$, the option holder will not exercise the option early.

At node u :

$$v_u^e = [(S_0u^2 - K) * \frac{R-d}{u-d} + (S_0ud - K) * \frac{u-R}{u-d}] * \frac{1}{R}$$

$$= \frac{(R-d)(S_0u^2 - K)}{(u-d)R}. \tag{23}$$

Assume: $v_u^a > v_u^e$. Then get the following:

$$S_0u - K > (S_0u^2 - K) * \frac{R-d}{u-d} * \frac{1}{R}$$

$$\frac{S_0u}{K} > \frac{uR - dR + d - R}{1 - \frac{R}{u}}. \tag{24}$$

Since $\frac{uR-dR+d-R}{1-\frac{R}{u}} < 1$, the inequality does not hold.

At node d :

$$v_d^e = [(K - S_0ud) * \frac{R-d}{u-d} + (K - S_0d^2) * \frac{u-R}{u-d}] * \frac{1}{R}$$

$$= 0. \tag{25}$$

Therefore, the options will not exercise early at node d .

At node 0:

$$V_0^w = (S_0u^2 - K) * \frac{R-d}{u-d} * \frac{R-d}{u-d} * \frac{1}{R}. \tag{26}$$

Since $K > S_0$, $V_0^e = (S_0 - K)^+ = 0$. The options will not exercise early at node 0.

V) For $S_0u < K < S_0u^2$ and $S_0d < K < S_0$, the option holder will not exercise the option early.

The situations of these two, are all the same as the $S_0 < K < S_0u$ and $S_0d < K < S_0d^2$, thus the option will not exercise at node $u, d, 0$ for the same reason.

VI) For $K > S_0u^2$

$$(S_0u - K)^+ = 0, (S_0d - K)^+ = 0, (S_0 - K)^+ = 0. \tag{27}$$

The option holder will do not exercise the option at any node.

The Decision Boundaries of American Put Option.

Figure 2 is a two-step binomial tree, which differs from one step in that there is an additional period of change, resulting in more price changes.

Summary of the conclusion on whether to exercise the option ahead of time:

The initial early exercise requires the following equation to be satisfied, which is based on Formula (10):

$$\text{nodeu} : (K - S_0u)^+ > (\frac{R-d}{u-d} * (K - S_0u^2)^+ + \frac{u-R}{u-d} * (K - S_0ud)^+) * \frac{1}{R}.$$

$$\text{noded} : (K - S_0d)^+ > (\frac{R-d}{u-d} * (K - S_0ud)^+ + \frac{u-R}{u-d} * (K - S_0d^2)^+) * \frac{1}{R}.$$

$$\text{node0} : (K - S_0)^+ > (\frac{R-d}{u-d} * v_u + \frac{u-R}{u-d} * v_d) * \frac{1}{R}. \tag{28}$$

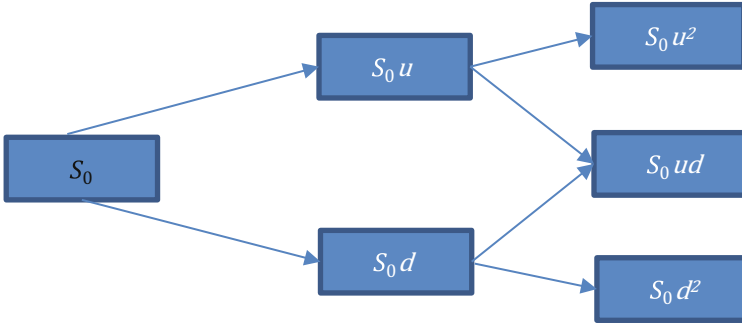


Fig. 2. Two-steps binomial tree (put option)

Table 1. Formula summary of the conclusion

Condition	$K > S_0 u^2$	$S_0 u < K < S_0 u^2$	$S_0 < K < S_0 u$	$S_0 d < K < S_0$	$K < S_0 d$
node u	Exercise	Exercise: $K > S_0 (\frac{u-R}{R-1+q} + 1)$	Don't exercise	Don't exercise	Don't exercise
node d	Exercise	Exercise	Exercise	If $K > S_0 * d * \frac{R-d+d+q}{R-1+q}$	Don't exercise
node 0	Exercise	$K > S_0 (\frac{R(dq-d-q+1)}{R^2+R(q-1)+q^2-q} + 1)$	Exercise: $K > S_0 (\frac{R(dq-d-q+1)}{R^2+R(q-1)+q^2-q} + 1)$	Don't exercise	Don't exercise

The above equation changes for six different ranges of values of K.

I) For $K > S_0 u^2$: the option holder will usually exercise the option early.

At node u :

$$\begin{aligned}
 v_u^e &= [(K - S_0 u^2) * \frac{R-d}{u-d} + (K - S_0 ud) * \frac{u-R}{u-d}] * \frac{1}{R} \\
 &= \frac{[(R-d)(K - S_0 u^2) + (u-R)(K - S_0 ud)]}{(u-d)R} \\
 &= \frac{(K - RS_0 u)(u-d)}{(u-d)R} \\
 &= \frac{K}{R} - S_0 u.
 \end{aligned}
 \tag{29}$$

Compare the value of v_u^e and v_u^a :

$$\begin{aligned}
 \frac{K}{R} - S_0 u &< K - S_0 u \\
 V_u^e &< V_u^a.
 \end{aligned}
 \tag{30}$$

Thus exercise the option immediately at node u .

At node d :

$$\begin{aligned}
 v_d^e &= [(K - S_0ud) * \frac{R-d}{u-d} + (K - S_0d^2) * \frac{u-R}{u-d}] * \frac{1}{R} \\
 &= \frac{[(R-d)(K-S_0ud)+(u-R)(K-S_0d^2)]}{(u-d)R} \\
 &= \frac{(K-RS_0d)(u-d)}{(u-d)R} \\
 &= \frac{K}{R} - S_0d.
 \end{aligned}
 \tag{31}$$

Compare the value of v_d^e and v_d^a : $\frac{K}{R} - S_0d < K - S_0d$

$$v_d^e < v_d^a.$$

Thus, exercise the option immediately at node d .

At node 0:

$$\begin{aligned}
 V_0^w &= [(K - S_0u) * \frac{R-d}{u-d} + (K - S_0d) * \frac{u-R}{u-d}] * \frac{1}{R} \\
 &= \frac{[(R-d)(K-S_0u)+(u-R)(K-S_0d)]}{(u-d)R} \\
 &= \frac{(K-RS_0)(u-d)}{(u-d)R} \\
 &= \frac{K}{R} - S_0.
 \end{aligned}
 \tag{32}$$

Compare the value of v_0^e and v_0^a : $\frac{K}{R} - S_0 < K - S_0$

$$v_0^e < v_0^a.$$

Thus exercise the option immediately at node 0.

II) For $S_0u < K < S_0u^2$:

At node u :

$$v_u^e = [(K - S_0u^2)^+ * \frac{R-d}{u-d} + (K - S_0ud) * \frac{u-R}{u-d}] * \frac{1}{R} \tag{33}$$

Assume: $v_u^a > v_u^e$, this work use proof by contradiction to explore the conditions for early exercise. After further calculation, the following conclusions can be drawn.

$$\begin{aligned}
 \frac{S_0u^2}{K} &< \frac{(d-u)(R-1)}{d-R} + 1 \\
 K &> S_0(\frac{u-R}{R-1+q} + 1).
 \end{aligned}
 \tag{34}$$

If the assumption above is correct, exercise the option immediately at node u is better. If the assumption above is incorrect, do not exercise the option immediately at node u is better.

At node d , it's similar to the result of situation $K > S_0u^2$, according to Formula (31), this condition can be transformed as:

$$v_d^e = \frac{K}{R} - S_0d. \tag{35}$$

Compare the value of v_d^e and v_d^a : $\frac{K}{R} - S_0d < K - S_0d$

$$v_d^e < v_d^a.$$

Thus exercise the option immediately at node d .

At node 0, since there are two different conditions at node u , whether or not to exercise the option at node 0 needs to be discussed into categories:

1) Do not exercise the option at node u .

In this time, it satisfies: $\frac{S_0u^2}{K} > 1 + \frac{(d-u)(R-1)}{d-R}$

$$v_0^e = [V_u * \frac{R-d}{u-d} + (K - S_0d) * \frac{u-R}{u-d}] * \frac{1}{R} \tag{36}$$

Assume: $v_0^a > v_0^e$. The calculation of whether or not to exercise at node 0 is also suitable to use proof by contradiction. After further calculation, the result is showed as follows:

$$R^2(u - d)^2(K - S_0) > [(R - d)(u - R)(K - S_0ud) + (u - R)(u - d)R(K - S_0d)]. \tag{37}$$

Since $ud = 1$, then simplify and get the following:

①: If $(3R - \frac{1}{u} - uR^2) > 0$

$$\frac{S_0u}{K} > \frac{(-1-R+uR+3\frac{1}{u}R+u^2R-R^2-uR^2+\frac{1}{u}R^2-R^2\frac{1}{u}^2)}{(3R-\frac{1}{u}-uR^2)}. \tag{38}$$

If the result of right-hand side is larger than 1, then it is proved that this assume is not correct, which means do not exercise the option at node 0. While the result of right-hand side is smaller than 1, the assume is correct, exercise the option at node 0.

It can be replaced as shown in Table 1: $K > S_0(\frac{R(dq-d-q+1)}{R^2+R(q-1)+q^2-q} + 1)$.

②: if $(3R - \frac{1}{u} - uR^2) < 0$

$$\frac{S_0u}{K} < \frac{(-1 - R + uR + 3\frac{1}{u}R + u^2R - R^2 - uR^2 + \frac{1}{u}R^2 - R^2\frac{1}{u}^2)}{(3R - \frac{1}{u} - uR^2)}. \tag{39}$$

If the result of right-hand side is smaller than 1, then it is proved that this assume is not correct, do not exercise the option at node 0 while the result of right-hand side is larger than 1, then this assume is correct, exercise the option at node 0.

It can be replaced as shown in Table 1: $K < S_0(\frac{R(dq-d-q+1)}{R^2+R(q-1)+q^2-q} + 1)$.

2) Exercise the option at node u , it's similar to the result of situation $K - S_0u^2$.

$$\begin{aligned} v_0^e &= [(K - S_0u) * \frac{R-d}{u-d} + (K - S_0d) * \frac{u-R}{u-d}] * \frac{1}{R} \\ &= \frac{K}{R} - S_0. \end{aligned} \tag{40}$$

Compare the value of v_0^e and v_0^a :

$$\begin{aligned} \frac{K}{R} - S_0 &< K - S_0 \\ v_0^e &< v_0^a. \end{aligned} \tag{41}$$

Thus exercise the option immediately at node 0.

III) For $S_0 < K < S_0u$:

At node u :

$$v_u^e = [(K - S_0u^2) * \frac{R-d}{u-d} + (K - S_0ud) * \frac{u-R}{u-d}] * \frac{1}{R}. \tag{42}$$

Since: $(K - S_0u^2)^+ = 0$, it can be showed as follows:

$$\begin{aligned} v_u^e &= [0 + (K - S_0ud) * \frac{u-R}{u-d}] * \frac{1}{R} \\ &= (K - S_0ud) \frac{u-R}{u-d} \frac{1}{R}. \end{aligned} \tag{43}$$

Since $(K - S_0u)^+ = 0$, do not exercise option at node u .

At node d , it's also similar to the result of situation I) use Formula (31), this condition can be transformed as:

$$v_d^e = \frac{K}{R} - S_0d. \tag{44}$$

Compare the value of v_d^e and v_d^a :

$$\begin{aligned} \frac{K}{R} - S_0d &< K - S_0d \\ v_d^e &< v_d^a. \end{aligned} \tag{45}$$

Thus, exercise the option immediately at node d .

At node 0, which is similar to situation II).

As the result above is 'do not exercise at node u ', it satisfies:

$$\begin{aligned} v_0^e &= [V_u^w * \frac{R-d}{u-d} + V_d^e * \frac{u-R}{u-d}] * \frac{1}{R} \\ &= [\frac{(u-R)(K-S_0ud)}{(u-d)R} * \frac{R-d}{u-d} + (K - S_0d) * \frac{u-R}{u-d}] * \frac{1}{R}. \end{aligned} \tag{46}$$

Assume: $v_0^a > v_0^e$. Then this inequality can be converted to following:

$$R^2(u - d)^2(K - S_0) > [(R - d)(u - R)(K - S_0ud) + (u - R)(u - d)R(K - S_0d)]. \tag{47}$$

Since $ud = 1$, then simplify and get the following:

$$S_0(3uR - 1 - u^2R^2) > K(-1 - R + uR + 3\frac{1}{u}R + u^2R - R^2 - uR^2 + \frac{1}{u}R^2 - R^2(\frac{1}{u})^2). \tag{48}$$

In this time, whether: ' $(3uR - 1 - u^2R^2) > 0$ ' is the core. Then here are two situations based on previous inequality.

①: If $(3uR - 1 - u^2R^2) > 0$

$$\frac{S_0}{K} > \frac{(-1 - R + uR + 3\frac{1}{u}R + u^2R - R^2 - uR^2 + \frac{1}{u}R^2 - R^2(\frac{1}{u})^2)}{(3uR - 1 - u^2R^2)}. \tag{49}$$

If the result of right-hand side is larger than 1, then this assume is not correct, do not exercise the option at node 0. Otherwise, the assume is correct, exercise the option at node 0.

It can be replaced as another expression $K > S_0(\frac{R(dq-d-q+1)}{R^2+R(q-1)+q^2-q} + 1)$.

②: If $(3uR - 1 - u^2R^2) < 0$

$$\frac{S_0}{K} < \frac{(-1 - R + uR + 3\frac{1}{u}R + u^2R - R^2 - uR^2 + \frac{1}{u}R^2 - R^2(\frac{1}{u})^2)}{(3R - \frac{1}{u} - uR^2)}. \tag{50}$$

If the result of right-hand side is smaller than 1, then this assume is not correct, do not exercise the option at node 0. Otherwise, the assume is correct, exercise the option at node 0.

It can be replaced as shown in Table 1: $K < S_0(\frac{R(dq-d-q+1)}{R^2+R(q-1)+q^2-q} + 1)$.

IV) For $S_0d < K < S_0$:

At node u :

$$v_u^e = [(K - S_0u^2) * \frac{R-d}{u-d} + (K - S_0ud) * \frac{u-R}{u-d}] * \frac{1}{R}. \tag{51}$$

Since $(K - S_0u^2)^+ = 0$, $(K - S_0ud)^+ = 0$; $(K - S_0u)^+ = 0$, there is no difference between American option and European option. Thus, do not exercise option at node u .

At node d :

$$v_d^e = [(K - S_0ud)^+ * \frac{R-d}{u-d} + (K - S_0d^2)^+ * \frac{u-R}{u-d}] * \frac{1}{R}.$$

$$v_d^e = [0 + (K - S_0d^2) * \frac{u-R}{u-d}] * \frac{1}{R}. \tag{52}$$

Assume: $v_d^a > v_d^e$, which means:

$$(K - S_0d) > [(K - S_0d^2) * \frac{u-R}{u-d}] * \frac{1}{R}. \tag{53}$$

Then calculate the inequality:

$$(K - S_0d) > \frac{(u-R)(K - S_0d^2)}{u-d} \frac{1}{R}$$

$$R(u-d)(K - S_0d) > (u-R)(K - S_0d^2) \tag{54}$$

Since $ud = 1$, simplify and get the following:

$$S_0(d - R) > K(\frac{1}{d} - R - \frac{1}{d}R + dR) \tag{55}$$

Since: $d - R < 0$

$$\begin{aligned} \frac{S_0}{K} &< \frac{\frac{1}{d} - R - \frac{1}{d}R + dR}{d - R} \\ \frac{S_0}{K} &< \frac{\frac{1}{d} - R - \frac{1}{d}R + dR + d - d}{d - R} \\ \frac{S_0}{K} &< \frac{(\frac{1}{d} - d)(1 - R)}{d - R} + 1. \end{aligned} \tag{56}$$

As $(u - d) > 0$, $(1 - R) < 0$, $(d - R) < 0$, $(S_0 > K)$

①

$$\begin{aligned} \frac{S_0}{K} &< \frac{(\frac{1}{d} - d)(1 - R)}{d - R} + 1 \\ K &> S_0 \left(\frac{d^2 R + d}{R - 1 + q} - d^2 \right). \end{aligned} \tag{57}$$

The assumption above is correct. Therefore, exercise option at node d .

②

$$\begin{aligned} \frac{S_0}{K} &> \frac{(\frac{1}{d} - d)(1 - R)}{d - R} + 1 \\ K &< S_0 \left(\frac{d^2 R + d}{R - 1 + q} - d^2 \right). \end{aligned} \tag{58}$$

The assumption above is incorrect. Therefore, do not exercise option at node d .

At node 0:

1) if exercise option at node d :

$$\begin{aligned} v_0^e &= [v_u^e * \frac{R-d}{u-d} + v_d^e * \frac{u-R}{u-d}] * \frac{1}{R} \\ &= [0 + (K - S_0 d) * \frac{u-R}{u-d}] * \frac{1}{R}. \end{aligned} \tag{59}$$

Since $S_0 d < K < S_0$, $(K - S_0)^+ = 0$ do not exercise the option at node 0.

2) if do not exercise option at node d ,

$$\begin{aligned} v_0^e &= [v_u^e * \frac{R-d}{u-d} + v_d^e * \frac{u-R}{u-d}] * \frac{1}{R} \\ &= [0 + (K - S_0 d^2)^+ * \frac{(u-R)^2}{(u-d)^2}] * \frac{1}{R^2}. \end{aligned} \tag{60}$$

Since $S_0 d < K < S_0$, $(K - S_0)^+ = 0$, also do not exercise the option at node 0.

V) For $S_0 d^2 < K < S_0 d$:

At node u :

$$v_u^e = [(K - S_0 u^2) * \frac{R-d}{u-d} + (K - S_0 u d) * \frac{u-R}{u-d}] * \frac{1}{R} \tag{61}$$

Since now: $(K - S_0 u^2)^+ = 0$, $(K - S_0 u d)^+ = 0$, $v_u^e = 0$.

Thus, do not exercise the option at node u .

At node d :

$$v_d^e = [(K - S_0 u d) * \frac{R-d}{u-d} + (K - S_0 d^2) * \frac{u-R}{u-d}] * \frac{1}{R} \tag{62}$$

Since: $(K - S_0 u d)^+ = 0$

$$v_d^e = [0 + (K - S_0 d) * \frac{u-R}{u-d}] * \frac{1}{R}. \tag{63}$$

Besides: $S_0d > K$, $(K - S_0d)^+ = 0$
 Therefore, do not exercise the option at node d .
 At node 0:

$$\begin{aligned}
 v_0^e &= [v_u^e * \frac{R-d}{u-d} + v_d^e * \frac{u-R}{u-d}] * \frac{1}{R} \\
 &= [0 + [(K - S_0d^2) * \frac{u-R}{u-d}] * \frac{1}{R} * \frac{u-R}{u-d}] * \frac{1}{R}.
 \end{aligned}
 \tag{64}$$

Since $S_0 > S_0d > K$, $(K - S_0)^+ = 0$, do not exercise the option at node 0.
 VI) For $K < S_0d^2$:

On this situation, both payoff and expected value equal to 0 at any node no matter what R, u, d is.

On another word:

$$(K - S_0u)^+ = 0, (K - S_0d)^+ = 0, (K - S_0)^+ = 0.
 \tag{65}$$

Do not exercise the option at any node.

2.3 Calculating American Option Premia Based on Early Exercise Conditions.

One-Step American Option Premia. After randomly selecting S_0, u, d, R under the premise assumptions, the premia of American options are found according to different K . The minimum value of the latter value of k will be smaller than the possible price of the underlying asset and the maximum value will be larger than the maximum possible price. In the following two examples with one-step period, the range of values of K is from 70 to 105, and 1750 numbers are taken on average in this range.

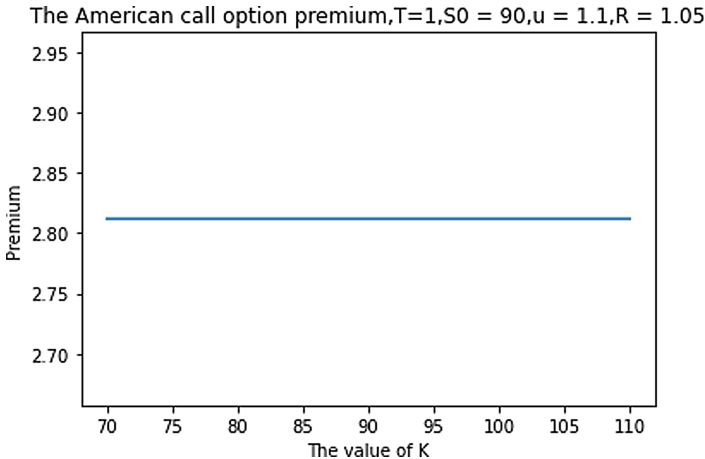


Fig. 3. American call option premium.

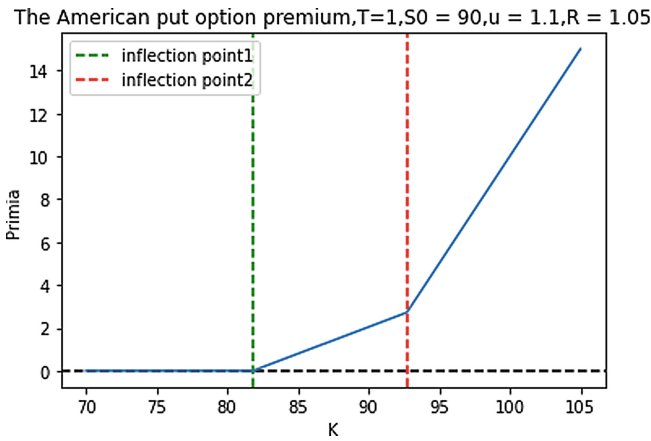


Fig. 4. American put option premium, $T = 1$.

Based on the derivation of the one-step binomial tree in the above section, the theory and practice of the American option premium above is consistent. The Fig. 3 show that American call option premium is always zero regardless of the change in K , provided the assumptions are met.

Also, for American puts, the premium of the option is always zero when K is less than a certain number, meaning no early exercise, showing in the Fig. 4 where the K is less than inflection point 2. And when K is greater than a certain number, the premium of the option grows at a fixed slope, implying an early exercise.

$$\begin{aligned}
 IP1 &= S_0 * d. \\
 IP2 &= \frac{S_0 u * (R - d)}{(R - 1)(u - d) + R - d}.
 \end{aligned}
 \tag{66}$$

According to the previous deduction, the *inflection point 1* and *inflection point 2* are equal to the above two formulas respectively. After bringing in the specific values and drawing vertical lines on the above graph according to the calculation results, it can be seen that the two vertical lines in green and red just coincide with the positions of the inflection points. Therefore, the above two inflection point formulas are correct.

Two-Step American Option Premia.

Two-Step and Multi-step American Call Option Premia.

The conclusions of the previous two binomial trees for pricing American call options are fully consistent with Fig. 5. Under the three assumptions, the option strike will never be exercised early. Based on the observation of one-step and two-step binomial trees, the American call option never exercises early under the three preconditions may be extended to satisfy the binomial tree no matter how many steps there are.

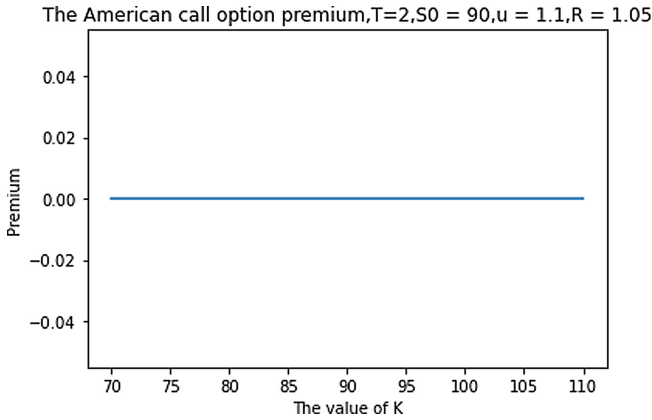


Fig. 5. American call premium $T = 2$

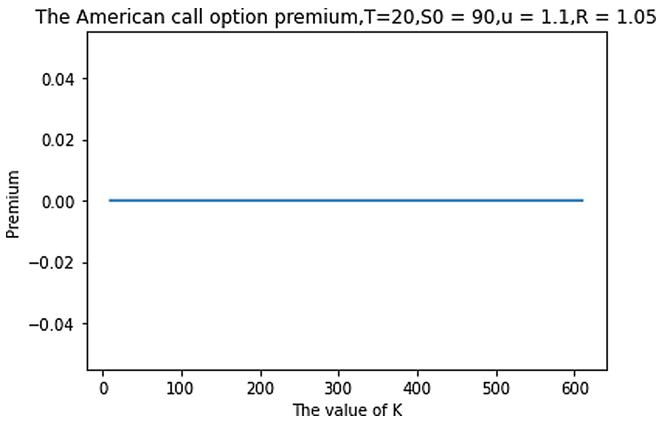


Fig. 6. American call premium $T = 20$

As mentioned above, when $t = 20, k = [10, 610]$, 30, 000 different values of K as a sample, the premium of the American call option is as Fig. 6. Therefore, American call options may never be exercised.

Two-Step American Put Option Premia.

For a European put option with a two-step binomial tree, the option value function is a segmentation function with three points of inflection.

$$\begin{aligned}
 IP1 &= S_0 d^2. \\
 IP2 &= S_0. \\
 IP3 &= S_0 u^2.
 \end{aligned}
 \tag{67}$$

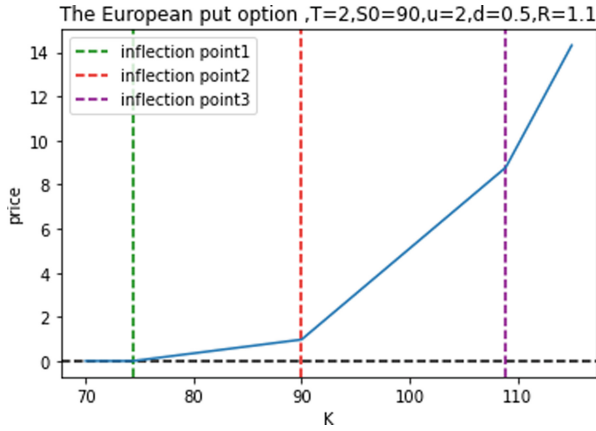


Fig. 7. European put option prices, T = 2

And substitute the values into the above inflection point equation and take K equal to the vertical line at the three inflection points, resulting in Fig. 7. The three lines coincide with each of the three inflection points.

The expression for the American option is a function that also has four points of inflection.

$$\begin{aligned}
 IP4 &= S_0 d^2. \\
 IP5 &= S_0 * d * \frac{R-d+d*q}{R-1+q}. \\
 IP6 &= S_0. \\
 IP7 &= S_0 * \left(\frac{R(dq-d-q+1)}{R^2+Rq-R+q^2-q} + 1 \right).
 \end{aligned}
 \tag{68}$$

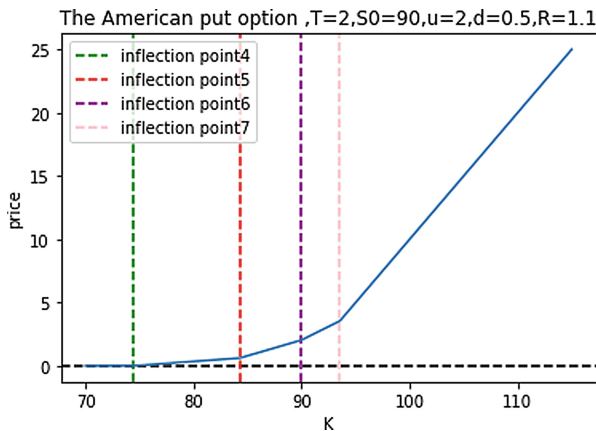


Fig. 8. American Put Option Prices, T = 2.

As in the previous steps, the values are substituted into the formula for the above inflection points to derive the values of the inflection points and take k equal to these values to draw the vertical line to obtain the above Fig. 8.

It can be seen that the inflection points of the image and the vertical line intersect exactly, so it proves that the previous inference is correct.

Finally, the premium of the American put option is the price of the American put option minus the price of the European put option corresponding to a different K . Since $IP1 = IP4$, $IP2 = IP6$, American put options will not be exercised earlier than $IP5$. Therefore, there are four inflection points in the premium of two-step American put options.

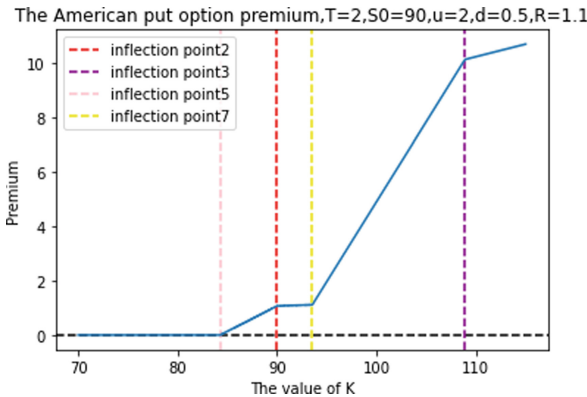


Fig. 9. American put option premium, $T = 2$

If the functions of the American put option and the European put option are subtracted, it results in the image shown above. It is obvious that in the Fig. 9 the four inflection points in the above graph correspond to $IP2$, $IP3$, $IP5$, and $IP7$ respectively, which match the formula of the viewpoint. Therefore, the premium of the two-step American put option is a five-segment function. Moreover, $IP2$, $IP3$ and $IP5$ are the inflection points generated by the American option function, and $IP3$ and $IP7$ are the inflection points generated by the European option.

3 Conclusion

In summary, this paper investigates the conditions for early exercise of American options based on a discrete-time model-binomial tree. American call options do not exercise early under the assumptions mentioned in the previous section, regardless of the number of observation periods t . However, the early exercise condition of American put options is much more complicated. In a one-step binomial tree, the option has two early exercise points. In a two-step binomial tree, the option has four early exercise points.

For the American option put option, it is also full of interest to continue to study the conditions under which the option is exercised early at t greater than two. If future

research can identify objective laws, then the study of discrete-event models with this basic precondition will be largely complete. The pricing of the American option discrete model will be of great practical significance.

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A Survey of Research on the Effect of Tangible Assets on Capital Structure

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Abstract. Capital structure has a crucial influence on financing decisions of corporates. Based on previous literature surveys, this work thoroughly explores the direct and indirect relationship between tangible assets and capital structure in developed markets and emerging markets in both theoretical and empirical manner, and summaries previous literatures about on tangible assets and capital structure model in several aspects. First of all, this work reviews the factors that affect the capital structure and focuses on the impact of tangible assets on the capital structure. In addition, the influence of intangible assets on the capital structure is discussed. Moreover, this article discusses the significance of collateral and theoretically explains the relationship between tangible assets and capital structures. Finally, the proportion of tangible assets of developing country enterprises and the method of optimizing and adjusting the capital structure of companies are proposed.

Keywords: Tangible assets · Capital structure · Enterprises · Investment

1 Introduction

Capital structure means the composition of different capitals of an enterprise as well as their proportional relationships. Capital structure is an important issue of corporate financing decision-making. Capital structure has a very important impact on investment [1]. Once the capital structure is not truly stable, it will pose a huge influence upon subsequent investments. As the capital structure is very important to the development of enterprises, a large number of literatures focus the important factors which can affect the capital structure. For instance, Jensen and Meckling [2] pointed out in their seminal paper on ownership, agency costs as well as capital structure which companies can employ funds achieved from financing of debt for riskier investment programmes. In other words, the company uses the option features of equity of shareholders transfer wealth from creditors towards shareholders. Tangible assets can be employed as collateral, thereby reducing the possibility of creditors which bears the above agency costs, when the company has more tangible assets. Therefore, it is often believed that the higher the level of financial leverage, because the higher the proportion of tangible assets. In these affecting factors, tangible is an essential factor. Existing theories believe that, based on physical value, compared to intangible assets without physical value as the basis,

the operational risk of tangible assets is much smaller. Likewise, Jensen [2] believe that real estate has stronger debt repayment support ability and more mortgage usage frequency. The higher the proportion of real estate, the more inclined and capable of debt financing, which indirectly suggests that intangible assets may have a negative correlation with the company's debt-to-asset ratio. However, with the development of science and technology, intangible assets occupy a higher proportion in the balance sheet of enterprise, for instance: patents (such as iPhone and Tesla), reputation of the company etc. Whether the above situation still applied? How has the overall relationship between tangible assets and capital structure evolved from the past to the present? This study will analyse and discuss the impact of tangible assets on capital structure mentioned in existing literature, and summarize how the relationship between tangible assets and capital structure has changed from the past to the present.

Regarding the selection of literature, this research will mainly focus on researches which directly examine the relation between tangible assets and capital structure both theoretically and empirically, including theoretical and empirical research literature, both of which will be referred to as the focus of this research. In addition, in order to narrow the topics of this research, this research will focus on selecting mature markets. Regarding the literature on emerging markets, this research will also select a small amount of literature for review to improve the research questions. In terms of review logic, this study will review important documents in chronological order, so as to clarify the development context of research on tangible assets and capital structure. Finally, in order to ensure the authority and credibility of the selected documents in this study, the range of journals selected for this study include: *The American Economic Review*, *Econometrica*, *Quarterly Journal of Economics*, *Journal of Political Economic* and *Review of Economic Studies*.

Based on the content of the current literature, this paper will investigate the relation between tangible assets and capital structure. There are 4 sub-points that we will illustrate step by step. First, the direct and indirect relationship between the tangible assets and capital structure. Second, results were observed from two different aspects which are theoretical and empirical by investigating and researching a large amount of paper. Third, the paper will talk about different relationships between tangible assets and capital structure under different markets—developed market and emerging market. Finally, early studies, models about tangible assets and capital structure will also be analyzed and mentioned in this paper. The paper would have 5 sections. The first part of the following will give a general introduction to the early literature, mainly including the influence of tangible assets mentioned in the literature on the capital structure in the past and scholars' views on this phenomenon. In addition, there will be a slight reference to the impact of intangible assets on the capital structure, enabling some contrast between tangible and intangible assets. The second part is Theory summary, which mainly explains the influence of tangible assets on capital structure in theory. This section deals with the specific theory, including the specific content of the theory. The third part is Empirical literature summary, which will discuss and analyse the empirical analysis of some important papers. The fourth part is the Research Papers, which provide theoretical and empirical discussion and analysis respectively. The last part relates to the research papers. Different papers will be discussed in this research that includes classical theoretical and

empirical papers. In addition, brief description of other key papers will be illustrated in this research, also these results will be analyzed by us. Furthermore, conclusions will be drawn at the last of the whole paper.

2 Theory Summary

A tangible asset is a part of the capital structure. Tangible assets are also fixed assets and liquidity of enterprises. Also, the debt ratio of tangible assets could evaluate the solvency of the enterprise. Theory suggests that contract incompleteness and limited enforceability reduces a firm's access to external finance [3, 4]. In the presence of friction, tangible assets are more preferable from the perspective of the creditor, because they are easier to repossess in a state of bankruptcy. So, it also explained that tangible assets are more likely to borrow loans. In addition, the capital structure is also the composition of capital. The capacity of capital opportunity to pay can also be called the debt ratio of each company. The tangible asset-liability ratio of each company is the ratio of total liabilities to total assets after deducting intangible assets. It can also evaluate the solvency of an enterprise.

Assets that are less firm-specific should allow for higher debt capacity because they are easier to resell, for example, to other firms in the same industry [5]. Tangible assets, however, often lose value when they are later reallocated [6–9]. Such losses imply that only those tangible assets that can be easily redeployed should sustain high debt capacity [5]. In other words, tangible assets should be a benefit for borrow loans only if they are liquidity assets. However, tangible assets are often illiquid and difficult to reallocate, indicating that companies' short-term solvency is weakened; Can enhance the enterprise long-term capital financing ability; On the whole, it enhances the overall earning ability of assets, so that it is not easy to go bankrupt to a company. To analyze the relationship between tangible assets and capital structure. According to the agency theory, the tangibility of assets is also a capital structure factor. Rajan and Zingales [10] claim that such assets lower the risk of agency costs connected with debt borne by the creditor by acting as collateral for a loan, increasing leverage. The pecking order theory of debt shows that the value of tangible assets has an impact on the capital structure. According to Frank and Goyal's empirical verification of this variable, the larger the share of these assets pledged as collateral, the higher the leverage [11]. In order to conclude the relationship between collateral and capital structure, S. Rampini and Adriano A. Rampini Viswanathan [12] utilized a dynamic investment model, and built a dynamic model which include investment, capital structure, risk management and leasing that based on the requirement to collateralize promises to pay with actual asset. Both finance and risk management need payment obligations based on the availability of collateral. In addition, leasing mainly follow the tradeoff theory that it is a high-risk, high-reward financing strategy that allows you to take advantage of higher leverage.

Furthermore, more constrained firms hedge less and lease more in both cross-sectional and dynamic measures. In term of a mature firm, it may minimize the risk management and sell and lease back assets when meet a cash flow shock [13, 14]. Productivity persistence reduces the rewards of hedging low cash flows, and firms may decide not to hedge at all. There is a fundamental connection across organizations' finance and risk management strategies since both need businesses to make payment

obligations, and financing considerations might override hedging concerns. In practice, under the stationary distribution, weakly capitalized enterprises do not participate in optimal risk management, while firms with despite extensive avoid risk management.

To concluded, the tangibility of assets and the ability of firms to lease capital are significant determinants of capital structure. The simple form of the optimal contract in our dynamic agency-based capital structure model should make calibration and empirical implementation easier, which has been a challenge for previous agency-based models. Due to its simplicity, our model may also prove to be a useful platform for addressing other theoretical challenges in dynamic corporate finance and financial macroeconomics.

3 Logical Explanation of the Relationship Between Collateral and Tangible Assets and Capital Structure

3.1 Significance of Studying Collateral and the Relationship Between Tangible Assets and Capital Structure

Since corporate finance, tangible assets, marketable securities and notes have been widely accepted as the mainstay of offsetting potash. In the era of shortage economy, social scarce resources are natural resources, labor and capital, so the expansion of enterprises mainly adopts horizontal development strategy, possessing resources and focusing on scale efficiency, so that is, physical form production factors namely - tangible assets play an important role in the production of enterprises; but in the era of surplus economy, social Scarcity of resources became knowledge management, reputation, the expansion of enterprises into a vertical development strategy to seize the technology with the intangible assets of this period because of climbing to the peak of the brand, mastering the air of setting standards and embarking on the social stage. The process of economic globalization further intensified, and enterprises recognized the status and role of intangible assets. As market competition becomes more and more intense and the business activities of enterprises become more and more complex, intangible assets are becoming more and more central to their status and role. Along with the strong development of intangible assets, contradictions have become increasingly evident. Intangible assets do not have physical form and cannot be measured concretely; there are legal failures and methodological failures, and no sound scientific legal system and evaluation system has been formed; intangible assets have a certain useful life, and with the renewal of technology, it leads to the diminishing value of intangible assets year by year, so that they are finally eliminated; with high risk, enterprises are like air gardens.

Nowadays, the credit system in the international market is not well established, the credit system is not sound, and the national debt of global countries is increasing, etc., not to mention that the proportion of intangible assets of enterprises is too large, which has increased the risk in the market. It is important to review the capital structure and discuss the relationship between tangible assets and capital structure for the sake of healthy and stable development of enterprises.

3.2 Explain the Relationship Between Collateral as Well as Tangible Assets and Capital Structure

Factors Affecting Capital Structure. Capital Structure is a Property Rights Structure Issue, the Result of Resource Allocation of Social Capital in the Form of Enterprise Economic Organization, and the Proportional Relationship Between Long-Term Liabilities and Equity Capital of the Enterprise. A Reasonable Capital Structure is Crucial to the Development of an Enterprise, and by Changing the Composition and Proportional Relationship of Enterprise Capital Value, the Cost of Capital Can Be Minimized and the Value Maximized. The Specific Factors that Influence the Capital Structure Are Mainly Micro and Macro Factors Such as Company Size, Fixed Asset Ratio, Profitability, Solvency, Growth, Non-debt Tax Shield, Cost Structure, Investment Opportunities, and Industry Characteristics, Market Environment, and Macro Policies.

Because of the Significant Value Characteristics of Tangible Assets, the Relationship Between Tangible Assets and Capital Structure Varies in Different Industries. With the Continuous Investment in Intellectual Property, R&D Expenditures in the Primary Industry, Intangible Assets Have an Increasingly Significant Correlation with Enterprise Value in the Primary Industry Compared to Tangible Assets, and Tangible Assets Occupy a Smaller and Smaller Proportion of the Capital Structure of the Relevant Enterprises. In the Secondary Industry, R&D Expenditures and Tangible Assets Have More Influence on the Enterprise Value of This Industry. The R&D of Enterprises in This Industry is Mainly Aimed at the R&D of Tangible Assets, so the More R&D Expenditures, the More Tangible Assets, but in the Secondary Industry, More Tangible Assets Means Lower Enterprise Value Because of the Increased Expenses and Wasted Enterprise Resources. So Tangible Assets Should Take the Primary Position in the Capital Structure of the Enterprise to Ensure the Rationalization of the Enterprise's Capital. In the Tertiary Service and Neutral Class Industries, Because of the Characteristics of the Industry Such as Small Investment, Fast Absorption and Emerging Industries, Tangible Assets Do not Have Much Utility with the Enterprise Value, and Intangible Assets Exceed the Proportion of Tangible Capital in the Capital Structure.

Relationship Between Collateral and Tangible Assets and Capital Structure in Mature and Immature Regions. The Capital Structure of Different Industries, as Well as the Differences in Economic Development, Cultural Level and Political System of Different Countries and Regions Lead to the Differentiation of Capital Structure in Different Countries. Therefore, the Relationship Between Tangible Assets and Capital Structure of Companies in Different Countries and Regions Can Be Analyzed According to the Different Levels of Market Development.

The relationship between tangible assets and capital structure in mature markets. In mature markets, intangible assets account for an increasing proportion of a company's assets due to a favorable market environment, and there is a strong positive relationship between intangible assets and leverage, with tangible assets still playing an important role in the capital structure as a source of original capital. Among tangible assets, however, the share of physical assets has declined, while financial assets have continued to increase. It is because companies increasingly need higher intensity liquidity to ensure

their vitality and corporate resilience and to reduce their risks. And in non-mature markets, some scholars have concluded from their studies that large companies use more short-term financing and less long-term financing, and further found that: there is a positive correlation between physical assets and debt; this indicates that due to the unstable environment of the market, and the influence of policies, companies use less long-term financing in order to pursue higher interests and increase leverage under a stable playing function strategy. More financing means is equity.

3.3 Related Recommendations

Developing Countries, Companies Should Increase the Proportion of Tangible Assets. Since Developing Countries' Corporate Markets Are Still in the Growth Stage of Immaturity, There Are Various Problems in the Activities of Intangible Assets, Such as Agency Delegation Problems, Which Lead to Uncertainty in the Performance of Intangible Assets. At the Same Time, the Impairment of Intangible Assets Caused by the Lack of Protection of Intangible Assets by Enterprises and Governments Reduces the Profitability of Enterprises and Increases the Market Risk of Enterprises. Therefore, in Developing Countries, Tangible Assets Should Occupy an Important Proportion in the Capital Structure, and the Capital Structure of Enterprises Should Be Rationalized to a Certain Extent, so as to Increase the Anti-risk Ability of Enterprises.

Reasonable Use of Debt Financing Methods to Optimize the Adjustment of the Company's Capital Structure. For Developed Countries, the Overall Market Environment Has Prompted Enterprises to Rely on Technological Innovation to Form High-End and Differentiated Competitive Advantages. R&D Investment Needs Stable Capital Support, and It is Often Unsustainable to Rely Only on Internal Financing to Solve the Capital Problem. Through the Listed Companies to Improve the Investment in Intangible Assets, Use the Ability of Intangible Assets to Obtain Continuous Cash Flow and the Ability to Support Debt Financing, Adopt Appropriate Debt Management Strategy, Use Debt Financing More Reliably to Increase the Level and Extent of the Company's Debt, Adjust the Ratio of Debt Capital and Equity Capital to Obtain More Financial Leverage Gains and Tax Saving Gains, and Improve the Profitability of Own Funds, so as to Solve the Company as Much as Possible to Further Enhance the Value of the Company by Solving as Much as Possible the Problem of Insufficient Funds for Long-Term Operation and Development.

4 Research Papers

Through the study of Collateral and capital Structure [12], it could be known that: the tangible property of assets and the ability of leasing capital of enterprises are the key determinants of capital structure. The relationship between leasing and financial leverage and capital structure is clearly mentioned in the study. Scholars believe that collateral determines the capital structure, and have established a dynamic agent-based enterprise financing model, and this model is based on the research done on the basis

of tangible assets as collateral. In the study, the given model assumes that firms need both tangible and intangible capital. But there is also a constraint, which means that only physical capital can be used as collateral and borrowed. The study also points out that risk management, companies with more mortgageable or tangible assets can increase leverage, investment, and improve corporate risk management to offset the impact of higher leverage on net worth fluctuations. In general, this paper argues that the development of enterprises cannot be separated from tangible assets and intangible assets, but at the same time, it also shows that the proportion of tangible assets required for enterprise development is a key determinant of leverage and enterprise financing dynamics. In addition, this study clearly considers the impact of the ability of enterprises to lease capital on the development of enterprises. The lack of tangible assets explains much of the company's low leverage. In addition, some research and analysis are also made on Intangible assets and capital structure [13]. According to this study, with the maturity and development of the market, the enterprise is constantly developing. At present, tangible assets are not the majority of enterprises, intangible assets also occupy a large part of the company's assets, and with the development of enterprises, the total amount of intangible assets is also increasing. For example, when a brand is bought, it is very small and the brand is not well known. However, after the brand is well managed, its popularity gradually increases. At this time, the value of intangible assets also increases along with its popularity, but the value remaining on the balance sheet is still only the value invested at the beginning. Furthermore, in addition to brands and patents, the value of many intangible assets is not reflected in the balance sheet, which amplifies the uncertainty of intangible assets.

Discussion: Through the study of literature, lots of literature puts forward that tangible assets is a very important factor. In the early literature, compared with intangible assets, scholars paid more attention on the debt-supporting role of real estate (i.e., tangible assets) and the impact on capital structure. Existing theories believe that, based on physical value, compared to intangible assets without physical value as the basis, the operational risk of tangible assets is much smaller. From the inflationary aspect, if there is no influence of inflation, monetary capital won't have any operational risk. However, as the time changed, under the current market environment, more companies pay more attention to intangible assets. These companies start to increase researches that can continue to explore the possible impact of intangible assets on the capital structure of a company. For example, Rampini and Viswanathan [12] analyzed whether intangible assets may have an impact on the solvency of a company. In addition, whether the intangible assets still maintain from the empirically aspects if there is any change theoretically.

5 Summary

From the above analysis, both tangible assets and intangible assets are important impact to the capital structure, and tangible assets and intangible assets have a very strong impact on financial leverage. However, according to literature research and actual practice of enterprises, intangible assets are not recognized in practice due to many uncertain factors [14]. Tangible assets, such as real estate and other fixed assets, have a fixed form of

existence, greatly improve the credibility, and play a relatively important role in the capital structure. In the future, whether intangible assets will replace tangible assets, and also whether intangible assets will have impacts on capital structure is questionable.

6 Conclusion

Tangible assets are one of the essential aspects describing the internal capital structure of a company. Compared with intangible assets, tangible assets have more liquidity and reconfigurability, and its ownership makes the corresponding company with a higher debt capacity. Because tangible assets are more likely to be valued or sold, their composition positively affects the debt level of a company. Based on the existing theories, compared with intangible assets without physical values, tangible assets based on physical values have more impact on business risks. The company's tangible assets can become collateral for company bankruptcy, thereby reducing financing costs. Low debt costs generally result in higher debt ratios. However, with the continuous changes in company structures, more companies have begun to attach importance to intangible assets. Therefore, intangible assets also have a gradual increase in the company's capital structures. Based on the dual importance of tangible assets and intangible assets, more research should be placed on the significance of the two to the company's capital structure. This paper deeply explores the direct and indirect relationship between tangible assets and capital structure in developed and emerging markets from both theoretical and empirical aspects, and describes tangible assets and capital structure models from multiple aspects. In addition, this work discusses the importance of collateral and explains the relationship between tangible assets and capital structure based on theoretical basic research. Finally, this work puts forward the proportion of tangible assets of developing country enterprises, and the method of optimizing and adjusting the capital structure of enterprises, which attaches great importance of the well-distributed capital structure in a company.

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Data Analytics Applications in the Soda Industry

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Abstract. The soda industry, led by Coca-Cola and PepsiCo, has been playing an essential role in the economy and life of modern society for decades, but the emergence of data analytics applications in recent years has changed and improved all aspects of this industry. This paper starts by discussing the value creation of the soda industry based on the value chain. It then analyzes the role of different popular analytics applications in the various activities of the industry by using several real examples. Further, based on the current industry situation and challenges, this paper predicts the future development trend of analytics applications in the industry.

Keywords: Analytics applications · Soda industry · Value chain

1 Introduction

After studying the application of analysis of data in real life, we gained a great interest in data analytics to a specific industry. After the discussion, we decide to focus on the data industry because it is relatively common in our everyday life, therefore people are more likely to be interested. Something we have not covered yet is the usage of data analytics in terms of natural resource recycles, such as plastics. In the work, we mainly focused on the value chain of soda and the current and future practical function of data within the industry. The research highlight how data are directly connected to us; it is not as far as we thought.

2 Industry Overview

Since the first *carbonation* device was developed in 1760, soda, a flavored beverage made from a combination of water and carbon dioxide, has been available for public consumption. Various flavors of carbonated drinks and advanced beverage production technology prospered in the following decades, making the soda business an essential

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industry. Today, Coca-Cola and PepsiCo are the major players in the industry and dominate the global market with their star products such as Coke, Fanta, and Sprite. Their franchised distribution systems allow them to sell their concentrates and syrups to bottlers worldwide in more than 200 countries. Statista indicates that, in 2020, Coca-Cola was the leading company in the U.S. with a 44.9% share and PepsiCo. had a share of 25.9% [1].

However, beneath the industry's prosperity, today's soda companies are confronting two significant challenges. First, being sugary beverages, soda products are being abandoned or boycotted by some former consumers, as they are believed to be detrimental to human health. As a result, the soda sales rate slumped in the 2000s to 44 gallons per year, which is a 20% decline from the peak in the 1990s. In fact, since 2002, 41% of Americans have expressed their intentions to avoid soda [2]. Second, as most bottling companies use plastic containers, soda products are considered to have a negative impact on the environment. As society pays more attention to environmental responsibilities and sustainable development, the soda industry faces stricter regulations and bears higher taxes. Along with other continuing challenges, such as changes in sales strategies caused by the emergence of social media, the development of the soda industry faces numerous difficulties and potential risks.

Despite the challenges the industry faces, opportunities often come together with challenges. With the pressure of challenges, the industry has improved various aspects, including products, manufacturing processes, management, and marketing strategies. Utilizing today's advanced data analytics techniques, the development of the soda industry has entered a new age. In the following sections, this paper will examine some applications of data analytics in the industry. Those applications are designed to improve businesses' competitiveness and maximize profits, impacting almost every component of the industry's value chain.

3 Industry Value Chain

Understanding how advanced technologies benefit the soda industry makes it essential to understand how the industry creates values. Based on Porter's value chain model, this paper explains the process that companies create value and generate revenue. The diagram below is a high-level rendering of the industry's value chain (see Fig. 1).



Fig. 1. The diagram below is a model of a industry value chain.

3.1 Procurement

As a manufacturing industry, obtaining raw materials is the first step for soda companies to create value. The range of items to be purchased for the soda industry includes equipment, machinery, raw materials such as corn syrup, carbonated water, and fruit. While most raw materials are ingredients for drinks, companies also need packaging materials like plastic and other natural resources for bottle production. These raw materials are mostly purchased from open markets and are subject to volatilities such as pricing, customer expectations, political impacts, and natural conditions. Thus, large companies have procurement teams to strategically source different types of products.

3.2 Inbound Logistics

The second step is logistics, which can be further divided into inbound logistics and outbound logistics. Inbound logistics includes the process of procurement and the procedure of handling, transporting, as well as storing raw materials. Big companies in the industry cooperate with various suppliers who source ingredients and process them. For instance, Cutrale Citrus Juices U.S.A., Inc is the primary supplier of orange juice from Florida and Brazil for Coca-Cola [3, 4]. Companies select suppliers from multiple locations worldwide to avoid significant continuous shortages caused by local accidents such as extreme weather conditions. Meanwhile, to ensure the quality of their processing, companies set up guidelines for all suppliers to follow.

It is also essential for companies to determine the most efficient delivery method. The most common transportations are facilitated via trucks, ships, or other vehicles. The specific vehicle for transportation is judged upon the geographical location of transportation destinations and companies' specific ways of operation. A typical example is that Coca-Cola would deliver by truck for those U.S.-based materials but transport those internationally sourced ingredients by ships.

3.3 Operations/Manufacture

The third step is producing the drinks. Large soda companies have numerous product warehouses and manufacturing plants around the world for convenient access and management. In addition, they usually separate their global operation into different segments, which only differ in their geographic locations - each segment "either independently or in conjunction with third parties, makes, markets, distributes and sells beverage concentrates, fountain syrups and finished [drink]s [5]". Thus, companies can better adapt locally in terms of taste and regulations. They can also enjoy proximity as well as efficiency. For instance, PepsiCo has divided its operations into seven areas, or geographical divisions, and five of them are related to soda beverage operation: (1) North America Beverages; (2) Latin America; (3) Europe; (4) Asia, Middle East, and North Africa; (5) Asia Pacific, Australia and New Zealand and China Region (4–7).

In practice, companies produce both finished products and concentrates according to conditions in the market. The majority of the operation is selling concentrates and syrup products to third-party bottlers. Bottlers add water and sweeteners to make the final products. They are further authorized to distribute and sell companies' branded products

in local markets with their local strategies. The usage of different bottling partners will best exemplify operations. For instance, Coca-Cola's five largest independent bottling partners based on unit case volume in 2020 were as follows: (1) Coca-Cola FEMSA, S.A.B. de C.V.; (2) Coca-Cola European Partners plc; (3) Coca-Cola HBC AG; (4) Arca Continental, S.A.B. de C.V.; and (5) Swire Beverages. Together, these five bottling partners represented "40% of Coca-Cola's total worldwide unit case volume [3]".

3.4 Outbound Logistic

The next successional step is outbound logistics, which is delivering products to customers in a variety of ways. For instance, Coca-Cola sets up a distribution network in cooperation with bottling partners around the globe, helping them to "capture growth by manufacturing, distributing and selling existing, enhanced and new innovative products to consumers throughout the world." As a result, in 2020, products bearing trademarks owned by or licensed to the Coca-Cola company are consumed at a rate of 1.9 billion servings per day [3].

Also, companies select different delivery methods according to products' turnover and purchase frequencies. For instance, PepsiCo has its unique Direct-Store-Delivery (DSD) system, direct delivery to retail stores. Such a DSD system is suitable for the distribution of products that are restocked more often. In contrast, for drinks that have lower turnover, PepsiCo prefers to deliver them from manufacturing plants and distribution centers to customer warehouses, which costs less [6].

3.5 Firm Infrastructure

Another activity that exists side by side with supply chain, logistics, and product manufacturing is a company's infrastructure. It includes company systems and the composition of its management team—such as planning, accounting, finance, and quality control. In this area, soda companies are not much different from other industries. Of course, some data analytics applications and technologies help companies increase their competitiveness, which will be discussed later in the paper.

3.6 Marketing and Sales

The sixth step is about marketing and selling products to different customers. Companies need to apply innovative strategies to stay on top of the competition. Activities to align with their strategies include market research, advertising, campaign, multi-channel promotion, segmentation management, logo differentiation, and more. For example, Coca-Cola delegated the illustrator Haddon Sundblom to paint the image of Santa Claus to build an association between Christmas and their brand. Such a strategy allowed the company to increase its sales in winter when it is usually a low season for soda drinks. Since 2014, each of the two most prominent industry players, Coca-Cola and PepsiCo, has invested around 4 billion U.S. dollars every year in advertising to reinforce their brand names worldwide [7].

Another approach of advertising is to build the company's brand by establishing a positive social image. Nowadays, soda companies are committed to maintaining their

sustainable development, environmental protection, and social equality, corresponding to the new standard, Environmental, Social, and Governance (ESG). To promote the positive image of the enterprise, both Coca-Cola and PepsiCo have established the ESG Reporting section on their websites, covering a wide range of ESG topics, such as Environmental Impact, Ethics and Governance, and Sustainability Management. For instance, PepsiCo aligned its reports with several well-known ESG reporting frameworks, such as Global Reporting Initiative (GRI) and the Task Force on Climate-related Financial Disclosures (TCFD). In this way, PepsiCo tries to spread the word that it works “on positive action for the planet and people.” Such a strategy is also known as PepsiCo positive ambition [6].

4 Current Applications of Data Analytics and Links to the Value Chain

Based on the industry’s value chain discussed above, this section discusses the current analytics applications according to the different representative activities in the soda industry. The companies in the soda industry apply these advanced methods to cater to the specific strategy and find the best solution. With the help of data analytics applications, soda companies can collect information regarding consumer preferences more accurately and optimize their infrastructure, logistics, manufacturing, marketing, and innovation under the trend of health-oriented lifestyles to have a firm footing in the beverage marketplace.

4.1 Human Resources (HR)

Most companies in the soda industry have applied advanced Artificial Intelligence (AI) technologies in recruiting activities. One application of AI is Natural Language Processing (NLP), which utilizes computers to process and understand human languages, such as Chinese, English, and other commonly used languages. The industry utilizes NLP to score and filter candidates to expedite the selection process.

For example, when PepsiCo needed to recruit 250 positions within two months, it used the technology, Robot Vera, to interview its candidates for open positions in Russia [8]. The Vera scanned candidates’ resumes to determine whether they had work experience in relevant positions and then called those qualified candidates. The Vera could respond to yes or no answers and asked follow-up questions to check if a candidate was suitable. It could also forward those call records to a human resources expert for the final review after making the preliminary decisions. Compared with traditional HR professions, AI can make faster and more complex decisions without confusion and fewer hesitations, making the process more efficient.

4.2 Firm Infrastructure

Besides recruitment, data analytics applications also help the soda industry’s management and operation system. Companies in the industry use the Enterprise Resources

Planning (ERP) System to integrate all enterprise information, standardize their processes, and unify their operations. The existing ERP system promises a unified database, application, and use interfaces for all sub-sectors like manufacturing, finance, sales, and distribution of an organization, which were initially independent of each other [9]. This system only collects and visualizes information but cannot analyze or provide insights to help companies improving management. However, it is the cornerstone of any future data analytics as it integrates all existing data across the enterprise.

For instance, PepsiCo utilized mySAP as the shared information platform to unify operations. As a result, the SAP provided PepsiCo the “common enterprise visibility and operations” and also “[met] the industry-specific needs of its diverse divisions.” With such increased information transparency, PepsiCo was able to set up a single, integrated operation process. It thus further streamlined its distribution and delivery, improving planning and forecasting [10].

4.3 Supply Chain and Logistics

Besides the company’s internal operations and management, the soda industry also has production and transportation processes. When it comes to the related areas, data analytics applications run through the whole supply chain. The core idea of utilizing these methods is to be accurate, profitable, and low risky, ensuring that enough products can be produced and transported to the designated customers timely and adequately.

Procurement. In procurement, companies try to lock in the range of raw materials they need accurately and balance the demand and the supply of those materials. By collecting purchase history from vending machines and applying AI to analyze customers’ taste preferences, soda companies gain insights into popular products and estimate the quantity demanded for related raw materials. Companies then utilize Machine Learning to carefully consider all the factors such as prices of the raw materials, yields of materials that year, and weather in the origins to determine when and how to source for those materials. They also use Regression Analysis to determine the usage of suppliers and type of ingredients to optimize their suppliers’ choices. For instance, Coca-Cola sources ingredients locally and prioritizes the type of sugar that the customers in the region favor. As a result, beet sugar is primarily used in Europe, cane sugar is mainly used in Asia, and corn syrup sugar is preferred in America [4].

In addition, to ensure that energy consumed during the production is always sufficient and affordable, companies use Quantum Investing strategies to purchase portfolios, such as buying futures, options, and other fixed-price agreements of gas, coal, and other materials. In this way, even if the supply of related resources fluctuates significantly, enterprises can purchase them at relatively stable prices.

Logistics. After acquiring raw materials for products, logistics leads to other processes. In particular, soda companies use Regression Analysis to find accurate and well-optimized routes by considering variables such as weather, holidays in the transportation area, traffic conditions, shipping data, and delivery order. In addition, companies apply Machine Learning to determine which vehicles are suitable for each particular route, depending on distance and road infrastructure.

For example, Coca-Cola integrates Machine Learning in the GPS devices of their delivery trucks to help quickly identify suitable delivery routes and times. This application enables better coordination between Coca-Cola's production planning department and the warehouse department. Thus, the company has more visibility into its logistic operations and higher efficiency in communication with partners. In addition, the precise docking of business activities makes Coca-Cola's products more available to valuable customers and reduces costs, such as insurance premiums.

4.4 Manufacturing

Having access to materials and resources from suppliers, enterprises then work on manufacturing to get the final products. Companies emphasize product quality and pass rates in operation, preventing potential accidents or problems by applying Machine Learning. Manufacturing plants use many automatic sensors to collect the generated signals in the production lines, such as sound and weight. Program codes of Machine Learning then automatically process those sensor data to monitor the quality and make subsequent adjustments. Companies such as PepsiCo "have been applying adaptive process control with statistical process control to its traditional manufacturing control processes," says Shahmeer Mirza, the senior research and development engineer at PepsiCo (2019).

Independent bottlers also utilize a mass of analytics applications in their factories, including advanced analytics, AI, and real-time asset monitoring. For instance, the world's sixth-largest bottler, Coca-Cola Icecek (CCI), modernizes its facility by creating a digital plant replica in the cloud. This new clean-in-place (CIP) digital twin helps CCI identify more than 20 points of optimization in its equipment cleaning processes, reduce electricity usage by 20%, cut water usage by 9%, and add 34 days to its production schedule [11].

4.5 Sales and Marketing

After producing saleable products, soda companies then conduct data analytics applications in Sales & Marketing activities. In this field, accurate targeting of potential customer groups, effective advertising, reasonable pricing, and appropriate sales methods are considered by soda companies.

Targeting. Major players in the industry are actively exploring advanced data analytics in mining Big Data to gain deeper insights and competitive advantage. As a case in point, since the purchase behavior varies significantly from region to region in the 200 countries that Coca-Cola serves, Coca-Cola utilizes Machine Learning to help facilitate its customers with a personalized experience. Machine Learning extracts patterns in consumers' purchasing history and relative texts on social media, thus identify customers' preferences and promote appropriate products to engage profitable customers. PepsiCo also launched its own Big Data platform, the Pep Worx, through which the company and its cooperative partners can identify beneficial customers by their locations, thus make better-justified decisions on their product development and retailing [12].

Advertising. Companies want their advertising process to be efficient, right to the point, and cost-effective. So big companies implement Data Mining and Regression Analysis on their websites for analyzing customers' browsing histories. These technologies enable them to predict trends and increase their brand attraction by improving their products or selective advertising.

Apart from the two methods mentioned above, companies further use Machine Learning for consumer behavioral analysis. Using Machine Learning, Coca-Cola assesses information related to its brands on the Internet with sentiment analysis and NLP to understand the information regarding prospective customers and their motivation for discussing the brand. In addition, AI helps detect images of its products on social media and serves ads accordingly. With the help of Machine Learning and AI, Coca-Cola was able to learn that its products were mentioned online once every two seconds in 2015. Correctly identifying profitable customers and matching needs and offers has increased the efficiency of targeted advertising up to four times compared to other methods [13].

Pricing. Today, companies in the soda beverage market are leveraging Machine Learning in price management. Machine Learning is able to dynamically automate prices based on various factors such as competitor pricing information, product life cycles, regional regulations, and customer response. Coca-Cola and PepsiCo optimize their data analytic pricing models to gain comprehensive views of the company's sales and generate suitable solutions for pricing. For example, when facing the soda tax, Coca-Cola reduced the size of its 1.75 L bottle to a 1.5 L bottle but raised the price by 20p [14]. Doing so, the company maintained its competitiveness in making revenue.

Retailing. In retailing, the industry improves the auto-setting function of vending machines to better collect and analyze consumer data and upgrade products according to the specific preferences in an area. In detail, with built-in AI, vending machines detect their locations and share company-wide sales data to work out the most suitable product assortment for each machine. AI's algorithm accurately forecasts consumer demands, ensuring that each vending machine's inventories can be sold. For example, a machine placed in a gym might set its mood to be refreshing and promote more water. In addition, Machine Learning methods like series analysis are utilized to predict demand according to rising and falling demand cycles of the products. Machine Learning also helps optimize plans for restocking since specific vending machines could need more frequent replenishing than others. It tells the specific amount of products to be replenished at a specific time to a specific vending machine, saving delivery and production costs significantly.

For example, established in 2017, the "Beijing Downstairs" vending machines are located in different communities and connected to the Internet. The vending machines' controller monitors the sales and inventory of different sites in real-time. Based on those data, the Machine Learning system automatically predicts the community's demand and purchase of different drinks. As a result, the company conducts more accurate logistics based on such analysis and prediction than before. This model has enormous advantages over traditional vending machines. Last year, "Downstairs" added 200 points in Beijing, and the profit of a single site achieved a 217% increase [15].

With all the above marketing and sales technique applications, the industry serves its products accordingly to the targeted customers at a competitive price.

4.6 Product Design and Development

Finally, soda companies need to accurately understand the demands in the market and transform the needs into the most suitable products for the consumers. Sentiment Analysis thus plays a significant role in helping the companies understand the current circumstances in the social network and the Internet. Applying NLP and Text Analysis techniques, companies obtain information about current trends and customers' perceptions of a particular brand, which could be implying potential demands of the future.

Based on the acquired information, Machine Learning then takes the next crucial step in integrating data analysis to find the development path that best meets the needs. For instance, in 2009, Coca-Cola promoted interactive soda fountains, enabling buyers to mix their drinks. The company assembled a large amount of data of customers' choices from the soda fountains and utilized Machine Learning to determine the popular versions. In this way, the new drink, Cherry Sprite, was introduced successfully nationwide with excellent customers' responses [13].

Overall, companies of the soda industry apply various data application methods assisting them in analyzing their current situation, improving their competitiveness, and maximizing their benefits. Furthermore, these applications are constantly updating with technological progress and changes in market demand. Therefore, a question naturally arises: what is the future of data analytics applications in the soda industry?

5 Future Applications of Analytics

Based on the existing data analytics applications and the trend of using artificial intelligence and mechanization in the soda industry, this paper speculates a possible future for the industry with an expanded role for analytics applications.

5.1 Direction of Industry Growth and Change

Confronted with the challenge of a health-oriented strategy, the soda companies have tried their best to develop more consumer-oriented products to keep and attract customers using analytics applications. Additionally, soda companies will optimize their internal management, including more efficient transportation routes and warehouse storage.

5.2 Advanced Analytics Applications

Create an Analytical ERP System to Optimize the Resource Allocation. This article proposes the first future hypothesis based on the current status of utilizing ERP systems in the industry. Since the existing ERP system only generates and stores data without analyzing or providing insights for the business, this paper speculates that, in the future, an advanced ERP system can be designed to provide additional analysis and insights for the industry. For instance, one potential application is that the system may find the best transportation plan according to the regional logistics and traffic conditions, ultimately optimizing the global resource allocation system.

The existing ERP itself contains all the internal data of the enterprise. Combined with the available external data, such as all the annual reports of the soda industry, the new

analytical ERP can integrate Machine Learning algorithms to calculate companies' profit indicators based on various factors, such as regional soda tax policies, transportation costs of different routes, and types of delivery products. For example, when deciding on a transportation plan, the analytical ERP system will consider all possible combinations of profit indicators for different transportation routes, recommending the best route for soda companies.

Meanwhile, the ERP system can automatically update the transportation route, mainly when unpredictable situations like earthquakes occur. Then, based on current demand and road condition analysis, the system will immediately design a relatively reasonable, safe, and efficient route. For example, people in certain countries and regions have to stay at home urgently because of COVID-19, which could lead to sudden increases in the demand for beverages in certain regions, negatively affecting the supply chain of the beverage industry. In this case, the analytical ERP system will provide a plan B immediately, such as finding a spare warehouse and figuring out logistics in time to solve the problem.

In addition to optimizing transportation routes, this new ERP system combined with Machine Learning technology can also play a role in other aspects of operational decision-making, helping the company make the most rational use of resources.

Design a Soda Machine to Collect the Information more Extensively. The paper's second hypothesis on the future direction of analytics development is to create more customer-oriented beverages by collecting more information. Since the customers' different tastes and attitudes towards health, soda products will be more personalized in the future. In the past, soda companies used methods like questionnaires to gain taste information which was time-wasting and resource consuming. Based on the existing collection methods, this article proposes to develop new soda machines that would collect and share more data about customers' preferences on caloric content and level of carbonation. The key idea behind this analytics application of soda machines is to collect more information, and then the soda industry can produce customized drinks.

In reality, it is a win-win prospect. First, the customers will be provided with maximum freedom in selecting the flavors they want to add to their drinks, ensuring a highly personalized purchasing experience. At the same time, for the soda makers, it is a wise choice to stay on top of trends and eliminate the beverage that is out of favor right in time to prevent dead stock. They can achieve so by observing changes in demand illustrated by the soda machine's data collected directly from customers. Moreover, it is high time that the industry should further produce customized drinks or develop new products based on those data to win much support and gain more profits.

5.3 Impact on Value Delivery

Based on reasonable predictions of possible future analytics and application methods, this article also roughly estimates the possible impact of these behaviors.

Employees. The new ERP system will have a significant impact on employees. On the first level, the new ERP will increase the demands on R&D and back-end service staff.

On the second level, using the system will ease employees' burden and allocate workload more reasonably, such as better planning of transportation routes during the COVID-19 pandemic and faster delivery of goods to those who need it.

Customers. The new soda machineS will meet customers' expectations for more personalized drinks. Adjustable sugar content and carbon dioxide concentration also make it possible to meet modern health needs. Meanwhile, customers can bring their containers to hold beverages, thereby reducing plastic bottles and cans. Customers will feel satisfied for contributing to environmental protection.

6 Conclusion

In our research, we parsed the basic structure of the soda industry by exploring the value chain of it. We emphasize and predict the future of soda industry through data we find online. In the future, we hope to study the impact of technology innovation on the soda industry, regarding data mind and cloud computing.

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Efficacy of Production Spread Strategy in the Chinese Futures Market

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Abstract. *Production spread* is a traditional trading strategy in the Western futures market, but with limited attention in the Chinese market. It tracks movements of price differences between raw material futures and final product futures, profiting when the difference returns from a more extreme value to the mean. This project investigates the efficacy of applying production spread strategy in the Chinese futures market. In this work, a sample portfolio is constructed with three pairs of commodities. The model is back-tested with market data from 2014.5 to 2018.12 as in-sample period, and 2019.1–2021.8 as out-of-sample period. The experiment returned 2.67% annualized return in the in-sample period, and –0.59% for out-of-sample. The low return could be attributed to the price volatility of the commodities due to various events in the period. Based on the results, though trading this strategy now is not recommended, there is plenty of space for refinements for this model.

Keywords: Production spread · Chinese future market · Commodity · Back-test

1 Introduction

Production spread strategy takes advantage of the relatively stable price spread between raw material futures and final futures, collecting profit when this spread returns from a more extreme value to the normal range.

In commodity markets, a high correlation exists between the price of the finished product futures and price of the raw material futures, which are inputs to produce the final product. When the price of the finished product is unusually high, the supply of that product is expected to increase. Then, the demand of the raw materials increases and therefore drives up the price of that raw commodity. As the supply of the final product continues to increase, the price of the finished product will finally decrease back to equilibrium. So, traders can take advantage of this price change by purchasing raw futures and sell finished futures when the price of the finished product is unusually high. Similarly, when the price of the finished product is unusually low, traders can make profit by selling raw material futures and buying finished product futures.

Production spread has been a popular and successful strategy in the Western futures market. Oil and its related products, also known as the “Crack Spread,” frequently attracts traders’ attention. Cummins and Bucca (2013) took a coherent investigation on 861 spreads in oil-related products, looking at data from 2003 to 2010 [1]. They identified profitable strategies with Sharpe ratio greater than 2, with average daily returns range from 0.07 to 0.55%. However, in 2008 with the global financial crisis, they witnessed a collapse in the number of profitable trading strategies. This confirms the economic institution that drastic price changes can negatively affect the performance of the production spread strategy. Another popular set of commodities is soybean and its related products, also known as the “Crush Spread,” where some researchers have concluded some patterns. Simon (1999) found that transitory deviations from the long-term equilibrium of crush spread existed from January 1985 to February 1995, affected by strong seasonality and an upward pressure in soy products prices relative to soybean prices [2]. Mitchell (2010) found that profiting trades last significantly shorter than the losing trades; exiting a trade near the 5-day moving average could improve trade performance compared to the traditional exit threshold of mean-reversion tendency [3].

Some researchers shifted the focus to the China futures market, where previous studies on the applicability of the production spread strategy have been limited. Liu & Sono (2016) confirmed that soybean, soymeal, and soy-oil futures prices in the Chinese market are cointegrated, characterized by significant seasonality and consistent time trends, which is desirable for the production spread strategy [4]. They simulated the trading performance using both the mean-reversion tendency and the 5-day moving average exit condition and found that both generated positive returns. Building on this pleasing result, this project further investigates the efficacy of the production spread strategy in the Chinese futures market, by incorporating more commodity types in addition to the crush spread into our model. From the simulated performance of our model, trading recommendations will be offered considering characteristics of the Chinese commodities market.

2 Data

The full data range is from 2014.5.1 to 2021.8.31. In this work, data covered a period from 2014.5.1 to 2018.12.31 are in sample, and data from 2019.1.1 to 2021.8.31 are out of sample. From all commodity futures traded on China financial futures exchanges, six representative combinations of commodities with input-output relationships were initially picked to construct the universe: coke and coking coal, soybean and soy-bean oil, methyl alcohol and polypropylene, iron ore and deformed steel bar, corn and corn starch, and rapeseed and rap oil. However, among these combinations, corn starch was added to the Chinese commodity market late in 2015, which gave limited data; the dominant contract of iron ore and deformed steel bar is in January, May and October, and the dominant contract of rapeseed and rap oil is in September and November, which does not match the January-May-September cycle for other goods. Thus, these three pairs were filtered out, and the other three pairs were combined to build the portfolio to ease the implementation.

Next, for every trading date in the in-sample period, this work filters out the price of the dominant contract (with the largest trading volume) for each commodity in each

day. With this continuous data, the work proceeds on to test the correlation within pairs and between pairs.

Table 1. Correlation matrix of the in-sample future prices

	B	Y	PP	MA	J	JM
B	1					
Y	0.828727547	1				
PP	0.391200027	0.345270695	1			
MA	0.230597221	0.204739436	0.732701	1		
J	0.293857248	0.2024403	0.334215	0.711835582	1	
JM	0.173175132	0.022099201	0.400524	0.758716754	0.856112	1

Table 1 shows the correlations within and between the combinations, the price correlations within combinations are all high over 0.7, and correlation between different combinations is relatively low, so simultaneously trading these combinations can diversify idiosyncratic risk. These combinations all have dominant contract in January, May and September for over eight years, and are suitable for regular rebalance. In addition to correlation test, all pairs also pass the cointegration test, so these production spreads tend to stay in a normal range.

For each future, this work collects data including the historic settlement price, trading amount (to determine whether it is the dominant contract), trading date (to determine which dominant contract to refer), fee cost, and the least variable unit in each future's price (to estimate bid-ask spread). The work also collects the risk-free rate and the input-output ratio between the raw materials and finished products. All data comes from China Stock Market & Accounting Research Database (CSMAR).

3 Methodology

3.1 Signal Generations

$$\text{Signal} = P_y - zP_x - \mu, \text{ where } \mu = \frac{\sum_{i=1}^n y_i - zx_i}{n} \quad (1)$$

y_i : future price of the finished product at a certain date in the last period

x_i : future price of the raw material at a certain date in the last period

n : total trading days in the last period

μ : average value of the difference in the last period

P_y : future price of the finished product at the current date

P_x : future price of the raw material at the current date

z : the input-output ratio which describes how many units of raw materials to produce one unit of finished product

σ : standard deviation of the difference in the last period

3.2 Portfolio Construction

Sizing. This work applies equal weighting between different combinations, and input-output weighting within each combination. Attempts to determine the weight between each combination in the portfolio according to the return rates and correlation coefficients of the previous period had been done, but it was difficult to assign weights when the return rate and correlation coefficient were negative. As a result, equal weighting is used.

Timing of Trading

Entry threshold:

- when $P_y - z * P_x < \mu - 0.75\sigma$ (1: long the spread)
- when $P_y - z * P_x > \mu + 0.75\sigma$ (2: short the spread)

Close threshold:

- When $P_y - z * P_x \leq \mu$ for (2) or $P_y - z * P_x \geq \mu$ for (1) or at the end of each period

Exit (stop loss) threshold:

- When $P_y - z * P_x \leq \mu - 2\sigma$ for (1) or $P_y - z * P_x \geq \mu + 2\sigma$ for (2) to stop loss

The work divides each year to three periods: from January 1st to April 30th, May (05) contracts were traded; from May 1st to August 31st, September (09) contracts were traded; from September 1st to December 31st, January (01) contracts were traded. At the end of each 4-month period, the work should exit the position and roll to the next contract.

Input-Output Ratio. In the futures market, the work applies the input-output ratio to simulate the production spread in the spot market. For example, if ten contracts of soybeans can be used to produce one contract of soybean-oil, the difference between the soybean-oil future price and 10 times the soybean futures price can be used as the spread.

In this work, the actual by-contract input-output ratios are:

- coking coal (JM): coke (J) = 10:7;
- soybean (B): soy-bean oil (Y) = 100:16.8;
- methyl alcohol (MA): polypropylene (PP) = 3:1.

Then, this work compares the current spread to the average spread over the last period (4 months). If the current spread is more than 0.75 standard deviations away from the last mean, the model is expected to make profit and enter the position. But, if the current spread is over 2 standard deviations away from the last mean, which is an extremely rare case for the original distribution, the market is predicted to move to a new equilibrium with a new distribution, so the model exits the position to stop loss.

3.3 Trade Execution

Transaction cost is paid each time the work open or close positions.

Components of the transaction cost include:

Fill Cost. The bid-ask spread per ton is estimated using one unit of the minimum-change unit of price per ton, because the dominant contract is in relatively high trading volume. This number is multiplied to get the fill cost per contract.

Following previous papers' approaches, the work assumes zero slippage. In fact, this estimate is still conservative due to the huge trading volumes for dominant contracts.

Fee Cost: The fee cost is a fixed amount per ton of commodity, which varies for different types of commodities, as shown in Table 2.

Table 2. Fee cost related to different commodities

Commodity	m	α	β
Coke	60	0.5	1 bps of price per contract
Coking coal	100	0.5	1 bps of price per contract
Soybean	10	1	0.1
Soya-bean oil	10	2	0.25
Methyl alcohol	10	2	0.2
Polypropylene	5	1	0.2

Thus, total transaction cost per contract is represented by $\alpha m/2 + \beta m$, where

- α : least variable unit per ton (¥)
- β : fee cost per ton (¥)
- m: the number of tons per contract, also varies for different types of commodities

Opportunity Cost. Since the work are comparing the performance of the return to the risk-free rate, opportunity cost was not included in the model explicitly.

4 Results and Discussion

4.1 In Sample Performance

In-Sample P&L Graph & Summary Statistics

In-sample back test period is set from May 2014 to December 2018. As shown in Fig. 1, the strategy generated positive return in the in-sample period. With the summary statistics shown in Table 3, the model entered position **124 times** in total. During **1141 trading**

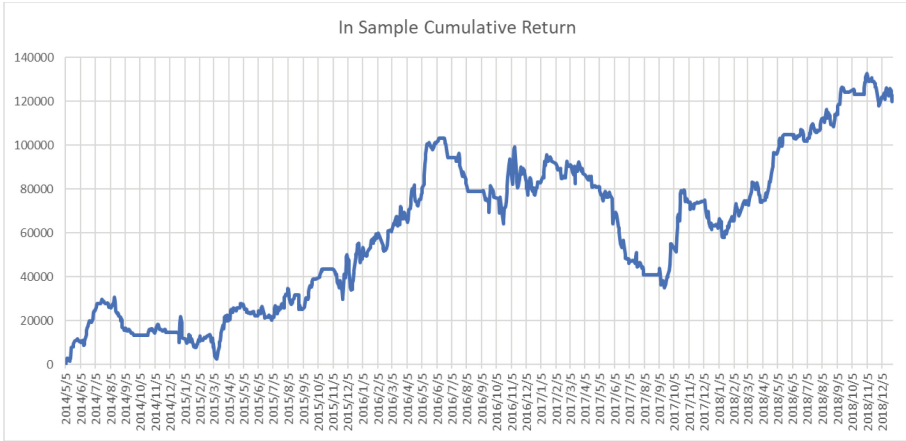


Fig. 1. In sample cumulative return

days the cumulative total money return is **¥121029.43**. Annualized return is around **2.67%** and standard deviation of return is about **2.94**. Estimated Sharpe ratio is nearly **0.398**.

As previously stated, fill cost is calculated as half of minimum price change. Transaction cost is overestimated in this strategy, so the return here is a conservative estimate, and actual profit would be higher in practice. Fill cost for each trade is expected to be lower since the model is trading dominant contracts with large trading volumes.

Table 3. In sample summary statistics

	In sample
Annualized return	2.672621%
Standard deviation of return	2.942046
Average daily return	0.010606%
Estimated Sharpe ratio	0.398573
Risk free rate	1.50%
Times of trading	124 times
Total trading days (days)	1141
Average holding period (days)	12.69

Abnormal Analysis. As shown in Fig. 2, there exists a tremendous loss in each commodity portfolio in summer of 2017. The lowest point of coking coal-coke combination and soybean-soya-bean oil combination both existed in contract 1709, ranging from May 2017 to the end of August. Loss totaled ¥16497.04 (−49.4% in return) on coking coal and coke, ¥9873.24 (−29.6% in return) on soybean and soya-bean oil. Besides, the

methanol-polypropylene combination met its staggering loss from September 2016 to November 2016 (contract 1701), whose loss reached ¥16995.7 (−50.9% in return).

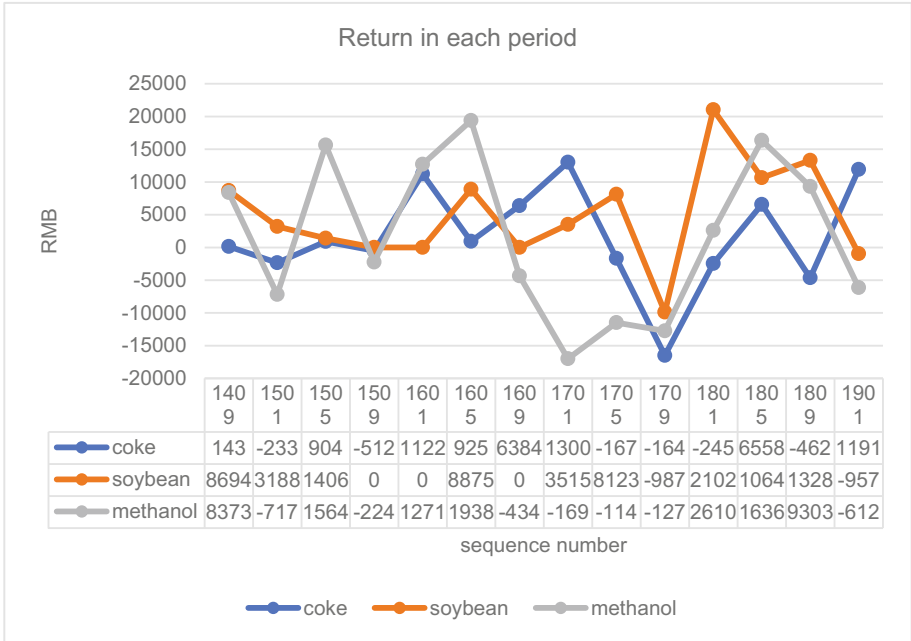


Fig. 2. RMB return for each pair of commodity in each period

1709 Contract. Ranging from May 2017 to August 2017 (contract 1709), all three production combinations had negative returns, which makes the performance worse than expected.

A feasible explanation for the tremendous loss is that, during this period, the United State Federal Reserve Board (Fed) announced plans to raise interest rates to domestic commodity futures, which lowers the expectation of trading [5]. Besides, this plan gives rise to the decline of international commodity futures market settled in US dollars, which led to a more violent decline in Chinese domestic commodity futures (Cngold.org, 2017).

1701 Contract. The enormous loss of methanol-polypropylene combination in contract 1701 might come from the extravagant prices of polypropylene. China Gold (Cngold.org) considers that the Chinese policy of cutting overcapacity still had a negative influence on yield of coal, which would result in an upward price trend [6]. It also discusses that the rising operating rate of steel mills drives the demand of coking coal to exceed beyond supply, which might imply that coking coal prices will continue to rise in future (Cngold.org, 2017). Cngold (2017) predicts that there might be overestimate of polypropylene prices at the time because of OPEC production limit agreement, which deviated the standard boom-bust cycle [7].

4.2 Out-of-Sample Performance

Out-of-Sample P&L Graph & Summary Statistics

Based on the market data, the strategy is simulated on the same production portfolio in the next two year. The start point is set at January 2nd 2019 and the end point is in August 2021. With the summary statistics shown in Table 4, In simulation the model entered position 92 times in total. During 649 trading days the cumulative profit totaled -¥13658.58. Annualized return is around -0.59% and standard deviation of return is about 2.94. Estimated Sharpe ratio is nearly -0.71.

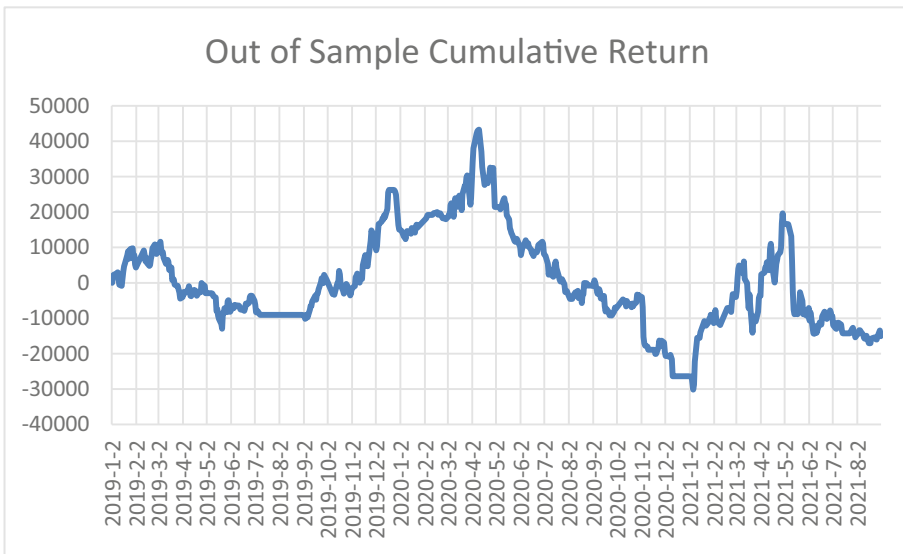


Fig. 3. Out of sample cumulative return

Surprisingly, this strategy resulted in a negative return in simulation. As shown in Fig. 3, from April 2020 to January 2021 the cumulative return had a significant declining trend.

Abnormal Analysis. Possible reasons for the negative return include the China-US trade friction and the COVID-19 pandemic, which drives the prices of domestic futures become extremely unstable.

Table 4. Out of sample summary statistics

	Out of sample
Annualized return	-0.589411%
Standard deviation of return	2.939647102
Average daily return	-0.002339%
Estimated Sharpe ratio	-0.710769
Risk free rate	1.5%
Times of trading	92 times
Total trading days (days)	649
Average holding period (days)	10.03

5 Conclusion

This paper studies the profitability of Production Spread trading strategies in the emerging futures market of China. Three pairs of commodities with input-output relationships are selected: coke and coking coal, soybean and soy-bean oil, methyl alcohol and polypropylene, to build our portfolio to ease the implementation. The data covered from 2014.5.1 to 2018.12.31 are in sample, and data from 2019.1.1 to 2021.8.31 are out of sample. Results come from back-testing using the historic market data.

5.1 Trading Recommendation

Overall, through the back-test, this strategy is not suitable for the Chinese futures market, because it has not obtained considerable returns. There are many market factors and suggestions to consider for improvements of the strategy.

Market Factors. The domestic futures market was established late (China's first futures exchange was established on 1990.10.12), and the number of participants was relatively small. Traders may have to pay a higher fill cost due to the inactive trading of some products. In addition, some types of commodities have low trading volumes, even for their dominant contracts, so that the problem of limited liquidity may be faced.

The domestic futures market is not mature. Thus, prices exhibit more volatile patterns in response to new information in the market. Unpredictable "Black swan" events easily cause large price fluctuations. For example, the Covid outbreak largely impacted prices of commodity futures compared to other assets, reflected as a huge loss in our out of sample return in January 2021.

Supply-Side Reform'. Within the timeframe of our sample data, starting 2015, the Chinese government initiated the 'supply side' reform and enforced stricter control on raw material price fluctuations, to create more steady growth environment to the real economy. Although the risk of price fluctuations may be reduced to some extent, the return of this strategy would still be negatively impacted.

Meanwhile, the introduction of new policies will also bring long-term impact on our raw materials and final products and sow the seeds for large price fluctuations. For example, in 2016, due to the influence of high temperature and low precipitation level in most regions of the country, the demand for coal rose in response to the increased demand for electricity. In addition, due to the reduction in coal mining in the previous years, the coal inventory was insufficient to accommodate the sudden increase in demand. As a result, the coal price rose sharply due to these factors.

The Introduction of New Regulations. Introducing new laws and regulations will set off a chain reaction on raw materials and products. For example, in 2012, the National Development and Reform Commission (NDRC) introduced the “Interim Measures for The Replacement management of Coal Consumption Reduction in Key Areas” to reduce air pollution. This has led the coal price to drop drastically in 2014.

Suggestions. At the same time, for future trades using this strategy, the following aspects need to be considered.

Pay Attention to the Fundamentals of Products in the Portfolio. Trading with production spread can hedge some risks to a certain extent. However, through the analysis of in-sample data, we can find that large price fluctuations of various raw materials in history are often related to the introduction of new laws and changes in policies. Therefore, in the current Chinese futures market, paying attention to the fundamentals of spot can largely avoid some market risks.

Selection of Thresholds. The threshold value of our strategy refers to the data 0.75 obtained in previous papers. It is relatively simple to choose the threshold value, and the threshold value is the signal to decide whether to trade or not. If the threshold value is too large, it will bring greater risks, while if the threshold value is too small, high-frequency trading will often lead to our profits being eroded by transaction costs. How to measure transaction frequency and risk is also extremely important.

Setting of Stop Loss Signal. When the price fluctuates sharply in the opposite direction of our expectation, it is particularly important to set the stop loss signal reasonably. Initially, ± 1.5 sigma was set in the experiment, but when the price fluctuates within a certain range, it is easy to touch our stop loss point, resulting in forced liquidation and huge losses. In addition, frequent trading will also bring huge losses, and when people set the stop loss point at ± 2 sigma, the investment frequency and return will be more stable, so the setting of stop loss signal is particularly important.

Finally, investors also need to pay close attention to the future market in China and wait for trading opportunities. In the process of sorting out the data, it can be expected that with the continuous maturity of the domestic futures market and the improvement of the policy, the fluctuation of the futures price will be within a reasonable range. Therefore, this strategy can bring better returns in the future. In recent years, all kinds of commodity futures have been listed continuously, which means that investors will have more raw materials and finished products to choose from. The diversity of the portfolio will also increase, and the correlation between each group of products will be reduced, so as to better disperse the risks of our portfolio. Meanwhile, more investors will enter

the market for futures trading, and the futures price will be relatively stable, which makes them face less market risk. Therefore, combining the market situation and solving the above problems, this strategy may bring benefits in the future.

Acknowledgement. They are all Shared first authorship. All author contributed equally.

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Evergrande? or Forever-Debt? – Evergrande Debt Crisis Case Study

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Abstract. This work analysis causation of Evergrande Group's debt crisis and the influence of the debt crisis. According to Evergrande's financial indicators, Evergrande's stock prices and dividends have been underperformed in recent five year. After Chinese government announced a policy regulation, Evergrande's debt financing ability is badly constrained and perpetual bonds' interest rate are higher than borrowing rate. However, Evergrande is striving to increase the cash flow and have made effective progress. By comparing with Lehman Brothers, this paper concludes that the Evergrande will not collapse like Lehman Brothers. Finally, this study provides feasible recommendations for Chinese real estate companies.

Keywords: Evergrande · Debt crisis · Real estate · Finance · Influence

1 Introduction

Evergrande Group is the leading real estate company in China. However, Evergrande Group is undergoing a debt crisis, which is manifested in the failure to settle maturing debts and the failure to repay the wealth-management products sold. Back in August, Evergrande Group announced that the group was going to sell some assets. Only one month later, Evergrande Wealth, a subsidiary of Evergrande Group, announced that it could not repay the wealth-management products it had sold. These two major announcements quickly captured the public's attention and exposed the crisis that Evergrande Group, is experiencing.

Based on external investigation focused on debt and internal financial reports about equity part, this paper investigates and exhibits the history of the formation and causation of Evergrande debt crisis, and to quantify its influence. Then, in comparison and contrasting of Evergrande and Lehman Brothers, this study would provide achievable recommendations on solving crisis and processing transformation.

2 Market Behavior and Dividend Distribution

This study compares the stock prices of Evergrande Group, Vanke, Poly and Greenland Holdings and the CSI 800 Properties Index since 2010. These four real estate companies

are among the Fortune 500 Company. The CSI 800 Properties Index is designed by China Security Index Company, Ltd, which can represent the overall property market condition. According to the data (see Fig. 1), Greenland stock prices have fallen off their peak since 2015. Except Greenland, from 2017 to 2018, Evergrande, Vanke and Poly all reached the peak in the past five years. Evergrande’s stock price peaked at \$4.045 on October 20, 2017; Vanke’s stock price peaked at \$6.43 on January 24, 2018; Poly’s stock price peaked at \$2.96 on February 5, 2018. Since then, the three stocks have been in a period of fluctuation.

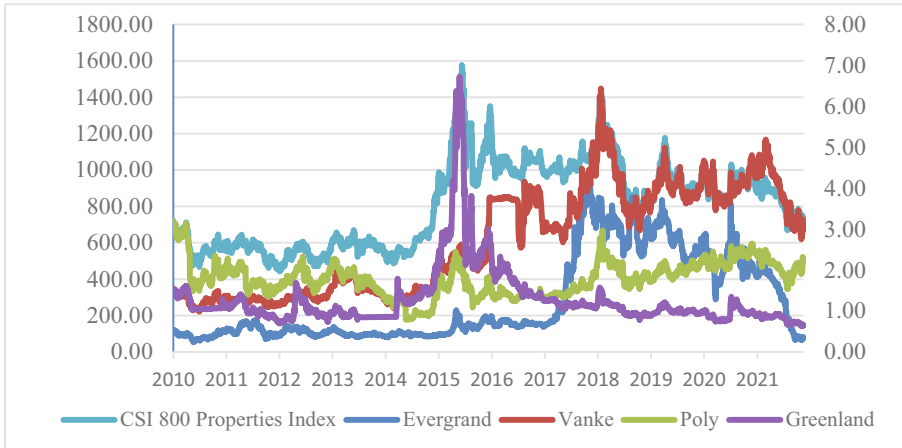


Fig. 1. Ten-year stock prices (USD) [1]

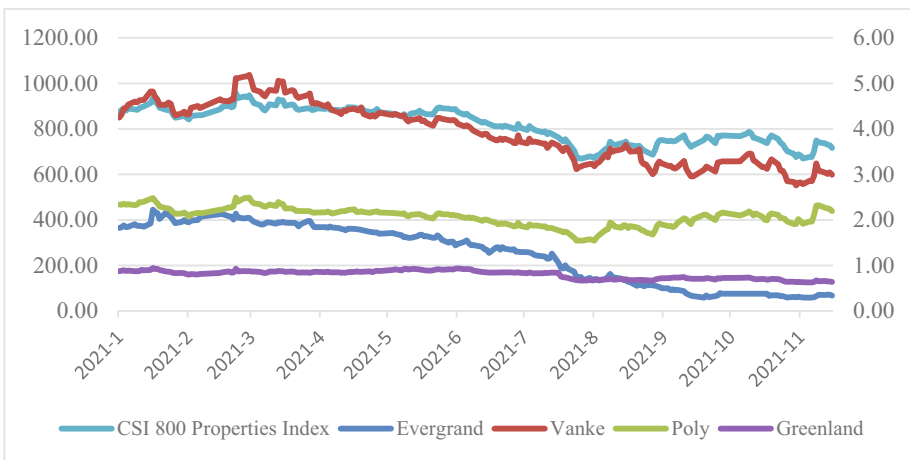


Fig. 2. Stock prices in 2021 (USD) [1]

However, in 2021, Evergrande stock price generally showed a downward trend, and fell to the lowest among the four stocks in August 2021 (see Fig. 2). In September 2021, Evergrande reported bad news. On Sept. 22, Evergrande's stock price hit its lowest this year at \$0.2915. After a brief uptick. On November 8, 2021, Evergrande's stock fell for four consecutive days to \$0.2929 again. Evergrande's stock has not seen an upward trend so far.

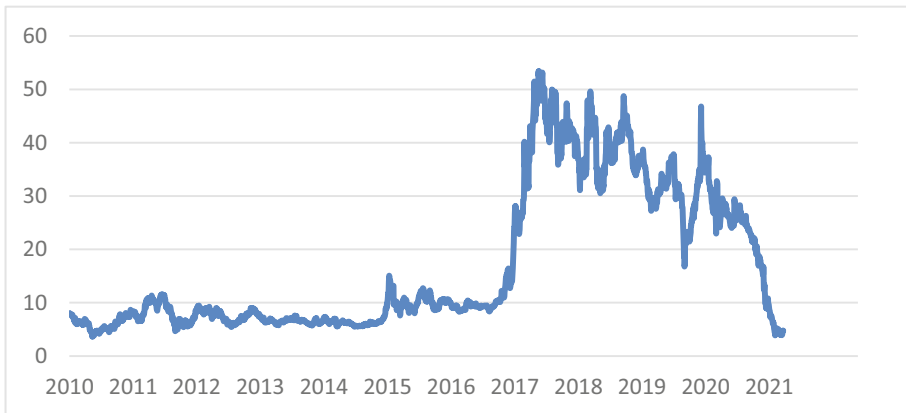


Fig. 3. Market value of Evergrande (billion USD) [2]

In the past decade, Evergrande's market value reached its lowest value of 3.62 billion US dollars on May 25, 2010, and reached its peak value of 53.41 billion US dollars on October 24, 2017. In the past five years, Evergrande's market value fell to its lowest level of 3.90 billion US dollars on November 8, 2021. Evergrande's market value fell all the way after the bad news released (see Fig. 3).

Evergrande group has one of the highest dividend payout rates among real estate companies listed in Hong Kong Exchange. In Fig. 4, the data from 2010 to 2020 are retrieved from Wind database. However, since 2021 has not yet ended when this study is written, the data in 2021 are retrieved from the intermediate report, thus some data are missing compared with the data from the previous annual report. Therefore, it is not known whether the dividend will be paid in 2021. Figure 4 shows that, Evergrande's net profit reached the highest in 2018, reaching 5448 million US dollars. Except 2016, Evergrande has paid dividends every year from 2010 to 2020. The year with the highest payout ratio was 2017 (58%) and the year with the lowest payout ratio was 2013 (24%). Prior to 2016, the overall payout ratio was on the rise. However, since 2016, Evergrande's overall dividend payout ratio has shown a downward trend, and in 2020 it dropped to the lowest level in five years (25%).

According to Fig. 5, ROIC of Evergrande has shown an overall downward trend in the past decade, and ROIC dropped to the lowest in 2020, which was 0.9%. The Dividend Growth rate fluctuates greatly.

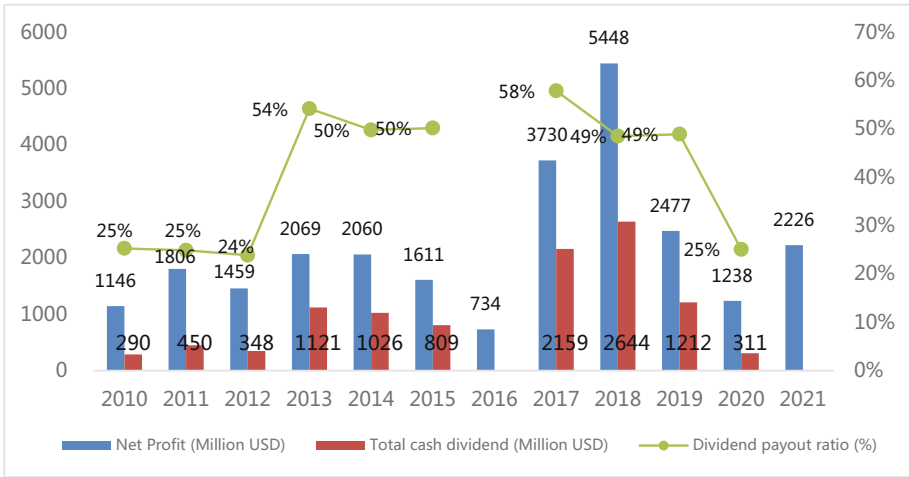


Fig. 4. Evergrande dividend record & ratios [3]

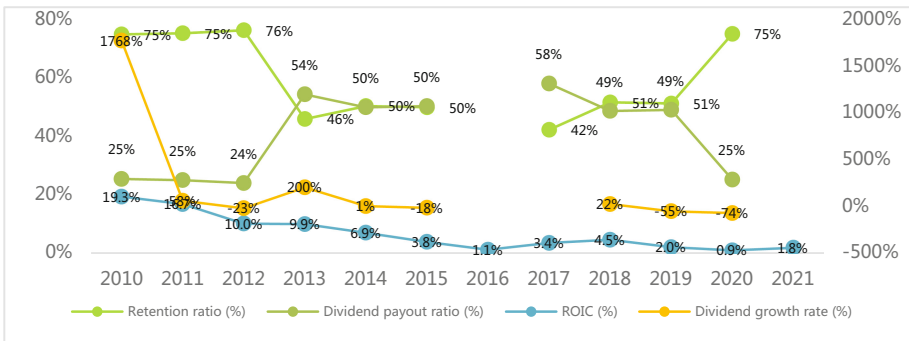


Fig. 5. Evergrande dividend record & ratios

3 About Evergrande

3.1 First Stage of Fast Expanding via Leverage

Taking advantages of new-born real estate market of China in 1990s when Chinese government first time tried to build a socialism capital market in China, Evergrande started its business as real estate constructor at Guangzhou, China, where possessed great geographic advantages, adjoint to Hongkong, and took incompatible political benefit, Shenzhen City as China’s first special economic zones. Chairman of Evergrande group, Jiayin Xu, built up his business from nothing. He made first bucket of gold in 1995, successfully loaned 20 million yuan (equivalent to 2.4 million dollars in 1995) from bank to purchase a land of an old factory. After possessing the property of this land, Xu loaned an extra 20 million yuan by mortgaging the land just bought to inject capital in running the business. Moreover, instead of starting building apartments, Xu spent greater amount into advertisement and renovation of the infrastructure for the apartment

than his competitors did, which successfully attracted consumers’ attention since no one had ever seen an apartment with such a beautiful garden and decent sidewalks back to that time. The superior living experience and comparatively lower price led customers to pay in advance for an ideal apartment. Therefore, Xu got another large amount of capital into the company’s account, which paved the way of finishing apartments quickly and safeguarded him from any cash flows pressure. By manipulating this “risk-free” leverage strategy, Xu started his own company, Evergrande, after several years’ capital accumulation.

Combining success of utilizing leverage and triumph in advertising, Evergrande managed to brand itself as high efficiency in constructing, selling, and delivering, and high quality in facility and service. In addition, Evergrande healthy and consistent cash inflows, banks were confident of its debt-repaying ability, thus willing to provide loans to Evergrande. Sufficient funds helped Evergrande to start new programs Then, Evergrande started its fast growing, market value took off and soared high. As leverage providing endless funds, Evergrande could easily have accesses to more and more areas to start its new projects and to launch its leverage strategy again and again.

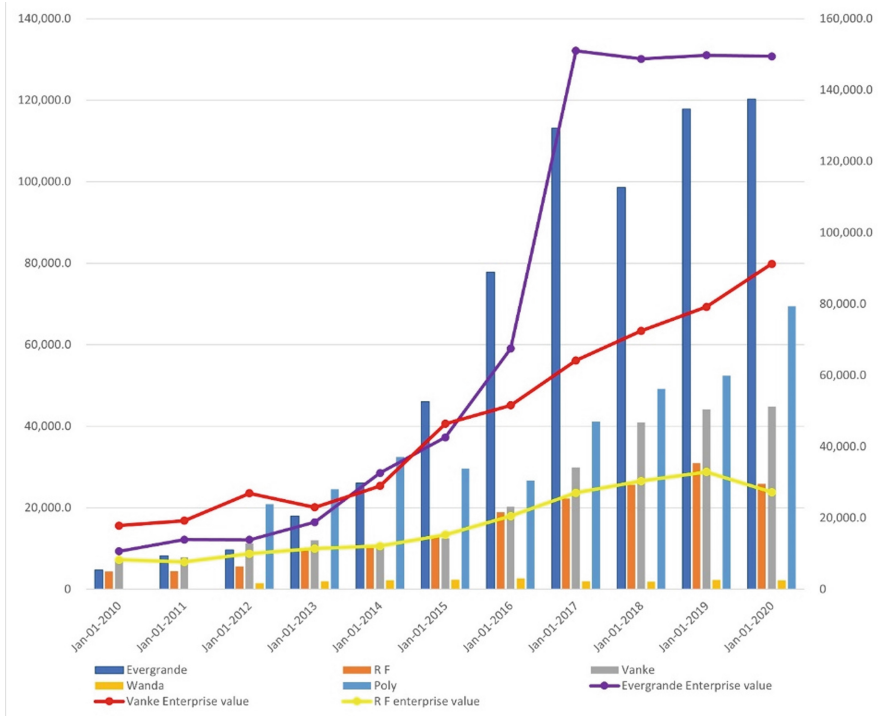


Fig. 6. Total debt (in million USD) vs enterprise value [5]

Figure 6 shows that Evergrande’s contracted sales area grew at a geometric average rate of around 125% every single year from 2010. According to Daniel, Evergrande Group possessed contracted sales area of 80.86 million square meters, equivalent to

31.22 square miles, which is around the 1.5 times of the total land area of Manhattan, New York City [4]. Astonishingly, Evergrande’s total debt accumulated to 120 billion dollars in 2020, which grew at 37.66% per year and was close Nebraska’s total GDP for the whole year. Its total enterprise value consistently grew at a geometric average rate of 34.13% per year from 2010 to 2020, outstandingly expanding itself 18 times. At the year 2016, Evergrande proudly ranked 496th on Fortune’s global 500 with total enterprise value of 42.5 billion US dollars. For the consecutive 6 years, Evergrande acted as the leader of Chinese real estate developers: growing fast and sustained preferred. Now, it ranked 122nd in global 500 of 2021 with total enterprise value of around 150 billion US dollars.

3.2 Second Stage of Undergoing Governmental Restriction

As time came to August 2020, Chinese government announced an unimaginable regulation on real estate industry of China. This regulation included three red-lines on the requirements of the developers’ finance situation: Liability to asset ratio (excl. Advance receipts) of less than 70%; Net gearing ratio of less than 100%; Cash to short-term debt ratio of more than 1x. Chinese government will place limits on companies’ capability and accesses to raise capital and to grow debt according to red-lines.

Table 1. Chinese three red-lines regulation [6]

Color code		Number of red lines breached	Allowable annual growth in debt
Green		0	15%
Yellow		1	10%
Orange		2	5%
Red		3	0%

Unluckily, heavily relying on leverage to inject sufficient cash flows to start projects, Evergrande’s debt financing ability is badly constrained. However, Evergrande’s prosperity was just built on its excess reliant on issuing debt. Based on Evergrande’s 2020 10-K and assumptions that unearned revenues are exactly all advance recipients, Evergrande’ liability to asset ratio, excluding advanced recipient is around 76.57%; its net gearing ratio is around 177.82%; its cash to short-term debt ratio is only 0.3995. Therefore, according to Table 1, Evergrande possessed “red” code in debt financing role and was illegal to issue any debt nor perpetual bonds as above mentioned before.

Moreover, as shown in Fig. 7, the weight and amount of trade payable owed by Evergrande outstood those of others’ several times. Evergrande’s ratio of trade payable over total liability reached its peak of 30% in 2020 while competitors stayed below 20%. This abnormal excess extent indicated that Evergrande’s trade payable is massive in quantity and influential in scale.

By deconstructing the borrowings of Evergrande, as shown in Fig. 8, amount of total debt plus trade payable weighted over 50% of total liability. Taking average total

liability/total asset ratio of over 80% into account, Evergrande would need to convert over 30% of its total assets into cash to pay its debt due in one year. All information implied that Evergrande’s desperately needs cash. Unable to pay trade payable alone would bring chain effects to its upper-chain suppliers and lower-chain customers.

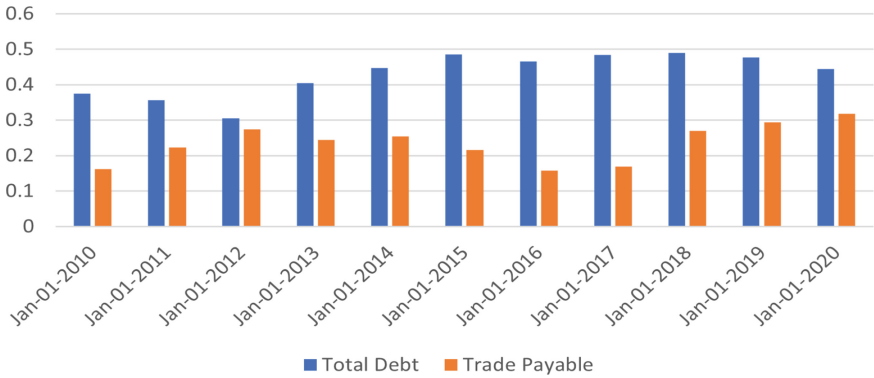


Fig. 7. Evergrande’ trade payable vs competitors [5]

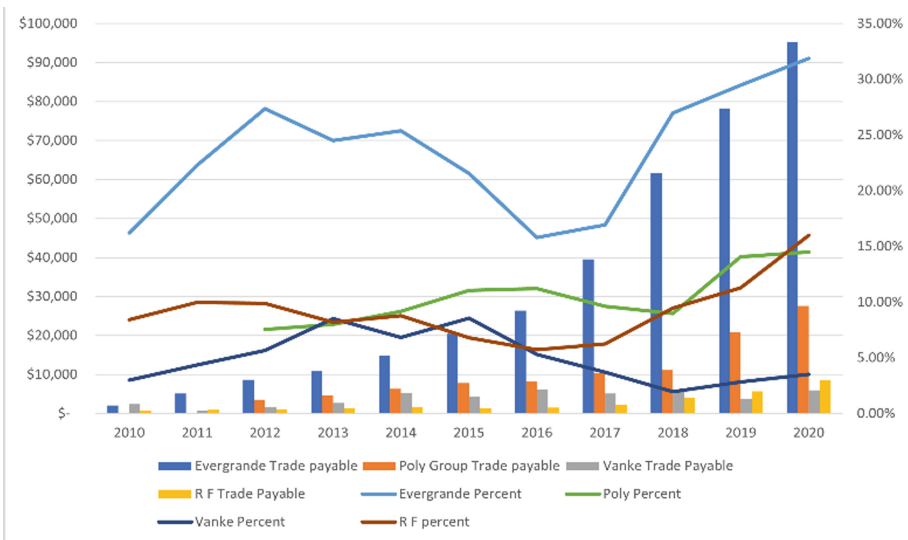


Fig. 8. Total debt & trade payable in total liability less unearned revenue [5]. Source: Capital IQ

3.3 Evergrande’s Complicated Decomposition of Debt

Evergrande’s debt financing strategy had determined its destiny before its prosperity in 2010s’. Except for normal debt financing methods in liability segment, one astonishing thing was perpetual capital instruments as an equity sector. Evergrande categorized “Perpetual capital instruments”, namely perpetual bonds, into stockholders’ equity.

Therefore, Evergrande’s actual debt should be higher than reported “total borrowing”. According to Qi, “perpetual capital instruments in ledger should be taken as perpetual bond. Perpetual bonds’ interest rate is quite higher than borrowing rate while it is calculated by compounded interest rates [7].”

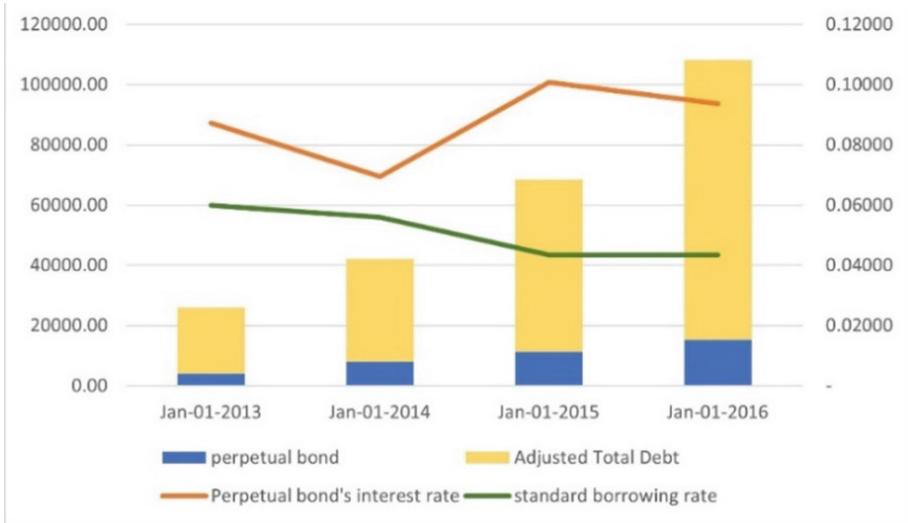


Fig. 9. Perpetual bond vs adjusted total debt [8]

Figure 9 exhibits that perpetual bond worth around 15%–20% of Evergrande’s total debt, which indicated an undervalue of around 20% of total debt before. However, Evergrande redeemed all perpetual bond in 2017 with no clarification of reason. Comparing its interest rate to borrowing rate, it would suggest that high repayment would be a financial risk and pressure for Evergrande, thus a possible causation for redemption.

4 Impact on Real Estate Product Chain

4.1 Upper Chain Suppliers

Table 2 shows eight upper chain suppliers’ financial position. Most of them are facing a high receivable. For each company, its receivable is much higher than its net profit.

Evergrande Group is striving to increase the cash flow.

Evergrande covers some of its payable by its assets. The total amount of commercial acceptance bills related to Evergrande Group held by Gold mantis is nearly 6 billion CNY, among which 1.7 billion CNY has been compensated with Evergrande assets. By the meantime, Evergrande has also reached agreements with some upstream suppliers to use real estate assets to repay debts. As of August 27, Evergrande had sold real estate units worth 25.71 billion CNY to suppliers to offset some of its arrears. It is worth mentioning that the chairman of the board-Hui ka yan sold his personal assets including

Table 2. Upper chain suppliers' financial position [9]

	Receivable (million CNY)	Gross revenue (million CNY)	Receivable to gross revenue ratio	Net profit (million CNY)
Gold mantis	20852.94	13669.78	152.6%	1099.65
PIANO	379.18	844.48	44.9%	102.93
OLO	642.21	744.87	86.2%	52.52
OPPEIN	103580.97	8200.18	12.6%	1012.12
3TREES	3845.54	4683.27	82.1%	132.33
YOUPON	449.62	453.56	99.1%	23.41
AUPU	239.30	904.81	26.5%	90.71
Trendzone	3660.41	2200.95	166.3%	-183.33

several luxury villas and three private airplanes for almost 7 billion CNY to pay the company's debt.

In addition to its assets, Evergrande has been selling shares it holds. Evergrande sold its share on Shengjing Bank Co., Ltd. at 6 CNY per share for a total price of 1 billion CNY. The 7.08% stake of Shenzhen Gaoxin Investment Group Co., Ltd. was sold at a total price of about 1.04 billion. 49% stake in Evergrande Spring Group Co., has also been sold for a total price of about 2 billion yuan. On November 18, Evergrande sold all its shares on HengTen Networks (00136, HK) for 2.1 million CNY.

All lawsuits involving Evergrande and its affiliated enterprises, will be transferred to Guangzhou Intermediate People's Court for centralized jurisdiction.

This action could be seen as a positive signal released from the government. For one thing, it can protect the interests of creditors. By making market participants realize that the country has taken notice of Evergrande's debt crisis, the government boosted creditors' confidence. For another thing, this action also works to maintain Evergrande's capital flow and sustainable operation ability by preventing disordered runs.

4.2 Lower-Chain Customers

Inventory of Evergrande (including finished unsold apartments and unfinished unsold apartments) weighted over 60% of total assets. Therefore, in order to boost its revenue and generate cash, Evergrande announced promotion plans for its apartments in early 2021. Therefore, Evergrande's apartment retailing price of square meters is a great measure of how its debt crisis cast impact on lower-chain customers.

Pricing data is mainly from (fang.com), one of the greatest Chinese real estate information opensource websites. To minimize the price disparity brought by locations, building time and branding, selection of Evergrande's price is limited in new housing projects and selection of counterpart is limited by geographic peripheral, well-matched branding and close completion time. Plus, instead of selecting metropolitans, preference on second-tier metro cities would avoid biases of pricing depending on scarcity instead of quality and comprehensive consideration. Then Fig. 10 presents that even though

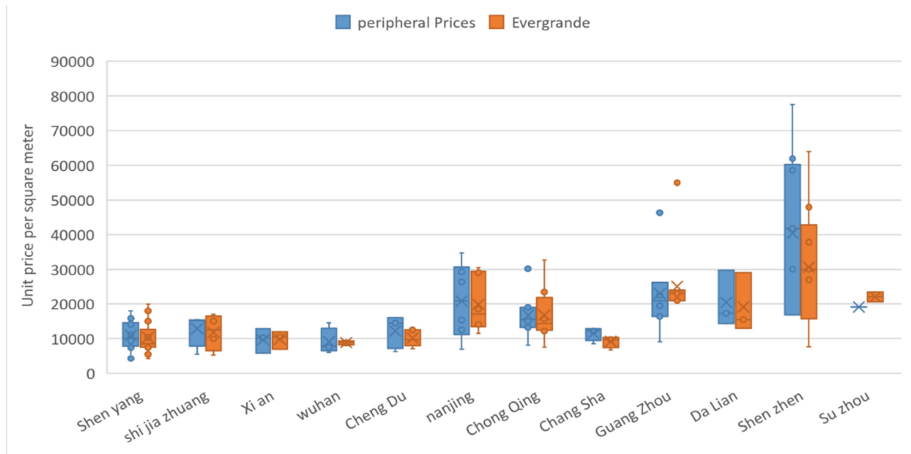


Fig. 10. Prices of Evergrande vs peripheral commercial housing among cities [10]. Source: collated and compiled according to data from fang.com

Evergrande's housing price range is often lower than the range of peripheral housing, its average prices (symbolized by "x") is close to average prices of peripheral housing, matching Evergrande's propagation of sales on housing. Feasible explanations of no obvious price disparity are: 1. most sales discount requires payment of full amount by cash; 2. sales is conducted intensively in comparatively lower average housing price areas, and thus sales are based on lower price, which is a comparatively smaller amount of decrement on unit price. However, the analysis on behavior of Evergrande in second market of housing needs further research to measure the impact of Evergrande debt crisis.

5 Comparison with Lehman Brothers

We have already seen signs of distress in China as its massive real estate bubble bursts. It seems that the world's second-largest economy is experiencing its own Lehman moment, shockingly reminiscent of what the U.S. experienced leading up to the Great Financial Crisis.

– George Schultze, from Forbes [11]

Both bearing heavy load of debt, both being leaders of specific industries and both casting tremendous influences on markets and society, comparison and contrasting between Evergrande and Lehman Brothers has never stopped. Lehman Brothers, which was the fourth-largest investment bank in the USA, filed bankruptcy in 2008, with over 630 billion dollars worthy assets on its balance sheet, which unfolded the financial crisis of 2008 around the world.

Acquired mortgage-lending companies, Lehman invested in real estate industry by providing mortgage and "repackaging loans it had sold as mortgage-backed securities

(MBS), an investment backed by assets” [11]. However, its loose credit assessment for loan takers undermined its business after mid-2006, when increasing defaults on mortgage payment led “an increase in foreclosures and an oversupply of houses for sale [11]” driving housing prices down. Over leveraged portfolio made Lehman subjected to subtle fluctuation on assets. Lehman’s involvement in subprime mortgage crisis and exposure to less liquid assets finally sentenced its bankruptcy.

Breaking down their develop strategies, it is hard to deny that the operational logic of Evergrande and Lehman is the speculation on housing sector in real estate industry. Evergrande and Lehman both believed there is excess demand on housing over supply, and thus one decided to provide supply while another granted people access.

However, despite both Evergrande and Lehman’s influences on market was detrimental, what directly dragged Lehman Brothers down was the fall of American house prices, while Evergrande’s debt paying ability was limited by governmental regulation. In fact, the house prices did not fall a lot, Chinese government published restrictions on the upper and lower limits of housing prices. Technically, what directly caused Evergrande’s debt crisis was profit shrinkage resulted from stabilized house price.

Moreover, value of Lehman’s assets was decimated by slumping share prices plus dropping value of mortgage-backed securities. The result is, Lehman was insolvent. On contrary, Evergrande’s assets, whether real estate or shareholdings, still have high market value. More specific, Evergrande can save itself by downsizing or slowing development, but Lehman Brothers can’t.

According to Pacelli, “in a climate of generalized distrust, many negative rumours, credible or not, were circulated by competitors or short sellers and found fertile ground in the investing public, while the official statements of the Bank were no longer considered reliable or plausible [12].” Thus, the U.S. government didn’t do much to help the Lehman brothers to get through crisis. The panic in the markets led to a massive run on the bank, adding to Lehman’s woes. However, Evergrande still possessed a healthy reputation. First, most of China’s banks are controlled by state-owned enterprises. This could prevent a mass run on Evergrande because state-owned banks are more responsive to state policy. Second, there have been cases in the past where the government has stepped in and taken over companies which were potentially valuable and recently in trouble. Back in to 2020, Hainan provincial government took control of Hainan Airlines, which was in crisis due to liquidity risks, and converted it from a private company into a state-owned enterprise controlled by the local government. Third, “real estate and other related industries contributed 24% of China’s GDP in 2016” [13]. Thus, considering real estate’s significance in finance development, to control house price, to lower cyclicity and to ration credit were more reasonable interpretation of Chinese government’s regulation.

6 Transformation and Recommendation

In October, the chairman of Evergrande Group, Jiayin Xu announced three strategic decisions for Evergrande to defuse risks and save itself: Firstly, go all out to achieve the resumption of work and production to guarantee the house delivery; secondly, fully implement the existing building sales and substantial pressure down real estate development and construction scale; the third is to realize the transformation from the real estate industry to the new energy vehicle industry within 10 years [14].

In addition to Evergrande, its competitors are also on the way of transformation. Vanke is developing logistics, vacation, education, and other industries in addition to its real estate business. In November 2021, Greenland Holdings announced that the industry category of the company has officially changed from “real estate industry” to “civil engineering construction industry”, and Greenland Holdings has made progress in “de-realty”. In September 2021, “Poly Real Estate” officially changed its name to “Poly Development”, one of the company’s important transformation directions is the elderly care industry.

A series of activities of China’s leading real estate enterprises seem to reveal that the transformation of China’s real estate enterprises is the general trend.

Based on the analysis and judgment of the macro situation, this study predicts that the development space of China’s real estate industry is still large, but the transformation will accelerate. China’s real estate industry has experienced rapid growth in the first half of more than 30 years and has now entered the mature second half of “bubble-extrusion, high-quality and sound development”. Under China’s three-red line policy, in the post-COVID19 era, capital dividend and investment drive in the real estate industry have ended. However, China insists on expanding domestic demand, urbanization continues to advance, rigid demand and improvement demand will continue to be released. Therefore, the real estate industry still has a large space for development, but it is inevitable to accelerate the transformation.

For the future, this study proposes the following recommendations for real estate companies:

Firstly, it is necessary to closely follow national policies, customer demands and technological development, minimize the uncertainty of policies and macroeconomic environment, and return to focus on the rigid demand.

Secondly, real estate companies should make reasonable business decisions based on their size of companies’ assets, so as to stabilize their short-term solvency and strengthen their long-term solvency. Companies should pay attention to strengthen the ability of assets to create operational cash flow, and then strengthen their own solvency, instead of blind investment.

Thirdly, real estate companies enhance digital capabilities, establish a digital asset operation system, empower the whole process of real estate development, marketing, operation and service with data and technology, realize the cost reduction and efficiency increase, so as to improve the asset return and cope the challenges from investment and operation.

7 Conclusion

Transformation in Evergrande’s operation strategies would be urgently required for long-term sustainable development. Governmental restrictions forbid Evergrande’s debt issuance abilities, thus trampling Evergrande’s debt financing strategies. Obsessing debt issuance and deferred payment, Evergrande’s incapability of repaying debt has cast unquantifiable financial pressure on its suppliers. However, accumulated profound reputation in the real estate industry and governmental intervention on price ceilings and floors maintained its price of new programs and its popularity among customers, which

protected Evergrande's income cash flows. Taking its valuable real estate inventory, special governmental supports, and enduring popularity among real estate customers into account, Evergrande will not collapse like Lehman Brothers, and, to some extent, it is too big to fall. However, further detailed research on Evergrande's trade payable accounts would be needed to quantify the impact of its debt crisis.

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The Influence of Talent Policy on Labor Mobility: A Case Study of Chongqing

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Abstract. This paper mainly studies the impact of talent policy on labor mobility, and takes Chongqing as an example for in-depth discussion. The study found that the current trend of talent flow in China is from inland to coastal, from central and western to eastern, from economically underdeveloped areas to economically developed areas, etc. Among them, the talent policy has an important impact on the flow of labor. However, the talent policy in Chongqing has the problems of blindness and backwardness. It is urgent to further optimize the guarantee of talent introduction policy, establish scientific concepts of personnel selection, broaden the channels of talent introduction publicity and innovate the talent incentive mechanism. The research in this paper is of great practical significance in formulating a reasonable talent policy, promoting the flow of labor and improving the coordinated development of the regional economy.

Keywords: Talent policy · Labor mobility · Chongqing

1 Introduction

Science and technology are the primary productive forces and talents are the primary resources. Talent is an important indicator to measure the strength of regional economic development. The competition in today's world is actually talent competition. It is very important to attract talents to promote regional economic growth. Therefore, the rational formulation of talents policy is of far-reaching significance. At present, the problem of unbalanced regional economic development in our country is more serious. Domestic and foreign research results on labor mobility are abundant in regional economics and geography [1, 2]. This paper will discuss the specific role of talent policy on labor mobility from the characteristics and facts of labor mobility in China and the impact of China's talent policy on labor mobility, and will take Chongqing as the key case for analysis, providing reference for the formulation of talent policy in the future.

2 The Characteristic Facts of Labor Mobility in China

2.1 The Current Situation and Trend of Labor Mobility in China

Table 1. China's inter-provincial labor inflow and outflow in 2000 and 2010

Province	2000					2010				
	Total population	Inflow	Outflow	Net inflow	The proportion of population inflow	Total population	Inflow	Outflow	Net inflow	The proportion of population inflow
Beijing	4637531	2463217	91702	-2371515	53.11%	10498288	7044533	274365	-6770168	67.10%
Tianjin	2181623	735033	82499	-652534	33.69%	4952225	2991501	273134	-2718367	60.41%
Hebei	4881712	930455	1218975	288520	19.06%	8297279	1404673	3498253	2093580	16.93%
Shanxi	3720553	667357	305148	-362209	17.94%	6764665	931653	1083291	151638	13.77%
Inner Mongolia	3827825	547923	504557	-43366	14.31%	7170889	1444181	1067556	-376625	20.14%
Liaoning	6482242	1045165	361944	-683221	16.12%	9310058	1786530	1014028	-772502	19.19%
Jilin	2949320	308605	608693	300088	10.46%	4462177	456499	1372853	916354	10.23%
Heilongjiang	3768411	386641	1174048	787407	10.26%	5557828	506397	2553648	2047251	9.11%
Shanghai	5384589	3134922	142657	-2992265	58.22%	12685316	8977000	253040	-8726660	70.77%
Jiangsu	9099849	2536889	1715634	-821255	27.88%	18226819	7379253	3058880	-4320373	40.49%
Zhejiang	8598662	3688851	1482465	-2206386	42.90%	19900863	11823977	1853940	-9970037	59.41%
Anhui	3558530	230116	4325830	4095714	6.47%	7100608	717463	9622595	8905132	10.10%
Fujian	5911225	2145256	810576	-1334680	36.29%	11074525	4313602	1667254	-2646348	38.95%
Jiangxi	3364797	253095	3680346	3427251	7.52%	5302276	599942	5787395	5187453	11.31%
Shandong	7468014	1033213	1104645	71432	13.84%	13698321	2115593	3095717	980124	15.44%
Henan	5200470	476239	3069955	2593716	9.16%	9764067	592134	8626229	8034095	6.06%
Hubei	5704620	609733	2805187	2195454	10.69%	9250228	1013612	5889792	4876180	10.96%
Hunan	4395720	348838	4306851	3958013	7.94%	7898815	724982	7228896	6503914	9.18%
Guangdong	25304316	15064838	430446	-14634392	59.53%	36806649	21497787	880600	-20617187	58.41%
Guangxi	3234513	428188	2441847	2013659	13.24%	6291811	841806	4184566	3342760	13.38%
Hainan	978148	381792	119403	-262389	39.03%	1843430	588463	275751	-312712	31.92%
Chongqing	2625102	403159	1005773	602614	15.36%	5440776	945194	3506899	2561705	17.37%
Sichuan	6665628	536246	6937793	6401547	8.04%	11735152	1128573	8905128	7776555	9.62%
Guizhou	2415486	408519	1596461	1187942	16.91%	4629542	763294	4048596	3285302	16.49%
Yunnan	3871640	1164402	343542	-820860	30.08%	6053805	1236549	1482442	245893	20.43%
Tibet	213777	108669	19849	-88820	50.83%	262005	165423	55185	-110238	63.14%
Shanxi	2365334	426029	804454	378425	18.01%	5894416	974362	1960598	986236	16.53%
Gansu	1556891	227888	585868	357980	14.64%	3112722	432833	1593265	1160432	13.91%
Qinghai	522035	124307	94988	-29319	23.81%	1140954	318435	242086	-76349	27.91%
Ningxia	672486	191891	90163	-101728	28.53%	1534482	368451	225794	-142657	24.01%
Xinjiang	2829699	1411086	156263	-1254823	49.87%	4276951	1791642	297261	-1494381	41.89%

Through the analysis of Table 1, we can find that China's population flow presents the following characteristics. First, from the perspective of the population flow scale, from 2000 to 2010, both inflow and outflow of population, the scale of floating population increased significantly. For example, the province with the most obvious change in the

net outflow of the population is Shandong, with an increase of nearly 14 times from 71,432 in 2000 to 980,124 in 2010. Another example is the most obvious change in the proportion of population inflow in Tianjin, from 34% to 60%. Second, economically developed regions are generally provinces with net population inflow, while less developed regions are generally provinces with net population outflow. From 2000 to 2010, Beijing, Shanghai, Zhejiang, Guangdong and other economically developed provinces experienced a much larger inflow than outflow and became the major net inflow provinces in China. In contrast, Anhui, Jiangxi, Henan, Hunan and Sichuan have large outflows. Third, from a geographical point of view, the net outflow of population from the province is generally in the northeast and underdeveloped areas in the central and western regions, such as Jilin, Heilongjiang, Anhui, Hunan, Sichuan, Shanxi, Gansu and so on. The net population inflow into the province is mainly in the eastern developed regions, for example, Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Guangdong, etc. Fourthly, from the perspective of the inter-provincial population inflow rate, the inter-provincial population inflow rate in economically developed regions is generally high, for example, Beijing, Shanghai, Zhejiang, Guangdong, etc., and factors such as higher wages and preferential talent policies have attracted a large number of labor inflows. On the contrary, the less developed provinces, such as Jilin, Gansu, Guangxi and Guizhou, have more net outflow of population.

To sum up, through the above analysis, we can find that China's labor force is flowing on a large scale and the economically developed cities have a strong ability to attract labor forces. A large number of labor forces flow from the economically underdeveloped areas in the central and western regions to the economically developed areas in the eastern region.

2.2 The Geographical Distribution of Labor Mobility in China

Through the analysis of Fig. 1, we can find that China's population flow presents the following characteristics. First, the provinces and cities with the largest population inflow are Beijing, Shanghai, Jiangsu, Zhejiang and Guangdong. Rich employment opportunities, excellent talent policies and other reasons have attracted a large number of people to flow into these economically developed provinces, forming a situation of "The Strong Will Stay Strong". Second, there is a "Proximity Principle" for population movement. For example, the population in the north will give priority to inflow into Beijing, Tianjin and Hebei, and the population in the south will give priority to inflow into the Yangtze River Delta and the Pearl River Delta. The "Agglomeration Effect" has come into being, and at the same time, a "Multi-polarization" situation has been formed. However, the population attractions of Beijing, Tianjin and Hebei are not as attractive as those of the Yangtze River Delta and the Pearl River Delta. Third, provinces with relatively developed economies, such as Beijing, Shanghai and Guangdong, have relatively small population outflows. Less developed provinces, such as Qinghai, Ningxia and Xinjiang, also have relatively small population movements. These phenomena may be related to factors such as the degree of economic development and population concept. Fourth, some provinces and cities have "One-on-one" and "Several-to-one" population flows of more than one million, such as from Hebei to Beijing, from Jiangsu and Anhui to Shanghai, from Anhui and Henan to Jiangsu, from Anhui, Jiangxi, Henan, Sichuan and Guizhou to Zhejiang,

and the State Council issued the Outline of the National Talent Team Construction Plan for 2002–2005, which put forward the strategic deployment of “A Powerful Nation with Talents” [1]. In 2007, the “Strategy of Strengthening the Country with Talents” was regarded as one of the three basic strategies for developing socialism with Chinese characteristics. In May 2010, China promulgated the National Medium and Long-term Talent Development Plan (2010–2020), which laid out the strategic layout of “Talent First Development”. In October 2012, the report of the 18th National Congress of the Communist Party of China pointed out that “We should push our country from a big country with talents to a powerful country with talents”. In March 2016, the 13th Five-Year Plan for National Economic and Social Development of the People’s Republic of China proposed to implement the Talent Priority Development Strategy. In December 2019, the general office of the State Council issued the Opinions on the Reform of the System and Mechanism for Promoting Social Mobility of Labor Forces and Talents, and constructed a policy system framework for promoting social mobility of talents [3].

Comparisons of Some Important Talent Policies among Shanghai, Hangzhou and Chengdu

See Table 2, 3 and 4.

Table 2. A comparison of some talent introduction policies in Shanghai, Hangzhou and Chengdu in recent years

Shanghai	Hangzhou	Chengdu
Nestling eagles homing plan	Zhejiang overseas high-level talent introduction program	Some opinions on encouraging and introducing overseas talents to start a business in Chengdu
Shanghai thousand-person plan	Qianjiang talent program	Interim measures of Chengdu on encouraging enterprises to introduce highly needed talents
Shanghai Pujiang talent program	Hangzhou “5050” plan	Opinions on establishing a long-term mechanism of “Linking Production and Sales” of talents
Peak talent program	One thousand people plan	Measures for the implementation of introducing high-level innovative and entrepreneurial talents in Chengdu

(continued)

Table 2. (continued)

Shanghai	Hangzhou	Chengdu
The 100-person plan	Hangzhou global talent introduction 521 project	Chengdu implements strategic action plan of talent priority development
Zhang Jiang 500 talent and chief scientist project		The outline of Chengdu's medium and long-term talent development plan (2010–2020)
Shanghai overseas high-level talent gathering project		
Central thousand-person plan		
National special support plan		
One million talents project		
Ten thousand people plan		

The talent introduction policy is the basic and important part of the talent policy, which aims to introduce special talents or high-level talents in line with the city's development. By contrast, Zhang Bo's research shows that Shanghai's talent introduction policy covers a wider range and a large number of high-end talents are introduced [4], covering key areas such as big data, computer science, biomedicine and the Internet of Things. Hangzhou pays more attention to returned overseas students and talents of science and technology, focusing on e-commerce, tourism and leisure [5]. Chengdu pays attention to market-oriented talents, with strong hierarchy and purpose, and has quantitative requirements for talents of different levels (Table 2).

Table 3. A comparison of some talent incentive policies in Shanghai, Hangzhou and Chengdu in recent years

Shanghai	Hangzhou	Chengdu
Some provisions on encouraging overseas students to work and start businesses in Shanghai	Some suggestions on innovation and entrepreneurship of Hangzhou overseas high-level talent innovation park (trial)	“Zero Threshold” for college graduates to settle
Shanghai residence permit implementation rules	Measures for the administration of “Qianjiang Talent Plan” in Zhejiang province (for trial implementation)	
	Interim measures for the administration of residence permits for overseas high-level talents in Zhejiang province	

The talent incentive policy can effectively mobilize the enthusiasm of the labor force and plays an indispensable role in the development of a city. The threshold for starting a business in Hangzhou is relatively low, and there are also large concessions on loan subsidies and housing rentals. Shanghai is relatively weak in talent incentives and has given certain benefits in terms of household registration and housing [6]. Zheng Xuefei and Li Xiang pointed out that Chengdu proposed to “Settle Down First and Then Work” and held a “Zero Threshold” attitude towards talent introduction [7]. At the same time, Chengdu’s talent incentive policy presents a diversified trend, combining material incentives with spiritual incentives (Table 3).

Table 4. A comparative study of some personnel training policies in Shanghai, Hangzhou and Chengdu in recent years

Shanghai	Hangzhou	Chengdu
Chief technician thousand person plan	151 talent engineering	The party and government personnel team optimization project
	131 culture engineering	The project of improving the quality of enterprise operation and management talents
	653 knowledge renewal project	High-tech talent training and introduction scheme
	356 training project	
	815 advanced blue collar training project	
	125 engineering	
	“Thousands and Hundreds” about Yangtze River Delta shortage of talents training project	
	The young artists discovery program	
	Training program for advanced talents in modern service industry	

The personnel training policy is the core content of the personnel policy, which aims at training and educating personnel. It can be seen that the policy preferences of talents in different regions are different and adapt to their economic and social conditions. Shanghai mainly aims to train highly skilled specialists, and basically adopts the project-based approach to fine-tune the training of talents. Hangzhou’s policy targets are mainly academic and technological leaders. Zhejiang University has formed the “Zhejiang University Model” by taking advantage of the synergy of government

and Industry-University-Research [8]. Chengdu's talent training standards are clear and there is a demand for talents at all levels. Moreover, Chengdu is not only limited to individual cultivation, but also focuses on team education [7] (Table 4).

3.2 The Impact of China's Talent Policy on Labor Mobility

Table 5. Education level of employed personnel and average years of education of labor force in each province and city of China (by year)

Province	The proportion of employed persons with undergraduate education (%)					The proportion of employed persons with postgraduate education (%)					Average number of years of education received by the labor force (unit: year)				
	2002	2007	2012	2017	2019	2002	2007	2012	2017	2019	2002	2007	2012	2017	2019
Beijing	9.70	16.07	27.52	30.39	31.10	1.70	3.31	6.79	7.15	9.60	11.0	11.8	13.3	13.5	14.0
Tianjin	5.00	7.25	12.89	18.67	22.00	0.40	0.57	1.17	2.30	3.50	10.1	10.4	11.2	11.8	12.4
Hebei	1.60	1.49	4.11	6.24	7.10	0.10	0.10	0.29	0.46	0.80	8.6	8.5	9.8	10.3	10.3
Shanxi	1.60	2.45	5.24	8.88	10.20	0.10	0.14	0.22	0.76	0.80	9.1	9.2	10.2	10.6	10.8
Inner Mongolia	1.80	2.32	5.28	8.95	11.00		0.05	0.34	0.53	0.70	8.3	8.5	10.0	10.3	10.6
Liaoning	1.50	3.37	5.18	9.89	11.30		0.30	0.34	0.91	1.10	9.0	9.2	9.8	10.5	10.7
Jilin	2.40	2.56	5.83	8.31	10.00	0.10	0.16	0.39	0.54	0.80	9.1	9.0	9.6	10.2	10.3
Heilongjiang	1.50	1.88	3.17	8.04	9.40		0.09	0.19	0.61	0.60	8.8	9.1	9.3	10.1	10.4
Shanghai	6.40	11.87	15.76	25.04	25.30	0.60	1.58	1.99	4.75	5.90	10.3	11.3	11.7	12.7	12.9
Jiangsu	1.10	2.11	5.77	10.78	11.70	0.10	0.16	0.45	0.93	1.30	8.1	8.6	10.0	10.8	10.8
Zhejiang	2.40	2.84	7.65	12.94	13.70	0.20	0.53	0.60	0.96	1.40	8.3	8.4	9.8	10.8	11.0
Anhui	0.80	0.83	3.69	5.19	7.80	0.10	0.02	0.33	0.45	0.70	7.2	7.2	9.0	9.0	9.5
Fujian	2.00	2.60	6.88	9.24	10.20	0.20	0.16	0.36	0.65	0.80	8.0	8.2	9.8	10.1	10.3
Jiangxi	0.70	2.63	2.83	4.72	6.20		0.34	0.15	0.26	0.50	7.9	8.6	9.4	9.6	9.9
Shandong	1.60	1.45	5.25	6.55	8.30	0.10	0.07	0.42	0.63	0.90	8.6	8.5	9.8	10.0	10.2
Henan	1.50	0.85	2.92	4.61	6.70	0.10	0.05	0.22	0.34	0.60	8.6	8.4	9.4	9.8	10.3
Hubei	1.20	2.29	5.05	6.50	8.10	0.10	0.22	0.41	1.12	1.30	7.6	8.4	9.7	10.0	10.3
Hunan	1.30	1.51	4.73	6.52	8.50	0.10	0.15	0.47	0.62	0.70	8.3	8.5	10.1	10.2	10.7
Guangdong	2.10	2.65	4.14	7.32	9.80	0.20	0.32	0.25	0.54	1.00	9.0	9.3	10.0	10.8	11.0
Guangxi	0.80	1.04	2.63	5.17	6.00	0.10	0.04	0.28	0.43	0.50	8.0	8.4	9.3	9.7	9.6
Hainan	0.90	1.48	5.23	6.45	8.50	0.10	0.07	0.31	0.27	0.60	8.6	8.6	9.9	10.0	10.6
Chongqing	1.00	0.98	4.82	7.81	10.10		0.02	0.42	0.86	1.00	7.7	7.9	9.2	9.9	10.5
Sichuan	1.20	1.41	3.55	5.12	7.20	0.10	0.07	0.28	0.36	0.90	7.6	7.5	9.0	9.1	9.6
Guizhou	1.20	1.11	2.78	5.17	7.00		0.02	0.17	0.16	0.30	6.9	6.9	8.3	8.3	8.7
Yunnan	0.70	1.11	3.34	4.48	6.40		0.03	0.25	0.39	0.50	6.3	6.8	8.2	8.6	9.0
Tibet			3.32	5.53	7.40			0.10	0.24	0.20	3.9	4.3	7.0	6.4	7.2
Shanxi	1.00	2.21	6.07	8.21	9.40		0.13	0.73	0.68	0.90	7.7	8.5	10.2	10.4	10.7
Gansu	0.80	1.14	4.44	6.77	7.90		0.07	0.31	0.33	0.70	7.1	7.1	8.9	9.3	9.4
Qinghai	1.30	2.92	6.58	8.86	11.00	0.10	0.17	0.19	0.19	0.40	6.4	7.3	9.2	9.4	9.9

(continued)

Table 5. (continued)

Province	The proportion of employed persons with undergraduate education (%)					The proportion of employed persons with postgraduate education (%)					Average number of years of education received by the labor force (unit: year)				
	2002	2007	2012	2017	2019	2002	2007	2012	2017	2019	2002	2007	2012	2017	2019
Ningxia	1.40	2.79	5.27	9.69	12.10		0.06	0.16	0.46	0.80	7.7	7.9	9.0	10.0	10.6
Xinjiang	3.30	3.20	5.49	10.77	11.00	0.20	0.20	0.41	0.70	0.70	8.9	8.8	9.7	10.5	10.7

Through the analysis of Table 5, we can find that the population flow in our country presents the following characteristics. First, with the advancement of time, the educational level of the employed people with bachelor's degree or above in various provinces and cities is generally on the rise, which is intuitively shown as the proportion of the employed people with bachelor's degree and postgraduate's degree is increasing year by year. From 2002 to 2019, among the provinces where the proportion of undergraduates increased by more than 5%, the change in Beijing was the most significant, from 9.7% in 2002 to 31.1% in 2019, with an increase of 21.4%. Henan Province recorded the smallest increase, from 1.5% in 2002 to 6.7% in 2019. The increase in the proportion of postgraduates employed varies greatly among provinces and cities, among which Beijing has the most obvious change, increasing from 1.7% in 2002 to 9.6% in 2019, an increase of 7.9%. Qinghai Province recorded the smallest increase, from 0.1% in 2002 to 0.4% in 2019, representing an increase of only 0.3%. Second, the proportion of undergraduates in employment in all provinces and cities is larger than that of postgraduates, and the proportion of undergraduates generally grows faster than that of postgraduates. Third, the average number of years of education of the labor force in each province and city is on the rise year by year. The smallest change was in Jilin Province, which increased from 9.1 years in 2002 to 10.3 years in 2019, with an increase of only 1.2 years. The biggest change was in Qinghai Province, which increased by 3.5 years from 6.4 years in 2002 to 9.9 years in 2019. Fourthly, the province and city with the largest average number of years of education per year for the labor force is Beijing, with 11.0 years in 2002 and 14.0 years in 2019. The least change was Tibet Province, with 3.9 years in 2002 and 7.2 years in 2019. The difference between these two cities decreased with the passage of years, from 7.1 years difference in 2002 to 6.8 years difference in 2019.

Through the above analysis, we can find that the educational level of the employed people in our country is gradually improving. The specific performance is that the proportion of undergraduate and graduate students in the employed people is increasing year by year, and the average number of years of education of the labor force is also gradually increasing.

4 The Influence of Talent Policy on Labor Mobility in Chongqing

4.1 Some Important Talent Policies of Chongqing in Recent Years

See Table 6.

Table 6. Some important talent policies of Chongqing in recent years

Policy name	Publishing time
The decision of Chongqing people's government on further optimizing the talent environment	2000
Opinions of Chongqing people's government on further encouraging and attracting overseas students to work in Chongqing	2005
Some preferential policies for introducing high-level talents in Chongqing	2009
Detailed rules for the implementation of some preferential policies for introducing high-level talents in Chongqing	2009
Measures for the implementation of Chongqing's 100 overseas high-level talents gathering plan	2009
The outline of Chongqing's medium and long-term talent development plan (2010–2020)	2010
The medium and long-term plan for the construction of talent team in Chongqing's key industrial industries (2011–2020)	2011
Measures for the implementation of the 1 million project leading talents training plan	2013
Chongqing special support plan for high-level talents (5 sub-plans)	2013
Chongqing industrial talent support plan	2015
Measures for the implementation of "Swan Goose Plan" by Chongqing municipality for introducing talents from home and abroad	2017
Supplementary notice on relevant policies of Chongqing municipality on introducing talents from home and abroad into "Swan Goose Plan"	2017
Implementation plan of Bayu Artisan 2020 plan	2017
Implementation plan of "Chongqing Creates Something New" entrepreneurship promotion action plan (2018–2020)	2017
Chongqing's action plan for promoting the city through science and education and strengthening the city with talents (2018–2020)	2018
Training plan for 100 party and government leaders	
100 outstanding entrepreneurs' training program	
Training program for 100 high-end engineering talents	
Chongqing 1,000 talents introduction program	
Chongqing talent team construction "6.3 Million" plan	
Chongqing's 100 overseas high-level talents gathering plan	

In recent years, the Chongqing municipal government has insisted on improving the construction of various kinds of talents, made great efforts to innovate the working mechanism of introducing talents, and successively promulgated a series of talents policies. In 2009, the Chongqing municipal government issued "Some Preferential Policies

and Regulations for the Introduction of High-level Talents in Chongqing City”, emphasizing the application of scientific talent concept and the introduction of talents through a flexible introduction and an intelligence introduction. In 2017, the Chongqing municipal government issued the “Measures for the Implementation of Chongqing’s ‘Wild Goose Plan’ for Introducing Talents from Home and Abroad”, which indicated that it would vigorously introduce high-level talents from home and abroad to provide talents support for the development of some key industries in the city. In 2018, the Chongqing municipal government issued the “Chongqing Municipality’s Action Plan for Prospering the City through Science and Education and Strengthening the City with Talents (2018–2020)”, saying that it would introduce 10,000 “High-skilled” talents and strive to make Chongqing a talent highland [2]. These policies have effectively promoted the introduction of high-end talents in Chongqing and promoted the economic development of Chongqing.

4.2 The Current Situation of Labor Mobility in Chongqing

See Figs. 2 and 3.

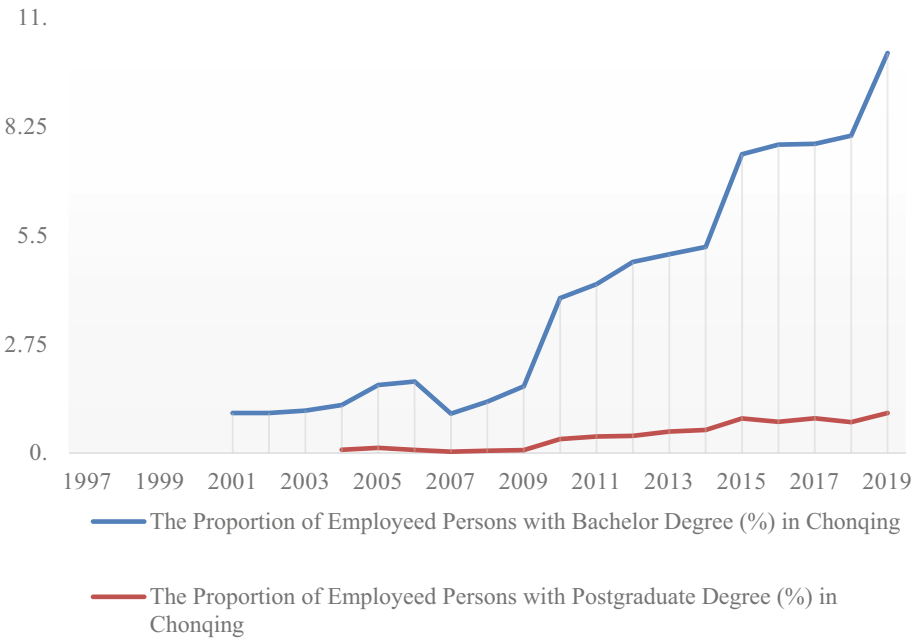


Fig. 2. The proportion of employed persons with educational level (%) in Chongqing

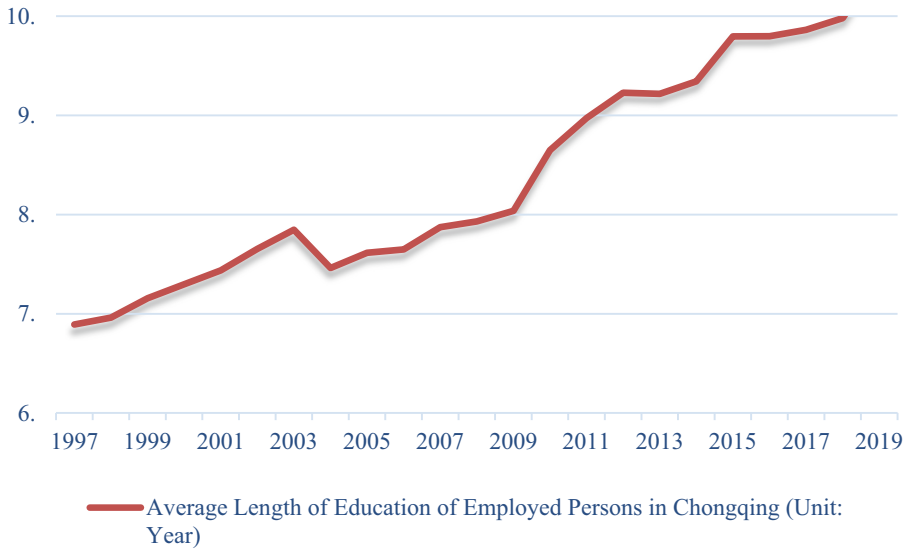


Fig. 3. Average length of education of employed persons in Chongqing (unit: year)

The proportion of employed persons integrates the factors of the employed population in a region and can measure the population richness of a region. Since Chongqing became a municipality directly under the central government, the proportion of employed persons with bachelor degrees or above in Chongqing has been increasing year by year. The proportion of undergraduates increased from 1% in 2001 to 10.1% in 2019. The growth rate of graduate students is generally slower than undergraduate students. The average number of years of education received by Chongqing's labor force increased from 6.9 years in 1997 to 10.5 years in 2019. These changes have provided high-quality, high-level and multi-faceted talents for Chongqing's economic development, played an important role in promoting Chongqing's rapid economic development and promoted Chongqing's rise in the west [9]. The continuous growth of Chongqing's talent team is closely related to the continuous improvement of the talent policy. In recent years, Chongqing has successively issued a series of personnel policies, such as "Chongqing's Action Plan for Promoting the City through Science and Education and Strengthening the City with Talents (2018–2020)" and "Implementation Measures for Chongqing's 'Swan Goose Plan' for Introducing Talents from Home and Abroad", which have effectively promoted the introduction and training of talents.

5 Conclusion and Enlightenment

5.1 Conclusion

To sum up, there are many factors that affect labor mobility, such as economic development, climate conditions, personal values, social and cultural environment, etc. Among them, the talent policy plays a vital role in labor mobility. The current trend of talent flow in China is from the central and western regions to the east, from inland to

coastal regions, and from economically underdeveloped regions to economically developed regions. Chongqing's economic development is in good shape, which cannot be separated from the continuous improvement of labor quality and the strong support of talent policy. However, there are still some deficiencies in Chongqing's talent policy, such as blindness in talent introduction, backwardness in the concept of talent introduction, and inadequate promotion of talent introduction, which still have some gaps compared with the economically developed regions of our country. At the same time, due to the one-sidedness of information and data collection, this paper still has certain defects.

5.2 Enlightenment

The uneven economic development in various regions of our country has led to the uneven flow of the labor force to a certain extent. Efforts should be made to further reduce the labor inflow restrictions in economically developed areas so that they can continue to maintain their economic vitality, while supporting economically underdeveloped areas to promote common prosperity. At the same time, Chongqing should improve the talent introduction system, optimize the policy guarantee of talent introduction, establish scientific concepts of employing people, broaden the channels of talent introduction publicity, innovate the talent incentive mechanism, support relevant key projects, and optimize the living environment of residents. The introduction of new labor forces will continuously inject new vitality into Chongqing's economic development and enable Chongqing to maintain its exemplary role in the development of China's western region.

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Analysis of Agriculture Industry Based on Fama-French Model Under COVID-19

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Abstract. COVID-19 is a severe global epidemic that began in 2019 and caused plenty of effects on people's lives in various industries. Agriculture is one of the industries affected severely by COVID-19. This paper focuses on the stock performance of the agriculture industry to evaluate the influences of agriculture under the epidemic and explores the plausible reasons behind the phenomenon. The research selects the data collected from Kenneth R. French's data library and selected two time periods: before the epidemic, from May 2019 to February 2020, and another after the COVID-19 explosion. By utilizing the CAPM and Fama-French Five-Factor Model, the paper compares the coefficients get from the multiple regression model. The result indicates that MKT and SMB are significant before COVID-19 and the rest factors are insignificant. After the epidemic, MKT is still substantial, and HML has become significant too. CMA and RMW are both redundancy factors. In conclusion, under the epidemic, the agriculture industry is less sensitive to the market than other portfolios because agriculture is the living basis for citizens. Therefore, agriculture is less threatened under crisis. In addition, the epidemic increases the demand for agriculture products, thus diminishing the significance of the size effect.

Keywords: Fama-French model · Agriculture · COVID-19

1 Introduction

Since 2019, the world has been in the grip of a virus crisis. As COVID-19 spreads around the world, countries are affected in varying degrees in different ways. Coronavirus is an irresistible sickness brought about by the SARS-COV-2 infection. When a dirty individual hacks, snuffles, talks, sings or inhales profoundly, tiny fluid particles are let out of the mouth or nose, spreading the infection. On March 11, 2020, the World Health Organization (WHO) described COVID-19 as a pandemic, highlighting north of 3 million cases and 207,973 passing in 213 nations and regions. Coronavirus isn't just a worldwide medical condition. It is likewise genuinely influencing the worldwide economy and monetary business sectors. The global lockdown disrupted transportation, services, and manufacturing industries. COVID-19 is also having a significant impact on global agriculture. Some agricultural products may be in short supply, causing prices to soar. In the early stage of the outbreak, any inadvertent panic could trigger a rush

on daily necessities, including agricultural products, just as during SARS, the prices of vegetables and other products skyrocketed in many places. In addition, massive blockades and quarantines have resulted in crop delays and reduced agricultural supply lines. Agriculture is the foundation of all economies and the guarantee of people's happy lives. Therefore, researching the impacts of COVID-19 on the agriculture industry seems to be of great importance, and CAPM is an excellent method to evaluate the effect. The capital Asset Pricing Model (CAPM) was developed by William Sharpe et al. in 1964 on portfolio theory and capital market theory. CAPM model helps evaluate the relationship between the expected return rate of assets and risk assets in the securities market. All through finance, CAPM is broadly utilized for esteeming unsafe protections and creating expected returns by thinking about hazards and the cost of capital. Notwithstanding, CAPM has a downside: it can't clarify the proceeding with unusual impacts since it has just one variable. In April 2015, Fama and French added benefit and a speculation factor dependent on the past three-factor model, giving the more target assessing strategy.

As the flare-up of Covid-19, numerous specialists evaluate its financial impact. Yang et al. examine the impact of COVID-19 on China and the Chinese government's strategy to manage the economic effect on the agribusiness industry by utilizing the technique for web crawler innovation and text mining. The research shows the result that the impact of COVID-19 to agriculture can be mainly concluded in eight aspects, and government take actions to deal with influences in agriculture in seven sectors; however, government is not target to the problems caused by COVID-19 precisely. Therefore, government has long way to go in order to better deal with COVID influence in agriculture economy [1]. Lee focus on the basic impacts of US stock market due to epidemic. The author studies the main idea by employing DNSI and Google Trends data. Moreover, in this study, changes in DNSI are measured and compared with the excess returns of US industries as the dependent variable in the time series regression model. Lee uses the Fama-French three factor model to estimate the excess return, and proposes a strategic investment planning by comparing changes in correlation level by time lag differences [2]. Huang et al. researched the connection between image value and the company's stock presentation during the Covid-19 period. By assessing four stock execution markers and gathering information from the Us recorded firm, Huang, Yang, and Zhu observed that organizations with notable brands have a higher stock return, a lower efficient danger, and a lower quirky risk than different firms. Furthermore, the discoveries can perceive the brand value and corporate social obligation consequences for stock execution during the Covid-19 [3]. Zaremba et al. concentrated on the critical job of deciding a country's economic invulnerability to a worldwide pandemic. Creators gather the data of 67 financial exchanges during the COVID-19 period and get examine the public authority mediations into the value market. The outcomes show that financial businesses in low-joblessness nations populated with moderate speculation approaches and low valuations comparative with expected benefits will generally be less helpless to the medical services emergency [4]. Liu et al. observed that Chinese and Asian securities exchange drastically declined during the COVID-19 period. They got this outcome by applying occasion concentrate on strategy and working out AR. The article likewise analyzed industry record reactions to the pestilence, which uncovered that drug producing, programming improvement, and IT benefits each had positive CAR, while transportation, housing, and providing food

all had negative CAR during the occasion time frame [5]. Kaczmarek et al. employed regressions and machine learning tool by cooperating datas collected from 1200 travel related companies through COVID-19 period in order to understand which factors play the important role in protecting leisure companies from the pandemic. The result shows that firms which have low valuations, limited leverage and high investment are more likely to survive through COVID-19. Moreover, another result indicates that countries with less individualism are better to confront epidemic [6]. Lin and Falk utilize philosophy based on the Markov system changing the model to investigate the movement and recreation organizations' unpredictability and their stocks' exhibition during the COVID pandemic. Instability estimations show system exchanging conduct appeared as a particular danger. The circumstance, probability, and length of this emergency system are generally affected by the creation of movement and recreation firms. Concentrate on outcomes exhibit that high-recurrence information and the model picked here can create ideal data about the impacts of the pandemic on the travel industry and recreation organizations that can be helpful for policymaking [7].

In addition, Many researchers used the pandemic as a background to study the impact of the pandemic on various industries and applied the five-factor model. Sun studies the roles of Fama-French five factor model in the US market during the Covid-19 period. The goal of the study is to validate the model's validity during the pandemic period, find out whether there are unexplained factors, and if Fama-French factor beta values change following the pandemic. Sun uses OLS in 49 industry portfolios and find the result that beginning of Covid-19 led to the increase in efficiency of Fama-French five factor model [8]. Li et al. studies the performance of Fama-French 3 factors model and Fama-French 5 factors model on game industry in US before and after the COVID-19 period. The results shows that game industry's performance was better after the pandemic. The result shows that Fama-French 5 factors model and Fama-French 3 factors model are both appropriate to U.S game industry after pandemic period, in addition 5 factors model perform better when RMW is redundant [9]. Liu applied Fama-French five factor model and multiple linear regression to evaluate the hardware industry before and after 2019 pandemic. The results shows that COVID-19 not only has negative effects to hardware industry, but there are some positive effects exist [10].

Therefore, the purpose of this paper is to explore the influences of COVID-19 on to agriculture industry. By choosing two time periods, one is before the epidemic, and another is after the epidemic and using the data collected from Kenneth R. French's data library to generate multiple regression results. Using the CAPM model and Fama-French five-factor model to analyze the coefficient and compare their significance before and after the epidemic, this study will analyze the pandemic's influences on the agriculture industry. Then in the discussion, it discusses each factor and find the plausible reasons behind the significant changes. In the conclusion part, giving some investment advice to investors based on the main findings.

2 Method

In the original CAPM model, the expected return of a security is equal to the risk-free rate of return plus beta for the security, which is a measure of systematic risk times the market premium. CAPM model is just a function of one factor, and Fama and French three-factor model provides more than one beta, as shown in Eq. (1):

$$R_i - R_f = +\beta_{mkt}(R_m - R_f) + \beta_{SMB}SMB + \beta_{HML}HML + \varepsilon \quad (1)$$

R_i refers to the expected excess return, which equals to the total return of a stock or portfolio i minus R_f , which is the risk-free rate of return; SMB S means small-cap stocks, B means large-cap stocks; therefore, SMB refers to the market return base on the size effect; HML which is high minus low, H high represents a portfolio that has high book market ratio, L low is the portfolio with low book market ratio; thus HML factor refers to the value factor. The Fama and French five-factor model considers profitability and investment factors.

Afterwards, the Fama and French five-factor model was proposed:

$$R_i = RF + \beta_{mkt}(RM - RF) + \beta_{SMB}SMB + \beta_{HML}HML + \beta_{RMW}RMW + \beta_{CMA}CMA + \varepsilon_i \quad (2)$$

where, RMW R is the robust profitable firms and W represents the weak profitable firms; RMW refers to the profitability factor is the returns of high profitable firms minus the weak profitable firms; CMA is the investment style factor, C refers to the conservative investment style, and A refers to the aggressive investment level; CMA is the return on difference between the conservative investment portfolios and aggressive investment portfolios.

3 Result

In order to estimate the effect of COVID-19 on the agriculture industry, this study employs the data collected from Kenneth R. French's data library. There is two selected period used to compare the COVID-19 impacts to the agriculture industry. The first period is May 2019 to February 2020, which is before the epidemic outbreak. The second period is after the COVID-19 explosion, which is from March 2020 to December 2020. The multiple regression model obtains the coefficients, and the two tables are shown as follows. By observing the table above, it is clear that MKT and SMB are significant before COVID-19, and HML, RMW, and CMA are insignificant. After the COVID-19 outbreak, MKT is still significant and HML has become significant too. SMB becomes insignificant after the epidemic, and it is noticed that the coefficient becomes smaller than zero. In addition, HML is insignificant before COVID-19, and its coefficient is smaller than zero; however, after the epidemic, the coefficient of HML becomes much bigger.

Table 1. Multiple regression result of agriculture before COVID-19 (2019.5–2020.2)

Item	Coefficients	Standard error	T stat	p-value
Intercept	0.010	0.098	0.107	0.915
MKT	0.964	0.116	8.281	0.000
SMB	0.705	0.220	3.218	0.002
HML	−0.137	0.225	−0.611	0.542
RMW	0.517	0.366	1.413	0.159
CMA	0.053	0.433	0.123	0.902

Table 2. Multiple regression result of agriculture after COVID-19 (2020.3–2020.12)

Item	Coefficients	Standard error	T stat	P-value
Intercept	0.096	0.131	0.735	0.463
MKT	0.873	0.061	14.387	0.000
SMB	0.077	0.156	0.497	0.620
HML	0.499	0.129	3.878	0.000
RMW	−0.094	0.261	−0.361	0.718
CMA	−0.359	0.334	−1.076	0.283

By observing the table above, it is clear that MKT and SMB are significant before COVID-19, and HML, RMW, and CMA are insignificant. After the COVID-19 outbreak, MKT is still significant and HML has become significant too. SMB becomes insignificant after the epidemic, and it is noticed that the coefficient becomes smaller than zero. In addition, HML is insignificant before COVID-19, and its coefficient is smaller than zero; however, after the epidemic, the coefficient of HML becomes much bigger.

4 Discussion

4.1 MKT

As shown in Table 1 and Table 2, the coefficient of MKT before COVID-19 is 0.964 and becomes 0.873 after the epidemic. The two coefficients are less than 1, which means the agriculture's stock price is insensitive to the market. However, there exists a slight difference between the two periods, and 0.873 is smaller than 0.964. The slight difference indicates that after COVID-19, agriculture's R_i is less sensitive to market change.

This phenomenon might be that the agriculture industry gets fewer negative effects from COVID-19 than other industries. Food is a critical factor to people's survival, and it guarantees people's health and living, especially under the epidemic. Therefore, almost every country has given strong support to agriculture during the pandemic to ensure it can survive the crisis. For instance, the USDA created and executed two rounds

of subsidizing the Coronavirus Food Assistance Program (CFAP). As indicated by the first round as CFAP 1 and the second round as CFAP 2, the two consolidated games gave \$23.5 billion (\$10.5 billion from CFAP 1 and \$13.0 billion from CFAP 2) indirect installments to ranchers and farmers in 2020. Besides, CFAP gave direct installments to makers who confronted market disturbances, expanded creation costs, and discounted ranch level costs. (Farms and Farm Households During the COVID-19 Pandemic, 2021) Those are the reasons why the agriculture industry has become less sensitive to the market under epidemic.

4.2 SMB

SMB refers to the market return based on the size effect. As shown in the results above, the SMB data was significant before the COVID-19, and the coefficient was greater than zero. It means that the market rate of return from a small business is higher than that from a large portfolio. After COVID-19, SMB becomes insignificant, indicating the difference between the market rate of return between small firms and the larger ones diminished. After the epidemic, the difference of outcome in investing in large firms and small firms become diminished, which can be explained by the fact that agriculture is the living basis for every citizen and under the special situation the demand for agriculture products soared. Therefore, as the result of COVID-19, the expectation of both small agriculture portfolio and the large portfolio are both increase therefore diminishing the market return difference between the two portfolios. However, before epidemic, people usually like investing in small businesses compared to large portfolios because small portfolios always positively correlated with high growth potential and higher expected returns.

4.3 HML

HML is a book-to-market ratio factor. HML changed significantly from the 2019 to 2020 period. The results indicate that, before COVID-19, HML is insignificant, which means the companies with high book-to-market ratios and those with low book-to-market value ratios do not have too much difference in their expected return. However, a noticeable change took place in 2021. HML coefficient in the agriculture industry becomes significant and positive. This phenomenon means that companies with a high book-to-market value ratio can generate a higher return than those with low. Investors prefer value stocks rather than growth stocks under epidemic. The reason may be that companies with a higher book market ratio can better survive under the epidemic and bring lower risk and higher expected returns to the investors. Because of the COVID-19, the regulations such as the lockdown and self-quarantine plan broadly impact the agriculture industry. The firms with high book-to-market value ratios and low book-to-market value ratios are affected. For instance, Ag Growth International (AGI), based out of Canada, has suspended its worldwide tasks in Italy, India, France, and Brazil as ordered by the public authority. The impact on horticulture would be disturbed by a decrease in worldwide development as US GDP has been diminished by \$1.5 trillion as far as a monetary result. (Dublin, 2021) However, the firms with low book-to-market ratios are more easily be affected and cause the decline of the stock price because of

previous high stock prices and pessimistic market expectations. Therefore, investors are more willing to invest in a portfolio with higher market value to avoid the risk and get a higher profit return.

4.4 RMW

RMW factor before and after the epidemic period is insignificant, indicating that RMW is a redundancy factor. The investors of agriculture industry don't have clear preferences between the robust, profitable firms and the weak profitable firms. The reason may be that expected return of robust agriculture firms and the weak profitable firms are relatively stable, and this situation is relatively fixed in recent years. Therefore, the investors may accept it and ignore the profitability factor.

4.5 CMA

The t value of CMA before and after the epidemic are both insignificant. According to the definition CMA, CMA is the investment style factor, C refers to the conservative investment style, and A refers to the aggressive investment level. CMA is the profit from the distinction between the moderate venture portfolios and forceful speculation portfolios. The insignificant CMA factor means that the agriculture industry does not have the preference between the conservative investment strategy and the aggressive investment strategy. The reason is that because of years of development, the agriculture's market pattern is relative stable and there is no clear difference between the two-investment strategy.

5 Conclusion

This paper adopts the Fama-French five-factor model to analyze the impact of COVID-19 on the agriculture industry. According to the results, MKT and SMB are significant before COVID-19, and after the pandemic, MKT is still substantial, and HML becomes significant too. However, SMB becomes insignificant are the epidemic. The plausible reason behind the change is that agriculture is essential to the society, especially under epidemic circumstances. The pandemic gives the agriculture portfolios with a high book to a market ratio more opportunity to survive and attract investors. Therefore, this paper strongly suggests investors invest the value stocks with high book to market ratio.

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Research on Legal Risks of M&A of Multinational Enterprises and Their Regulation: A Comparison Based on Chinese and American Legislation

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Abstract. Chinese enterprises' overseas M&As have gone through the stages of initial exploration, stable development, rapid expansion and gradual rationalization. How to control the risks (including legal risks) in the process of overseas M&As under the general trend of Chinese capital going abroad deserves particular attention. By comparing the current legislative provisions in the field of anti-monopoly in China and the United States, this paper appropriately interprets the existing M&A risks and their regulation, introduces and discusses in detail the main processes and risk control of overseas M&A of state-owned enterprises from the legal level, and then makes feasible suggestions for the improvement of Chinese anti-monopoly legislation.

Keywords: Multinational enterprises · Overseas M&A · Risk control · Comparative study

1 Introduction

Overseas mergers and acquisitions (M&A) refer to the consolidation companies or industrial assets via financial transactions on a global scale. It generally consists of inward and outward M&A. This essay, however, mainly focuses on outward cross border M&A, which refers of outward financial transactions because of purchase of a foreign company. Compared with other developed countries like America, China started much later in cross-border M&A. Since China's accession to the WTO in 2001, Chinese companies have embarked on a new wave of cross-border mergers and acquisitions. It is reported in the statistical bulletin on China's outward foreign direct investment (FDI) that, by 2004, China's cumulative net outward FDI has amounted to US\$44.8 billion. Outward FDI enterprises (hereinafter referred to as overseas enterprises) are from 149 countries and regions, covering 71% of the countries (regions) worldwide. The number of outward non-financial direct investment by Chinese enterprises rose from US\$435,269.3 million to US\$491,952.3 million from 2012 to 2020. The leasing and business services sector tops the list with \$831.64 billion, while wholesale and retail trade and information

transmission/software and IT services occupy a significant position [1]. In general, cross-border M&A can be considered paradoxical: although companies are able to spread their comparative advantages and create substantial value overseas with stronger core competence [2], they will still face political, legal, and cultural challenges. Among those obstacles, security, corporate, and competition related laws could hardly be without divergence. And due to these constrains, two thirds of Chinese companies have ended up with failure in consolidating foreign firms. Hence, it is of great significance to review the employment regulations, antitrust statute, and other contractual requirements before considering the deal. Chinese scholars began to carry out the research of cross-border M&A much later, with research from the 1990s mainly focusing on what the potential consequences brought by outward cross border M&A as well as how to expand outward cross border M&A. Since the 2000s, it mainly focused on analyzing the potential cultural and financial risks. For example, in 1998, Shi Jiansan advocated a proper sense of its pros and cons [3].

In 2008, Zhao baoguo and Li weiwei analyzed the financial risks of cross border M&A from enterprise valuation, financing, and payment strategies [4]. In 2011, Xiao Zhirun proposed that cultural integration in cross-border M&A should strengthen the study of the culture of the company to be acquired and its host country, expand cross-cultural communication channels, and create a good environment for cultural integration and other measures [5]. However, apart from that, most Chinese scholars just devoted to analyze the factors contributing to business failure from the perspective of talents, politics, and core competencies in a more general way, while few concentrate on the study from the perspective of laws. As such, this essay could fill in the gaps.

2 Current Situation of Overseas M&A in the United States

2.1 Early Start and Large Scale of M&A Behavior

The first wave of overseas M&A in the U.S. emerged in 1981–1989, a period of economic expansion in which many companies began to promote corporate mergers by acquiring stock. Subsequently, between 1992 and 2000, there were 52,045 M&A cases in the United States. In this period, cross-border M&A mainly took place in the telecommunications, finance, automotive, pharmaceutical, media and Internet industries. Another significant feature of this round of M&A was the integration of emerging industries with traditional industries. In addition, M&A cases in the United States were characterized by huge amounts of money, with GM's acquisition of Daewoo as a typical representative. Through such M&A actions, the relevant enterprises can firstly directly obtain the production factors such as land, plants and labor that are readily available in the location of the acquired company, shortening the construction cycle and investment cycle. Secondly, it can directly occupy the market share of the host country, thus reducing the competitive pressure. Finally, after the acquirer completes the acquisition of the overseas target company, it can make full use of and adapt to the management mode and management personnel of the host country business environment to reduce the break-in costs.

2.2 A Well-Developed Legal System

As one of the first countries to regulate corporate mergers and acquisitions, the U.S. has a well-developed legislation that identifies tax, accounting, corporate, securities, antitrust, trade regulation, environmental, intellectual property, insolvency, labor and employee benefits law, and other significant issues relating to structuring and acquisition. The Sherman Act, enacted in the late 19th century, is the world's first antitrust law. In addition, the U.S. antitrust legal system includes the Federal Trade Commission Act of 1914, the Clayton Act, and several subsequent amendments [6]. The U.S. has enacted the Superfund Act (Comprehensive Environmental Response, Compensation and Liability Act of 1980); Resource Conservation and Recovery Act; Surface Mining Control and Reclamation Act; and Foreign Investment Risk Assessment Modernization Act (FIRMA) in August 2018 to give CFIUS broader review authority. In addition, the U.S. has also specifically developed merger and acquisition guidelines, merger and acquisition review system.

3 Current Status of Overseas M&A in China

3.1 Achievements

Diversification of M&A Areas and M&A Regions. Despite the decline in the number and amount of deals, Chinese companies are now increasingly diversifying their overseas investments, mainly in: the energy and minerals sector, manufacturing and service industries, areas that other countries such as Europe and the US are still willing to open to Chinese companies because they need more financial support and a broader Chinese market. For example, in 2016, Midea successfully acquired the Toshiba brand at the cost of taking over about \$220 million in debt from Toshiba Appliances [7]. After the Chinese government proposed the “One Belt, One Road” initiative in 2013, its overseas M&A target countries started to focus on Asia. In 2019, Asia accounted for 35% of the number of overseas M&A deals.

More Compliant Transactions. On the one hand, Chinese companies pay more attention to ODI and overseas compliance, and pay more attention to the regulations of administrative authorities such as NDRC, MOFCOM and SASAC in the process of designing structures, not only considering tax planning and transaction planning, but also paying attention to the relevant legal regulations of Chinese companies' outbound investments; paying more attention to the regulations of local countries or regions. On the other hand, Chinese state investment approval is more legal and compliant, first of all, the domestic Development and Reform Commission (NDRC) approves and approves projects: for Chinese investments of USD 2 billion or more, the NDRC reports to the State Council for approval; for overseas investment projects in sensitive industries or in sensitive countries and regions, the NDRC approves them [8]. (Subject to the National Development and Reform Commission's publication of the Catalogue of Sensitive Industries for Overseas Investment (2018 Edition), specifically: i. Development and production of weapons and equipment maintenance; ii. Cross-border water resources development and utilization; iii. News and media; iv. The National Development and Reform Commission's

January 31, 2018 publication of the Notice of the National Development and Reform Commission on the Publication of the Catalogue of Sensitive Industries for Overseas Investment (2018 Edition) according to the Notice of the General Office of the State Council transmitting the Guidance Opinions of the National Development and Reform Commission, the Ministry of Commerce, the People's Bank and the Ministry of Foreign Affairs on Further Guiding and Regulating the Direction of Overseas Investment (Guo Ban Fa (2017) No. 74), the industries requiring restrictions on enterprises' overseas investment are (a) real estate (b) hotels (c) cinemas (d) entertainment (e) sports clubs (f) the establishment of equity investment without specific industrial projects abroad Investment funds or investment platforms.

According to the provisions of the "Measures for the Administration of Overseas Investment", overseas investment projects with an investment amount of less than 300 million U.S. dollars by the audit of the competent government investment department for the record, rather than a strong administrative color approval. Secondly, the overseas investment of Chinese enterprises involving sensitive industries or sensitive countries and regions shall be reported to the Ministry of Commerce for approval, while central enterprises shall be reported to the Ministry of Commerce for record, and local enterprises shall be reported to the Provincial Department of Commerce for record.

3.2 Problems

The Overall Trend is Declining. Due to the influence of external factors as well as the domestic economic environment, the number and value of overseas transactions of Chinese companies have shown a decreasing trend. On the one hand, under the influence of political events, Europe and the United States have had stricter investigation on Chinese investments, especially in areas involving sensitive industries, national security and high-tech industries, a good example being the acquisition of German semiconductor equipment manufacturer AIXTRON by the Chinese-owned Fujian Hongxin Fund Investment Co. in 2016; although the Chinese-owned acquisition was approved by the German authorities in 2016, because AIXTRON Enterprises has extensive operations in the U.S., the German government withdrew permission and launched an investigation into the transaction after the U.S. received the information. Finally, after the CFIUS rejected Fujian Hongxin's acquisition of AIXTRON's assets in the U.S. on national security grounds, Hongxin announced its abandonment. And because of the epidemic, it led to a decrease in China's overseas M&A deals from \$234 million in 2016 to \$46.4 billion in 2020. It can be seen that although Chinese private companies are active in overseas M&A, it is more difficult to obtain acquisition funds compared to between.

Low Success Rate. Although Chinese overseas M&A was having rapid growth in recent years and its scale was broadened, the success rate is not high due to both internal and external factors. From external factors, in addition to the political risks mentioned above, there are also differences in the national and corporate cultures of the M&A parties; from internal factors, the lack of experience in cross-border M&A of enterprises due to the lagging development, as well as the poor international competitiveness in terms of financing ability, talent assurance, management level, and experience in foreign

economic activities; in addition to the above factors, legal factors are the most prominent willing and you, such as the lack of knowledge of the subject country law, taxation, investment, equity, labor protection and other aspects of the study, to strengthen the international trade bilateral multilateral protein reciprocity laws and regulations are also not sound, the legal and regulatory construction of overseas investment insurance lags behind. According to the April 2017 by McKinsey's (Chinese enterprises cross-border M&A Xuzhou Guide), in nearly 300 overseas M&A case studies found that Chinese companies overseas M&A rate of only 40%, compared to 60% in developed countries in Europe and the United States.

In summary, although China's anti-monopoly legislation and its corresponding enforcement system design are worthy of recognition, the specific practice still reflects its shortcomings in dealing with cross-border mergers and acquisitions, which need to be improved at the institutional level.

4 Suggestions for Improving the Legal System of Overseas M&A in China

Enterprises' overseas M&A projects should pay attention to whether there are significant legal risks in the M&A target company, whether the M&A plan is reasonable and feasible, and whether the transfer of equity or assets abroad is in compliance with local laws as well as domestic laws, etc.

4.1 Implementing Anti-monopoly Regulation for the Whole Business Field

In January 2006, China International Marine Containers (Group) Corporation (CIMC) and Borg Industries (a supplier of transportation equipment) signed a draft agreement agreeing that CIMC and Borg Industries (a supplier of transportation equipment) In January 2006, China International Shipping Container (Group) Corporation (CIMC) and Borg Industries (a transport equipment supplier) entered into a draft agreement whereby CIMC and the shareholders of Borg Industries would establish a new joint venture company, with the new company owning 100% of Borg and CIMC owning 75% of the new company. In November 2006, the acquisition plan and structure were adjusted to divest the standard tank business, which was suspected to be antitrust, and the acquisition of Borg was completed.

4.2 Establishment of Antitrust Examination Preceding Procedures

In order to ensure the legality of the transaction, the antitrust examination can be set as a prerequisite in the transaction documents, taking into account the laws already in place in the EU. Even if the acquirer's turnover does not meet the criteria for triggering the antitrust merger control procedure, it is still necessary for the acquirer to communicate with the Commission in advance to ensure that the turnover of the business will not be cumulative. If it is required to be cumulative, there is a greater likelihood that the transaction will be subject to antitrust scrutiny. Companies that fail to prepare and provide information in advance may face a longer advance notice period.

5 Conclusion

The trade war between China and the United States has brought many adverse effects to Chinese companies' overseas investments [10]. The top management of both China and the U.S. realize that the trade war has not only caused serious damage to the economic development of both sides, but also has a negative impact on the development of the global economy. Domestic companies going out and foreign investors coming in are both opportunities and challenges. Due to the differences in business culture and legal system, foreign companies need to conduct cultural bonding during business negotiation and more importantly, legal risks in transaction declaration and document preparation in order to ensure the smooth realization of M&A transaction goals in the transaction of attracting domestic investors for M&A. We believe that if the trade war between the two countries ends, Chinese enterprises will once again see a spring in their "going out" and state-owned enterprises will quickly achieve their goals of market internationalization, product and technology upgrading and management modernization through overseas M&A of quality companies.

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Analysis of Impact of COVID-19 on Chinese Economy—A Case Study of Li Ning

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Abstract. This essay studies the impact of COVID-19 on Chinese economy through analyzing Chinese financial performances and the case of a business called Li Ning. However, it is also important to study the extent of the impacts to Chinese economy during specific periods which are the time before the pandemic, start of the pandemic and middle time of the pandemic. In order to reflect the macro-economic and financial performances of China, one macro financial market and one specific business are both used for analyzing. Shanghai Stock Exchange Market is chosen as the macro financial market and therefore SSEC is used for macro analysis. The daily return of Li Ning is analyzed, and Li Ning's stock market performances are compared between before and the other two periods, and the result of stock market analysis shows an opposite situation to that of Chinese macroeconomy. Therefore, the fiscal report of Li Ning is further processed and analyzed to interpret the successful business strategies of Li Ning during the COVID-19. Additionally, the daily return of SSEC is also analyzed and concluded. To make the discovery and conclusion more accurate and convincible, hypothesis test is applied to help prove whether there is difference of daily return between before and the other two periods of both Li Ning and SSEC. The result found by this study is useful for business to use for reference that how to cope with inevitable disasters to avoid loss and important for other governments to learn experience from.

Keywords: COVID-19 · Financial markets · Economic indicators · Business · SSEC · Li Ning

1 Introduction

1.1 Introduction

Covid-19 outbreaked in Wuhan at the end of 2019, and the global mortality rate continues to rise because the virus is extremely transmissible and lethal. The outbreak has become a topic that has attracted considerable attention worldwide. The global impact of the epidemic is immeasurable, not only shaking the international status of some countries, but also making some countries shut down their production and economic crisis. This

thesis will examine the impact of the epidemic on China's economy through its financial performance.

This thesis will look at the impact of the epidemic on the economy in terms of GDP, GNI and the unemployment rate (Figs. 1, 2, 3, 4 and 5).

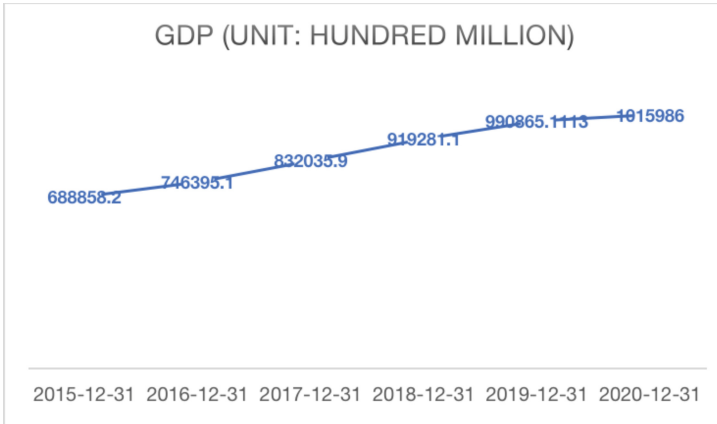


Fig. 1. GDP (Unit: Hundred Million)

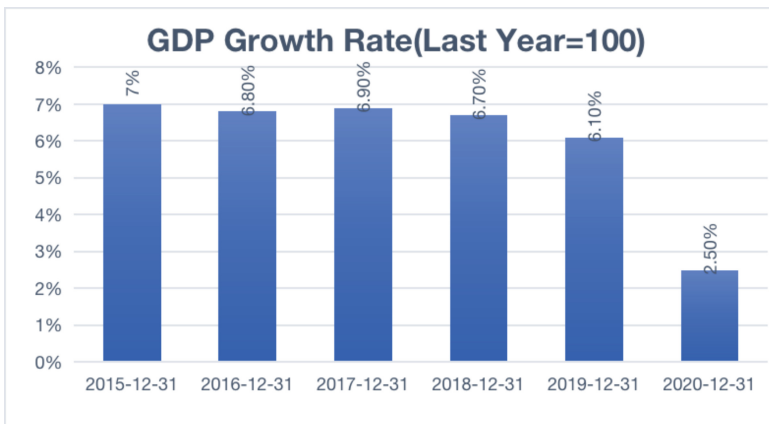


Fig. 2. GDP growth rate (Last Year = 100)

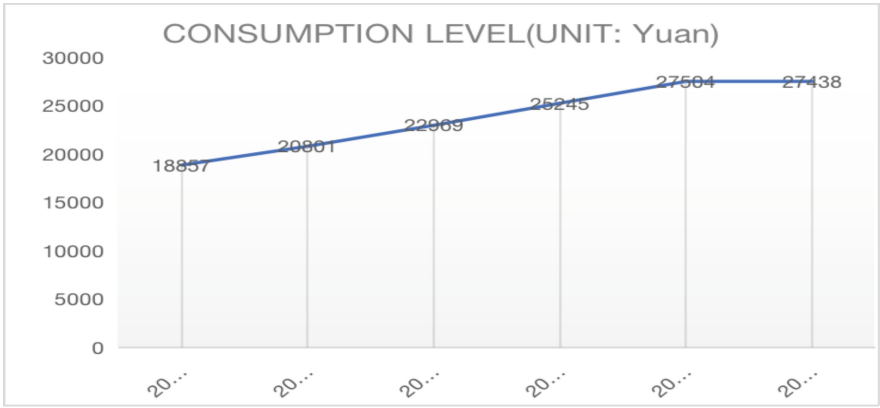


Fig. 3. Consumption level (Unit: Yuan)

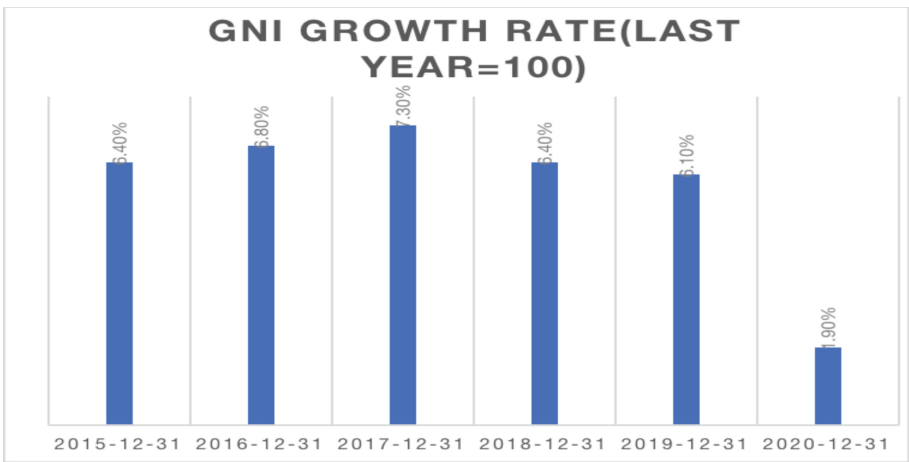


Fig. 4. GNI growth rate (Last Year = 100)

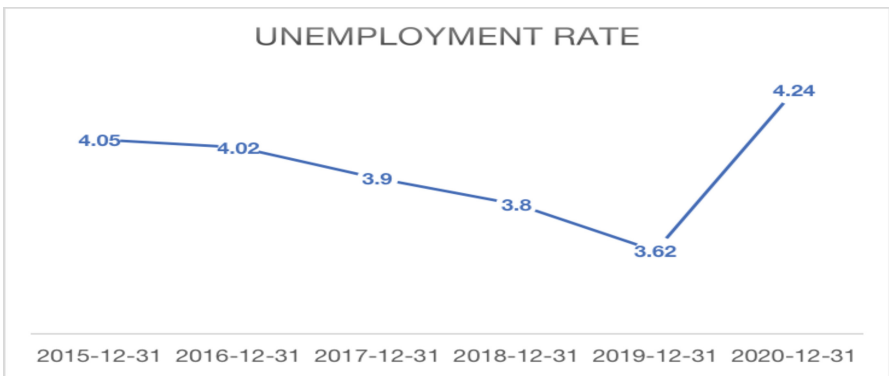


Fig. 5. Unemployment rate (Data comes from <https://data.worldbank.org/cn/country>)

The main objective of this paper is giving the full view of the China economy performance through the financial performance and summarizing the advantages of successful company during the epidemic which other firms can learn from it.

Other crucial and detailed descriptions have been uploaded to the website: <https://docs.google.com/document/d/14LnsE2XSnaIL3Eu6mnB2EIYIPvJzRNzZrYEizG1STyE/edit?usp=sharing>.

1.2 Literature Review

By collating past papers, two of their shortcomings are summarized. The one is fewer specific figures and the other is the essay which focuses on the total tendency and ignore the fluctuations. The first problem is inevitable, as most of the papers were published in the mid or late 2020s. These articles are often not backed up by a large amount of data, so the predictions for the future and the solutions offered are largely unreliable.

The second problem is that other papers do not effectively segment time, they only focus on the overall trend but do not analyze the fluctuations within it. Without the time segmentation it is difficult to see the extent of the impact of the epidemic or even to determine whether it is the epidemic that is having the impact. This thesis divides the time into 3 segments: before the epidemic, starting of the epidemic, and at the height of the epidemic. A comparison of the data from the three time periods clearly shows the impact of the epidemic on the financial markets.

1.3 Methodology

At the first phase of the study, the group employed desk research to collect a series of econometrical and financial indicators to make provisions for later research of the influence of the COVID on China's economy and its financial markets. The selection of such econometrical indicators included GDP (per capita), HDI, Unemployment rate, Natural Growth rate of population, Rate of mortality, Industrial value added of primary, secondary and tertiary sectors Amounts of bonds issued and inflation rate. These data are recorded in annual basis in a 5-years interval from 31/12/2015 to 31/12/2020. All data was gathered from the disclosure from the central government. (One year's data is usually promulgated as "administrative measures" on 29th, Jan in its following year). Followed by an assembly of such sets of data into an excel - based database.

Financial-wise, data from 2 composite indexes in Mainland China (Shenzhen Component index, SZSE and Shanghai Component Index, SSE) was taken and recorded. Then, 8 companies from 4 representative industries were randomly selected. The names of the companies and their brief introductions are listed alongside their corresponding industries:

- Clothings: Li-Ning, Bo Sideng
- Catering Services - Quan Jude, Meituan
- Commercial Aviation - China Eastern (1 of the 3 major Chinese Airlines)
- Hotels, Tourism & Hospitalitys- Jinjiang Inn
- Real estate: R&F Properties
- Logistics, express & postal services: S.F. (Shun feng)

Similar to the process of the econometrical data acquired previously, stock prices of the companies in daily basis were archived then; from 03/06/2019 to 31/12/2020. The collection was comprised of closing and opening, high and low prices and volume of trade of each company's stocks. An identical procedure was adopted on processing of the 2 composite indexes.

For the second phase of study, samples are narrowed down into 1 Composite index (SSEC) and 1 (Li-Ning) amongst the 8 companies chosen previously were proceeded with a case study. It mainly involved running a hypothesis test with the samples' existing data. In order to compare the performances of Li-Ning and SSEC during different stages of the pandemic, the timeline was divided into following sub-periods:

- Prior to the outbreak (Before): 01/01/2019–19/01/2020
- Start of the outbreak (Start): 20/01/2020–01/02/2020
- Climax of the pandemic (Height): 02/02/2020–12/03/2020
- Mitigation of the pandemic (Mitigation): 13/03/2020–31/07/2020
- This was followed by the carrying out of empirical-based investigations.

To start, simple calculations was carried out to obtain a clearer view of the financial-wise effects of COVID, including the calculation (SSEC and Li-Ning only) of the rate of fluctuation of stock prices, the rate of return compared to the previous day and the current ratio during the four sub-periods respectively.

2 Process

2.1 Time Division

The data of people confirmed during the period of COVID-19 in China from 20 January to 31 July (In fact, the first case of people confirmed happened on 12 December 2019. The cases confirmed before 21 January were ignored due to the tiny volume of samples) shows a general trend that the number of people confirmed increased generally during that period with an extremely rapid increase from 20 January to 21 February and then slowed down suddenly in the next five months.

In order to analyze the financial performances in China, focusing on the phenomena and fluctuation of stock market during that period is necessary. Therefore, dividing the entire timeline from the outbreak to the mitigation of COVID-19 into separate periods is essential for comparisons and further analysis. The Fig. 6 below is made from the number of people confirmed for dividing the timeline. Also, the increment of number of people confirmed is also calculated to intuitively reflect the difference or comparison of number of people confirmed between two days which reflects the growth degree for further analysis that whether the pandemic situation is worse or better.

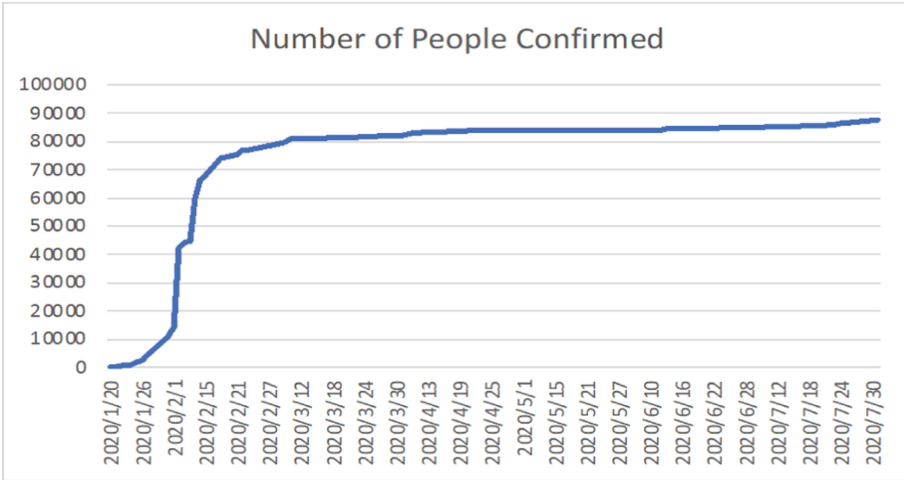


Fig. 6. Number of people confirmed

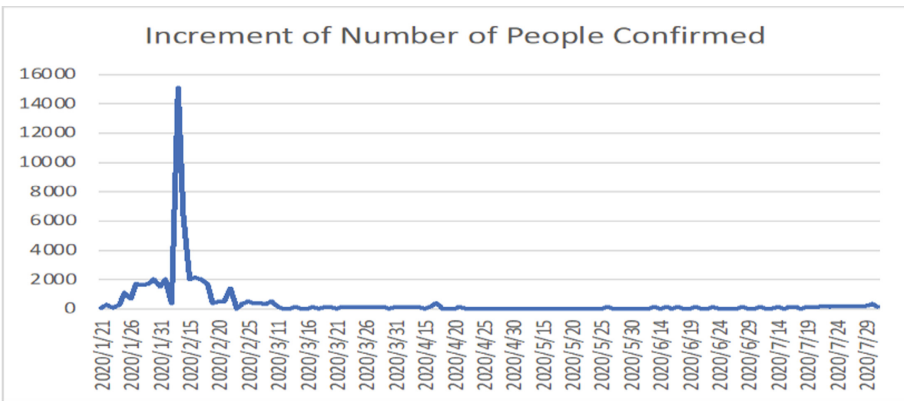


Fig. 7. Increment of number of people confirmed

Figure 6 shows the number of people confirmed and Fig. 7 shows the increment of number of people confirmed. The number of people confirmed increased significantly from 20 January 2020 to 27 February 2020 and the tendency tended to be stable in the past months with the increased quantity only eight hundred that is considered as the mitigation of the COVID-19. In Fig. 7, there is a sharp increase of the increment and then the number plunged immediately during 31 January 2020 to 20 February 2020.

Therefore, the timeline of COVID-19 in China can be easily divided into two periods which respectively are from 23 January 2020 to 25 March that stands for the start of the pandemic and from 26 March 2020 to 29 May 2020 that stands for the middle stage of the pandemic with no significant increase of people confirmed.

To compare whether the COVID-19 did do negative impacts to the financial performances of businesses and the whole economy, the period before the COVID-19 should be included. Thus, the ‘before period’ is chosen from 1 November 2019 to 31 December 2019 due to the availability of data and the consideration of whether it is close to the outbreak time of the pandemic. Therefore, the timeline is divided into three periods for further analysis.

2.2 Analysis of Daily Return of Li Ning

As the division method of last chapter, the entire analysis is divided into three periods that are Before (2019.11.1–2019.12.31), Start (2020.1.23–2020.3.25) and Height (2020.3.26–2020.5.29) respectively.

Li Ning is a Chinese famous clothing and sports equipment brand which issued its offerings initially in 28 June, 2004 in Hongkong Stock Exchange and its stock code is 02331. HK. As a relatively fashion commodity brand, it is expected to be influenced negatively by the pandemic.

The COVID-19 had severely damaged Chinese economy and many small and medium-sized enterprises were closed, and the rate of employment and people’s disposable income decreases to different extents [1]. Then, the Wuhan government made the announcement of locking down the city on 23 January, 2020 and all the mass gathering places and offline shops were forced to be temporarily closed by the government. Under this situation, the demand to Li Ning was expected to decrease significantly, the firm would make economic loss and entered the financially hard time.

However, the dramatic and unstable fluctuations of stock prices are not the most important thing for investors to consider but the daily return rate is. The formula of calculating the daily return rate is,

$$\text{Daily Return } R_{t+s} = \frac{P_{t+s} - P_t}{P_t}. \quad (1)$$

The calculation formula is composed by the prices of two consecutive days without any other parameters or variables. Therefore, not only the information efficiency of the daily return is the same as that of prices, but also the daily return is more intuitive and more convenient for investors to pay attention to [2].

As the way of time division in last chapter, the data of daily return of Li Ning’s stock is also separated into three parts. For each part, 41 days are chosen as the samples from the different time periods that are before (2019/11/1–2019/12/31), start (2020/1/29–2020/3/25) and middle (2020/3/30–2020/5/29) respectively. In order to compare the financial performances between before and the other two periods, the two scatter diagrams are made to show the situations intuitively.

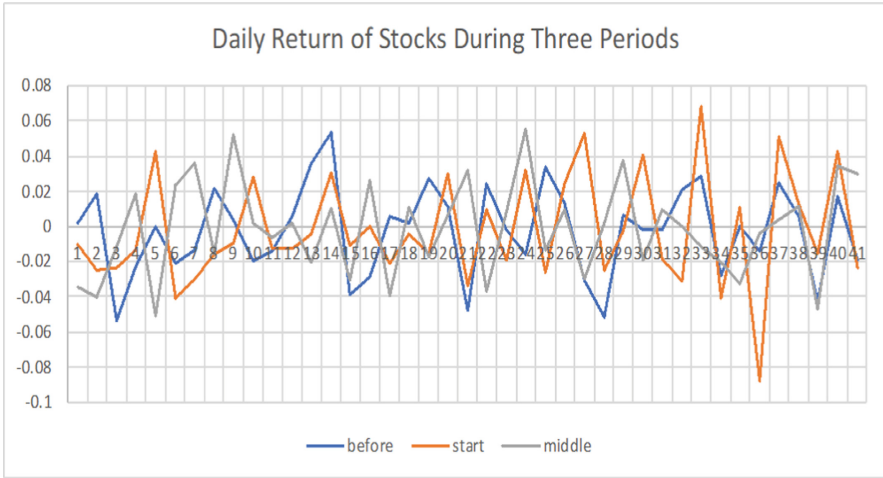


Fig. 8. Daily return of stocks of Li Ning during three periods

As the Fig. 8 shows, the number of samples that have the value larger than zero of before, start and middle are 20, 14 and 21 respectively which means the period of the start of the COVID-19 performed worst in financial market based on the analysis of the possibility of gaining positive return since the statistical number of it is only 14 that is 6 smaller than that of before the pandemic. However, another result turns out that the performance is the best in the period of middle which is still in the course of the pandemic.

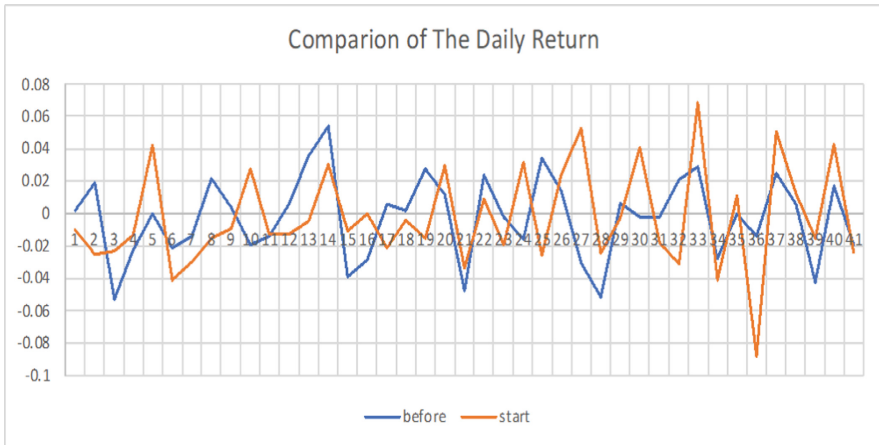


Fig. 9. Comparison of the daily return of Li Ning between before and start

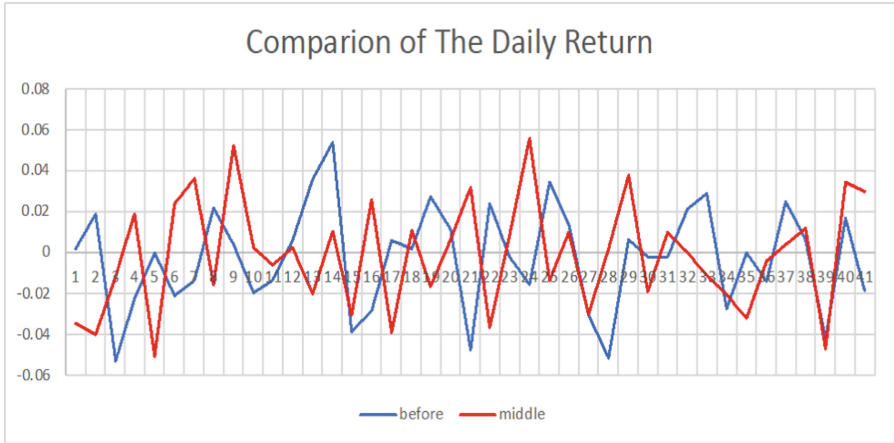


Fig. 10. Comparison of the daily return of Li Ning between before and middle

To make further analysis, the line charts (Fig. 9, Fig. 10) are also created respectively to make the trends and fluctuations visually illustrated. The two comparison figures both show that the general degrees of fluctuations are similar of three time periods, so the calculation of variance is necessary for quantitative and accurate analysis of the certainty of whether or not the investors could gain return [3].

$$\text{Variance } var(R) = \frac{\sum_{t=1}^T (R_t - \bar{R})^2}{T - 1} \quad (2)$$

The variances of the three periods are 0.000649751, 0.000985589 and 0.000734819, and the highest one is that of the start time which means the fluctuations of the start period is the most unstable and it is also most uncertain one for investors to gain return.

In general, the COVID-19 did have some impacts to the stock of Li Ning during the start time, but Li Ning adjusted successfully and immediately to minimize the loss which could be reflected from the performances of the middle time and the impacts themselves were not quite significant or obvious due to the small percentage difference between the start time and before time. Therefore, the prediction that the COVID-19 made lots of negative influences on Li Ning is not completely exact and whether the pandemic did strike Li Ning much should be tested and analyzed by more data and methods.

Other crucial and detailed descriptions have been uploaded to the website: https://docs.google.com/document/d/16RWyqSfvJ805DHTpb_E8H90yem5cCv4663APYZM749U/edit?usp=sharing.

Fiscal Report and Business Strategies Analysis of Li Ning: https://docs.google.com/document/d/1RcJxWX_rNdbHN_cExw5pWQsrlPjsztrGzW_1NiI3M_M/edit?usp=sharing.

https://docs.google.com/document/d/1TtsLwBZ_BeSOrGPfclKQm5evzWRmXMm9ngEJmF2Igw/edit?usp=sharing.

2.3 Analysis of Daily Return of SSEC

In last two chapters, the financial and fiscal performances of Li Ning are clearly and detailly analyzed with data of the stock market and fiscal report. However, it is not sufficient to conclude the financial situation of the whole economy through just one business, therefore, a more macro studying object should also be used to help prove the conclusion. In this chapter, the same method is applied to the analysis of daily return of SSEC in order to further investigate whether or not the financial market or even the whole economy was not impacted significantly by COVID-19.

Figure 11 shows all 39 samples of the data chosen for each time (the reason why there are only 39 samples chosen instead of 41 is due to the lack of availability of complete data) and the number of samples which have value above zero for each time are 23, 24 and 20 respectively. It is surprising that the result shows a completely different situation to that of Li Ning that the possibility of gaining positive return is the largest in the start time, and the worst is the middle time. However, the percentage difference is not significant neither between before and start nor between start and middle. Therefore, the result shows in this process is not convincible to overthrow the former result that the start time performs the worst.

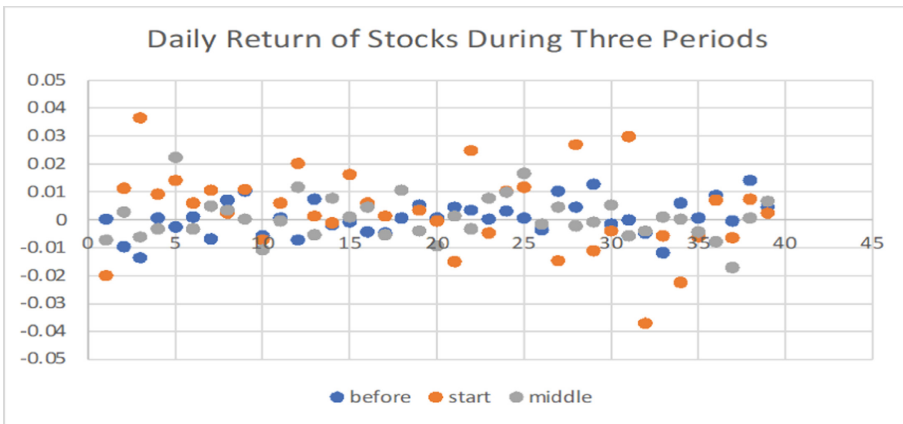


Fig. 11. Daily return of stocks of SSEC during three periods

Then, the line charts (Fig. 12, Fig. 13) are created respectively to make the comparisons of the general degrees of fluctuations of three time periods, again, the calculation of variance is also applied to this analysis.

The variances of the three periods are 0.0000398647, 0.00021336 and 0.0000583573 respectively and the highest one is also that of the start time as the analysis of Li Ning which means the fluctuations of the start period is the most unstable one and it is also most uncertain one for investors to gain return.

In addition, the percentage difference of before time and start time is approximately 435.21% and that between before time and middle time is approximately 46.39% that are both larger than those of Li Ning which means it is the most uncertain for the investors

to gain return in SSEC during the start time and the most possible time is in the before time that is same as the conclusion of Li Ning.

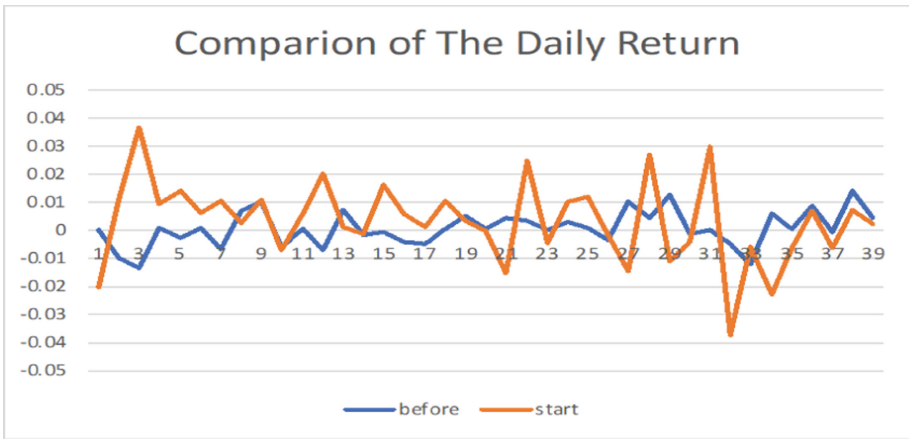


Fig. 12. Comparison of the daily return of SSEC between before and start

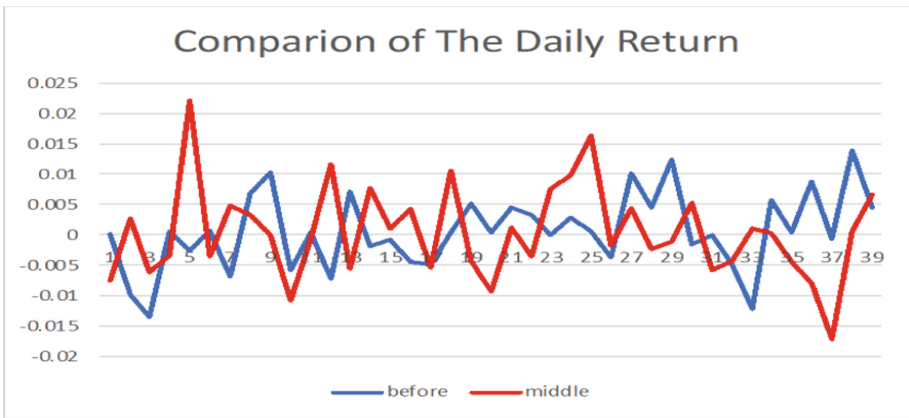


Fig. 13. Comparison of the daily return of SSEC between before and middle

The most essential distinction is that the two difference values are not as large as the ones of SSEC which leads to two completely different conclusions. In stock market of Li Ning, the COVID-19 did have some impacts but not significant generally which could be reflected from the performances of the middle time and the impacts themselves were not quite significant. However, in stock market of SSEC, there are two significant difference percentage values, especially between the before time and the start time which means the COVID-19 has impacted SSEC severely than Li Ning even if the financial performances of the middle time improved a lot according to the 40% difference of the variance, compared to that of the before time [4].

2.4 Hypothesis Test

To make the most accurate analysis, hypothesis test (T-Test is used in this study) is applied to analyzing the daily return of Li Ning and SSEC and the process software is RStudio. The test process is demonstrated below,

T-Test (Confidence Interval is 95%):

Before and Start

Formula:

$$T\text{-test: } t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \quad (3)$$

$H_0: \mu_{before} = \mu_{start}$

$H_1: \mu_{before} \neq \mu_{start}$

Do not reject,

$\therefore H_0: \mu_{before} = \mu_{start}$

\therefore There is no difference between before and start.

R-code process is uploaded to website: <https://docs.google.com/document/d/1QWYxhqghX6YOpWKxZW9J4-5Zhb1QzC03GUBvimafsHY/edit?usp=sharing>.

3 Conclusion

3.1 Conclusion

COVID-19 is a globally spread disaster and has made a lot of far-reaching negative and inevitable impacts and loss to the entire world, especially the economy aspect. Although the Chinese macroeconomy has also been impacted severely, the follow-up actions of both the Chinese government and some of the Chinese businesses were effective and admirable to minimize the loss brought by the pandemic.

On 1 February, 2020, the central bank and ministry of finance announced to decrease the interest rate for loaning; on 11 February, 2020, the executive meeting of the State Council announced to lower the interest rate and mitigate the tax burden; on 12, February, 2020, Meeting of the Standing Committee of the Political Bureau of the CPC Central Committee announced to actively use the fiscal policies and higher the government spending and keep the flexibility and feasibility of the monetary policies; on 20 February, 2020, the central bank announced to down 10 basis points from the previous value of the one-year LPR and down 5 basis points from the previous value of the five-year LPR and so on.

Through these practical policies, the impacts to the Chinese economy were mitigated quickly and the Chinese economy returned to the stable and normal development which could be reflected from the close variance values of daily return and the number of samples that have the values larger than zero of SSEC between the before time and the middle time. Besides, the hypothesis test result of do not reject the null hypothesis that is there is no difference of the daily return of SSEC between the before time and start time and between the before time and the middle time can also help prove the conclusion

that the expansionary fiscal and monetary policies made by Chinese government have effectively help the financial market.

In addition, Li Ning is also studied as a successful example for businesses that Li Ning alter its business strategies in time like making discounts and closing off-line shops to minimize loss and actively opening online shops and seeking for methods to lower production costs were useful to maintain its performances in stock market that could be reflected from the small differences of daily returns of its stock market during three periods, the little actual influences to its revenue, gross profit, profitability and current assets and the 'do no reject' result of the hypothesis test.

In conclusion, although the COVID-19 has impacted negatively to the macroeconomic performances of China at the beginning which could be reflected from the real GDP, unemployment rate, inflation rate and so on, the effective government policies have successfully avoided the impacts to expand that was reflected from the macro financial market (SSEC) of China. Also, the active actions of some businesses like Li Ning helped the business to pull through the pandemic that was reflected from its stock performances.

Reflection: <https://docs.google.com/document/d/1niQXAvt0LhtGMrAhNpxEvkU85aNQ92cysocReG3RMk/edit?usp=sharing>.

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An Empirical Analysis of the Fama-French Five-Factor Model in Partial Pharmaceutical Companies Listed on NYSE

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Abstract. The five-factor model is proposed to comprehensively price assets, adding profitability and investment based on Fama French three-factor model. This paper narrows the research in the 41 pharmaceutical companies on the NYSE, using the single-sorted technique and the five-factor model to test whether five-factor performs better and explore the relationships between companies' expected return and factors. The argument shows that the five factors do not apply to the 41 pharmaceutical companies' stocks.

Keywords: Fama French Five-Factor model · Pharmaceutical companies

1 Introduction

Fama French proposed an updated asset pricing model in 2015, adding two new factors to the three-factor model to form a five-factor model, which provides a more comprehensive study of asset pricing [1]. However, whether five-factor model outperforms three-factor model is suspicious and might be affected by the categories of industries and companies. In this paper, the objective is to test whether the new factors of five-factors in the selected 46 companies are essential to assess their expected return.

2 Data

To further explore the application of the Fama-French five factors model in the pharmaceutical industry, Companies are selected from the list of major pharmaceutical companies going public on the NYSE provided by topforeignstocks.com. From the list of major pharmaceutical stocks trading on the New York Stock Exchange. The research period is from January 2021 to October, 2021, in order to concentrate on the situation of pharmaceutical companies after the outbreak of the unprecedented pandemic.

In the original list there are a total of 46 companies in the NYSE, while five of them did not disclose the date entailed. Thus, only 41 companies will be considered as valid research objectives.

This paper uses data of market capitalisation (company size), abbreviated to MC; price-to-book ratio, which represents the ratio of share price per share to net assets per share, we abbreviate P/B; return on equity, i.e., ROE, which is a measure of the return to equity investors; investment (INV), which reflects the growth in the size of a company's assets; and the month-end stock closing adjustment price. At the same time, treasury bill is used as the risk-free rate. The average monthly return of the portfolio as rit. These data were downloaded from the Yahoo Finance, Macrotrends and WSJ.

3 Methodology

3.1 CAPM

CAPM is an asset pricing model, exploring the relation between securities' performance and their risk [2]. Formulation is shown in the following:

$$R_E = R_f + \beta(R_m - R_f) \quad (1)$$

A brief explanation of the formulation is that the expected return of a specific security or portfolio is equivalent to risk-free rate plus risk premium. It is notable that this is model is ideally envisages that all the investors are risk averse. In this article, CAPM is used to estimate the value of R_m because the research objective is the 41 companies' performance from Jan 2021 to Oct 2021, the values of R_E , R_f and β are available. Then the different values of $R_m(i = 1, 2, \dots, 41)$ will be plugged into the formulation of Fama-French Five Factors Model. The reason we use CAPM to assess the risk rate of the market is that 41 pharmaceutical is only a small part of the whole pharmaceutical industries, thus the figure provided by S&P 500 will generate bias if it used in the models. In addition, CAPM is widely agreed that it can, to some extent, accurately assess the relation between expected return and risk regardless of the specific industries. The outcome demonstrates that the rate of market risk in various months is considerably different, in other words, generally, the fluctuation of the whole market formed by these 41 companies are drastic and risk-averse investors are supposed to consider their investments in pharmaceutical companies listed on the NYSE carefully.

3.2 Single-Sorted Technique

The single-sorted technique is used to observe the mean value, standard deviation and to analyse if the value of one factor is related to the remaining factors [3]. Firstly, the 41 companies are arranged in descending order, from the company with the highest market capitalisation to the company with the lowest market capitalisation. Then we classified these data into two averagely weighted portfolios, P_1 and P_2 . P_1 is marked as size 0, meaning pharmaceutical corporations with relatively high market capitalisation. P_2 is marked as size 1, representing the set of low market capitalisation companies. It is notable that, due to the number of companies used as samples are odd, after comparing the value

of 21st companies' market capitalisation, we determine to put the 21st company into P_1 . In line with such an approach, these data are also sorted with respect to P/B ratio, rate on equity and growth of asset. P/B ratio is used to reflect stock value of companies, rate on equity is employed to measure profitability, calculated by net income over common equity, and growth of asset is the table for observing investment of companies, to define if a company is congressive or aggressive. After the data being sorted in the way mentioned above, six portfolios are generated, marked from three to eight. After determining the portfolios, descriptive analysis is employed to show the tables of standard deviation and means and test of normality. Test of normality is a crucial element to decide the following analytic approach we use. In the form of normality, there are two methods, Kolmogorov-Smirnov Method and Shapiro-Wilk Method. Both of these two methods are used to observe if there is a specific distribution. Due to the amount of our sample, which is less than 50, it is preferential to select Shapiro-Wilk test to determine if the data from certain month is rejected or accepted normality. The significance is used to test if the set of data is in line with normal distribution. When the value of significance is less than 0.05, it represents that the distribution of the data rejects the normality. Whether data refuse normality decides the next analytic approach to be used. If the significance is larger than 0.05, t-test will be used, while if the significance is less than 0.05, nonparametric independent test will be employed. Nonparametric analysis will show the distribution of two different categories of two portfolio, to observe if the selected independent factor will apparently influence other factors.

Table 1. Mean of the MC,P/B ratio, ROE and growth of asset in 2021(Jan–Oct)

	MC (billion USD)	P/B ratio	ROE	Growth of asset
Jan	52.910244	4.16629	7.14%	31.10%
February	46.017073	4.7037	6.49%	17.31%
March	44.4283	2.71487	−221.70%	6.74%
April	48.469024	5.98829	33.56%	49.64%
May	55.094478	5.17471	−5.05%	28.56%
June	55.094478	5.17471	−5.05%	28.56%
July	58.46741	6.1141	−27.61%	28.56%
August	67.7112	6.0576	−27.61%	19.28%
September	56.8311	6.0134	−27.61%	19.28%
October	61.1541	5.09741	−19.80%	94.46%

Source: Calculated and formed by authors.

Table 1 shows the mean value of 4 factors from January to October. The average value of capitalisation of major pharmaceutical companies listed on NYSE is around 52.857 billion. According to the pharmaceutical manufacturing market size report, 2021–2028, in 2020, the market size of pharmaceutical manufacturing industry was valued at USD 405.52 billion. The major 41 companies chosen as sample account for approximately

first eight of the total market values, which means it is reasonable to regard the 46 market as the miniature of the whole pharmaceutical industry.

Then, we test the significance of normality. Outcome is observed having a seasonal characteristic. In the first step to test the normality, it expects that majority of data (exempt to data in October) reject the normal distribution. Then, we use nonparametric test and set the null hypothesis is set as “the distribution of factor A is the same across categories of factor B”. Out of May, June and July, all the null hypotheses between ROE and MC are rejected, which means ROE and MC have a strong relation, in other words, higher MC in general has higher ROE, and vice versa. In addition, it is worthwhile discussing the situation in May and June, which the outcome of analyses has the apparent difference from the other months. As testing the relation between MC and other factors, most null hypotheses are rejected. The strong seasonality can be explained by the characteristics of biotech or pharma company, in the specific time, demands of certain medication will be extremely higher. For example, during certain season, there is an outbreak of flu and then, the demand of flu will be increased. Big companies in which product a widely categories will increase the investment and have higher revenue. From the perspective of data, it might show a strong relation between certain factors among the factors mentioned above.

3.3 Fama French Five-Factor Model

To comprehensively evaluate the excess return of a portfolio, Eugene F. Fama, Kenneth R. French proposed Fama French five-factor model which is based on the FF three-factor model in 2015 [4]. The five-factor model adds two new factors, the profitability factor RMW and the investment factor CMA [5], which further analyses the relationship between the average portfolio return and its size, book-to-market ratio, profit and investment and the market. The Fama French five-factor model as follows:

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + S_iSMB_t + h_iHML_t + r_iRMW_t + c_iCMA_t + e_{it} \quad (2)$$

In this model, R_{it} represents the return of portfolio i at time t ; R_{Ft} represents the risk-free rate of return; R_{Mt} represents the return of the market portfolio weighted by market capitalization, and $R_{Mt} - R_{Ft}$ represents the market risk premium; SMB_t is the size factor, which represents the difference between the return of the small cap portfolio and the large cap portfolio at time t ; HML_t is the book-to-market ratio factor, which represents the difference between the return of a high book-to-market ratio equity portfolio and a low book-to-market ratio equity portfolio at time t ; RMW_t is the profitability factor, which represents the difference between the return of a portfolio with a high level of profitability and a portfolio with a low level of profitability at time t . CMA_t is the investment factor, representing the difference between the return on the more conservative portfolio and the more aggressive portfolio at time t . e_{it} is the residual with a mean of zero.

4 Data Processing

Before calculating the size factor, the portfolios of 41 pharmaceutical corporations are classified by size, value, profitability, and investment style. This paper adopted the 2×3

sort method in the factor model [4]. Firstly, companies sorted by market capitalisation. They averagely fall into to two groups, small group, labelled as “S” and big group, “B”. Then, the same 41 companies were ranked again by their price-to-book ratios and divided into *L*(lowP/Bratio), *M* (mediumP/Bratio), and *H*(highP/Bratio), each accounting for 33% [3]. The stocks in the above two sorts were cross-grouped to obtain the six sorts of portfolio *SL*, *SM*, *SH*, *BL*, *BM*, *BH*, marked as “MC-PB”. Next, the profitability factor and investment factor are sorted into *W* (weak stocks), *N* (neutral stocks), *R* (robust stocks), *C* (conservative investment style), *N* (neutral investment style), *A* (aggressive investment style), where each sort accounts for 33% [3]. After the independent sorting, crossed with 50% of the stocks in the market capitalization sort to obtain *SW*, *SN*, *SR*, *BW*, *BN*, *BR*, *SC*, *SN*(*ROE*), *SA*, *BC*, *BN*, (*INV*(*BA*), the first six groups marked as “MC-ROE” and the last six groups marked as “MC – INV” for a total of 18 groups. Finally, the weighted average monthly returns of the 18 portfolios mentioned above are then calculated on a month-by-month basis.

Eventually, the value of SMB_{PB} is calculated by the difference between the sum of three portfolio, *SL*, *SM* and *SH* and the sum of the other three portfolios, *BL*, *BM* and *BH* divided by three. In line with the same method, SMB_{ROE} and SMB_{INV} are calculated [6]. They are already obtained by the following formula:

$$SMB_{PB} = \frac{(SL + SM + SH) - (BL + BM + BH)}{3} \quad (3)$$

$$SMB_{ROE} = \frac{(SW + SN + SR) - (BW + BN + BR)}{3} \quad (4)$$

$$SMB_{INV} = \frac{(SC + SN + SA) - (BC + BN + BA)}{3} \quad (5)$$

$$SMB = \frac{SMB_{PB} + SMB_{ROE} + SMB_{INV}}{3} \quad (6)$$

For the calculation of *HML*, based on the average monthly return of the 18 portfolios obtained above, *SL* and *BL*, *SH* and *BH* are selected, and calculating the difference between this average monthly return mean [6]. *RMW* and *CMA* are calculated in the same way as the *HML*, using the following formula:

$$HML = \frac{(SL + BL) - (SH + BH)}{2} \quad (7)$$

$$RMW = \frac{(SR + BR) - (SW + BW)}{2} \quad (8)$$

$$CMA = \frac{(SC + BC) - (SA + BA)}{2} \quad (9)$$

5 Data Analysis

Table 2 shows the analysis of descriptive analysis of three different portfolios sorted in the approach of cross-group. From the descriptive analysis of the cross-grouped, the changes

of the mean return lack order. For instance, concentrating on the group “ $MC - P/B$ ”, it shows that big companies with smallest P/B ratio have the highest rate of return, while in the scope of small companies, P/B ratio is not similarly inversely proportional to the company return. The small companies with middle P/B ratio have the highest return. In the groups, $MC - ROE$ and $MC - INV$, it seems that the influence of ROE and INV are contrast regarding company size. In the small companies, ROE and INV positively impact the expected return of the companies while in the large companies, the result is totally opposite. Thus, it proves it is not able to solely analyses the certain factors and portfolios and a regression by using Fama French five-factor model are entailed. While in the range of big company, all the factors are inversely proportional to the return of company. On the other hand, we can see that there is a large difference between the maximum and minimum monthly returns for each portfolio, indicating that there is instability in the returns of individual months for each company over the ten months. In the $MC - PB$ portfolio, big companies show higher returns, averagely weighted returns on the B/L portfolio are 4.79%, but averagely weighted returns on the S/L portfolio are negative. For the $MC - ROE$ portfolio, the overall profitability is better except for neutral stocks, where small companies have less variation in profitability and large companies have more variation. The $MC - INV$ portfolio reveals that large companies have overall higher investment capacity than small companies and the change in investment is more stable.

Table 2. Five-Factor model descriptive analysis results for the portfolio

MC-P/B	S/L	S/M	S/H	B/L	B/M	B/H
Mean Return	-0.0034	0.0260	-0.0007	0.0479	-0.0156	0.0237
Std. Dev	0.1229	0.1352	0.1785	0.1330	0.0445	0.0447
Max	0.2496	0.4030	0.3300	0.4346	0.0249	0.0896
Min	-0.1542	-0.0893	-0.3569	-0.0596	-0.1351	-0.0521
MC-ROE	S/W	S/N	S/R	B/W	B/N	B/R
Mean	0.0037	-0.0218	0.0231	0.1436	0.0010	0.0039
Std. Dev	0.1440	0.0903	0.1415	0.1728	0.0323	0.0343
Max	0.3626	0.0852	0.3119	0.5135	0.0700	0.0405
Min	-0.1384	-0.2229	-0.1618	-0.0220	-0.0509	-0.0583
MC-INV	S/C	S/N	S/A	B/C	B/N	B/A
Mean	-0.0030	-0.0141	0.0317	0.0445	0.0047	0.0145
Std. Dev	0.0971	0.1508	0.1814	0.1508	0.0453	0.0285
Max	0.2049	0.3216	0.2335	0.4678	0.0673	0.0568
Min	-0.1330	-0.1627	-0.3706	-0.1103	-0.0783	-0.0380

Test the significance of independent variables of FF Five-Factor Model.

Table 3 describes the regression analysis of the Fama French five-factor model. The coefficient “a” in the chart is the value of the intercept term of the five-factor model for the stocks of the 41 pharmaceutical companies, which shows a significant zero, indicating that the five factors can explain well the variation in the returns of the 41 companies. The independent variable, $R_m - R_f$, is statistically significant due to the 5% level of significance, indicating that $R_m - R_f$ is an essential influencing factor of the expected return of 41 pharmaceutical companies. The coefficients of risk premium, b, are almost positive and greater than 0.5, indicating that risk premium is a crucial measure determine the expected rate of return of all the portfolios. The tendency of the fluctuated coefficient s indicates company size is an essential factor. In the group “ $MC - P/B$ ratio”, it can be observed that the coefficient of *SMB* in the portfolios with the label of “small company” are all positive, while in the portfolios consisting of big companies, the coefficient s is all negative. It means that investors prefer investing the small-cap stocks among companies while they are interested in big-cap stocks regarding the investment in big companies. Meanwhile, through comparing the absolute values of “s”, middle value mitigates investors investment preference. No matter in the scope of the small companies or the big companies, the absolute value of “s” of portfolio composed by the companies with middle value are the least in comparing with the other two portfolios. In the other two group, the situations are similar, though in the portfolio $MC - ROE$ there are two exceptions. However, the relatively smaller absolute values mean they cannot disturb the pattern.

The variable for the *P/B* factor is *HML*, whose coefficient is denoted as *L*. Among the $MC - PB$ and $MC - INV$ classifications, only the *SM*, *BH*, *SC*, *BA* combinations have a negative *P/B* factor, which are -0.370 , -0.542 , -0.305 and -0.207 respectively, and these four combinations have a negative effect on the *P/B* factor. On the other hand, in $MC - ROE$, the negative effect occurs mostly in big companies, e.g. *BW*, *BR*. The rest of the coefficients are positive, so the positive effect of *HML* is more pronounced in $MC - PB$ and $MC - INV$, which indicates that the higher the value of the *P/B* factor *HML*, the higher the risk-reward of the stock or portfolio. These are the high-quality stocks among these 41 stocks with high development potential and high expected investment returns.

R is the regression coefficient of the profitability factor. In the size and *PB* portfolio, *SL*, *BM* has the strongest profitability, while *SM*, *BL* has a negative effect on profitability, indicating the existence of losses and unsuitability for investment. For the $MC - ROE$ portfolio, with increasing *ROE*, profitability also increases, but except for the *SN* portfolio. In contrast, neutral stocks are more profitable in $MC - INV$ portfolio. Therefore, the rule that the more profitable companies have higher returns and higher stock returns does not apply to these 41 companies.

The coefficients of the investment factors are mostly negative, indicating a greater chance of a negative effect of the investment factors. Smaller investments in the $MC - PB$ portfolio and the $MC - INV$ portfolio are more likely to show a positive effect, indicating that the investment factor has a significant contribution to the return of this type of equity portfolio, while it has only a negative effect on the return of the other equity portfolios.

In this regression test, rate of return is the exact data calculated according to companies’ financial reports. The core of the observation is the change of coefficients of

$R_m - R_f$, *SMB*, *HML*, *RMW* and *CMA* in the different portfolios sorted by market capitalisation and P/B ratio. It is notable that R-squared of all the portfolios, *SL*, *SM*, *SH*, *BL*, and *BH* is over 50%, among which most values of R-square are between 0.95 to 0.985. R-square is a statistical measurement to test to what extent the observed variants can be explained by model applied for analysis. Fernando states that in investment a R-square between 85% to 100% can be regarded creditable, indicating the highly correlation between stock or fund’s performance and index. In the regression for observing the relation between return of selected companies and indexes proposed in the model of Fama-French Five Factors, R-square can be considered high enough to prove that performances of companies are related to the five factors. Only one portfolio, *BM*, represented big size companies with middle value should be excluded, because its R-square is considerably low. Longitudinally comparing coefficients of the rest of five portfolios, it can be observed that coefficients *b* in five groups are, under most circumstances, higher than the other coefficients. Coefficient *b* is used to describe that the return spread between the capitalisation-weighted stock market and cash. The significance of $R_m - R_f$ is prominent in evaluation of 41 pharmaceutical companies listed on the NYSE.

After that, the comparison between original three factors model and two new factors proposed by Fama-French. It is found that, except the portfolio “*SM*”, the absolute values of *L*, *r*, *c* are lower than the absolute values of *b* is in other four portfolios. It violates the conclusion stated by Fama and French in 2014 which points out the redundancy of *HML* for describing average return when factors *RMW* and *CMA* are added into the formulation.

Table 3. Five-Factor model regression results for the portfolio

MC_PB							
Portfolio	a	b	s	L	r	c	R-squared
SL	0.01160	0.699*	0.749*	1.066*	0.496	-0.293	0.969
SM	-0.00573	0.895	0.130	-0.370	-0.583	0.564	0.952
SH	-0.01720	1.538*	0.399	0.202	0.135	-1.263	0.955
BL	-0.00779	1.718*	-0.770*	0.358	-0.206	-0.290	0.984
BM	-0.01950	0.705	-0.475	0.739	0.604	-0.600	0.257
BH	0.00605	0.880*	-0.568	-0.542	0.092	0.385	0.724
MC_ROE							
Portfolio	a	b	s	L	r	c	R-squared
SW	-0.03400*	1.957*	-0.25	0.289	0.071	-0.313	0.981
SN	0.02040	-1.811*	1.956*	-0.452	-0.800*	0.563	0.934
SR	0.04210	1.888	0.211	0.599	1.261	-0.009	0.841
BW	0.11200	0.352	0.283	-1.239	-1.095	1.352	0.550
BN	-0.01510	0.482	-0.377	0.448	0.095	-0.452	0.673
BR	-0.00920	0.915*	-0.609*	-0.086	0.344	0.006	0.787

(continued)

Table 3. (continued)

MC_INV							
Portfolio	a	b	s	L	r	c	R-squared
SC	0.00685	0.436	0.636*	-0.305	0.006	0.790*	0.975
SN	-0.01780	1.990*	0.009	0.486	0.807*	0.196	0.966
SA	0.00453	0.926*	0.789	0.309	-0.558	-1.317	0.956
BC	0.00345	1.172	-0.268	0.407	-0.328	-0.002	0.900
BN	-0.00983	1.147*	-0.675	0.368	0.542	-0.377	0.589
BA	0.00576	0.682*	-0.421*	-0.207	0.236	0.105	0.730

Note: *indicates statistically significant at the 5% level of significance.

6 Conclusion

Focusing on FF Five-Factors Model, this paper has analysed whether the expected returns of 46 pharmaceutical company stocks are related to five factors. We demonstrate the validity of the five-factor model by constructing a portfolio and applying regression analysis. A limitation of this study is that the sample is not broad enough to represent the entire pharmaceutical industry with the results of the study. In addition, as the stock of pharmaceutical company fluctuates greatly, the investment risk is high, and the five factors cannot predict the expected return well, so we suggest that the investors of this kind of stock should choose carefully when investing.

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Research on the Effects of Privatizing the Education Sector in Less Economically Developed Countries Without Government Intervention

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Abstract. Against the backdrop of an era characterized by rapid economic growth, policymakers across the globe, with the aim of improving human capital, have placed more attention to refining their countries' educational systems than ever before. As one approach to improving an economy's educational system is through privatizing the education sector, the debate about public versus private education arises under spotlight. To examine the consequences of privatization and, on the contrary, the government's monitoring of the education sector, this paper, relying upon inductive reasoning as well as economic theories and models, conducts a thought experiment on the effects of establishing a totally private education sector in a Less Economically Developed Country (LEDC) without government intervention. Ultimately, this paper argues that privatization could result in two seemingly contradictory outcomes in a LEDC, either leading elitism to prevail or providing all households with a diverse range of educational opportunities.

Keywords: Education · Government intervention · Elite approach · Monopolistic competition

1 Introduction

Education imparts students academic skills, prepares them for independent life, and is now widely accepted as a fundamental resource for both individuals and societies. On a macroeconomic dimension, education positively correlates with increases in human capital and economic growth, as it helps societies establish a more skilled, disciplined, and productive labor force.

According to classical economic theory, the public sector's main objective is to cater to the demands of individuals, thereby maximizing social welfare. This assumption, interestingly, has been mirrored by the global expectation that governments should provide basic education for, at least a proportion of, their citizens.

It should be noted, however, that public schools are struggling to meet the rising demand for high-quality education in such Less Economically Developed Countries (LEDCs) as India and Vietnam, which are manufacturing powerhouses that should not be neglected by scholars, as stated by researcher David N. Plank.

In the context of LEDCs, while privatizing the education sector seems to be a solution to the quandary, the fact that the masses tend to believe that private educational institutions are less willing to accommodate poorer or academically less competent students and therefore contribute to promoting “unfairness” in society implies that many are reluctant to support private schools. This makes private schools unpopular on a micro and, possibly, national scale in LEDCs, the implication of which is that governments are less inclined to fund and foster the growth of private educational institutions as they do not want to risk their popularity.

According to basic microeconomics, a high demand for education in LEDCs means that an equally high level of supply is needed to prevent a shortage in the market, regardless of its public or private nature. Nonetheless, recent studies by such researchers as James Tooley show that public and private forces of education often cannot sufficiently cater to the demands of contemporary LEDC societies. This result, which generates negative externalities, correlates with higher unemployment and crime rates and even signals a gloomy future with an undisciplined and unproductive labor force, as stated by a number of economists.

To help policymakers resolve the contemporary dilemma about the provision of education, this paper aims to conduct a thought experiment, the name of which indicates its unconventional nature, on the establishment of a totally private education sector in LEDCs. By doing so, this paper theoretically explores the effects of privatization and the undoing of public schools.

2 Literature Review

It is now a consensus that education is a merit good that generates positive externalities for both individuals and societies. Nevertheless, public versus private provision of education has long been a topic of debate. In addition to disagreeing over the nature of the two education sectors, researchers cannot agree on the extent to which education should be respectively provided by the two sectors, given that contemporary scholars have recognized the impracticability of nationalizing or privatizing the entire education industry in real-world context.

Due to its controversial nature, the topic of public vs. private education has received much attention from researchers, many of whom express their concerns over an education market dominated by private institutions, arguing that private education undermines social equality and cohesion. Harry Brighouse [1] of the University of Wisconsin–Madison argues that equality of opportunity is one of the most significant values in a free society, and as the privatization of education, in the best-case scenario, could only improve the overall quality of education at the cost of leading to increased discrimination against less academically competent students, its negative externalities outweigh its merits. Sociologist Stephen Ball and Alex Molnar [2], an expert on the commercialization of public education, elaborate on Brighouse’s claim and explain that the profit-motive of private individuals, which disincentivizes them from taking every person’s welfare into account, is what renders the privatization of education a catalyst for social inequity.

At the other end of the spectrum, however, researchers argue that a private education sector generates greater positive externalities for society. Researchers maintain that it

is false to assume that every private individual is solely motivated by profit, and that private institutions can accommodate more students while providing them with better educational opportunities. Citing examples of yore, Edwin G. West [3] contends in his seminal work “Education and the State” that before governments got involved in education in England, Wales, and the United States hundreds of years ago, private provision of education was prevalent in those countries, which helped them improve their human capital. Researcher Andrew Coulson [4] takes a similar approach and argues that there had been cases of commercialized education markets as early as 400 BC in Ancient Greece, and the prosperity of Greek culture and society at the time challenges the idea that private education is incapable of nurturing intellectuals and artists and promoting social cohesion.

In addition to citing examples from the past, researchers also explore the merits of private education in contemporary case-specific examples. James Tooley [5] of the University of Buckingham puts forward that while demand for education is expected to grow annually in Pakistan and India, public schools are unable to accommodate all students due to their limited capacity, and it is private educational institutions that accommodate the “average” students. Investigating Chile’s private market of education, researchers Martin Carnoy and Patrick J. McEwan [6] conclude that public educational institutions are in fact more selective than their private counterparts, as they are obliged to nurture future elites for their home countries. Furthermore, researchers Jana Švecová [7], Prachi Srivastava, Sonia Exley, and others have respectively examined the education markets of countries including the Czech Republic, Vietnam, and South Korea, arriving at similar conclusions.

Overall, one, perhaps far-fetched, implication of the review of previous studies is that a socially optimal education market, regardless of its public or private nature, should be able to strike a perfect balance between generating excellent learning outcomes and promoting equality of opportunity. The review of literature also clearly demonstrates the fact that policymakers have not yet reached an agreement as to how a socially optimal education sector could be established in reality. The lack of consensus amongst previous researchers, along with the fact that previous studies are largely dependent upon case-specific examples, leads this essay, by conducting a thought experiment, to explore the two most likely outcomes of the full-scale privatization of the education sector of an imaginary country that exhibits the attributes of a LEDC.

By taking such an approach, this paper will at last arrive at two outcomes seem contradictory on an intuitive level. Nonetheless, it should be noted that the paper’s paradoxical quality mirrors the unpredictability of events that take place in the real world, in which not all variables can be controlled, and thus provides policymakers with insight into the effects of privatization under varying circumstances, as this paper acknowledges that one cannot generalize about education and does not aim to reach a single, absolute conclusion, which would be a product of confirmation bias. It is also worth noting that the focused scope of this essay, which is concentrated on the education sector of LEDCs, allows some general conclusions to be drawn and adds an element of creditability to the thought experiment.

3 Examining the Effects of Privatizing the Education Sector

3.1 Appraisal of Education Sector

To examine the effects of privatizing the entire education sector of a country that can be reasonably classified as a LEDC, the definition of an education sector and the attributes of a LEDC must be made clear. Over the course of this paper, an education sector is defined as a market in which all economic activities relating to institutions' and individuals' provision of learning services to children and young adults take place, and a LEDC, which stands in antithesis to a More Economically Developed country (MEDC), refers to a country with a lower level of economic development and value of annual real Gross Domestic Product (GDP) per capita, typically a value below \$9,500 (PPP), than does its more economically developed counterparts [8]. In addition, without overcomplicating the content, the public sector refers to the market run by the government, and the private sector refers to the industry run by private institutions with no or minimal government intervention.

Since the thought experiment is the bedrock of this essay, the theoretical process by which a total privatization of a LEDC education sector is established must also be explained. Hypothetically, the transformation of the education sector into a privatized market would take place as the government of the imaginary LEDC totally withdrew from the education sector, no longer directly providing education, subsidizing private institutions, or interfering in educational affairs. Consequently, established private institutions would prevail and new private schools emerge, but the absence of public institutions would lead to a decrease in the supply of education, at least in the short-term, resulting in potential issues regarding the allocation of education resources.

To understand how the withdrawal of governments would really impact the education sector, it should be noted that efficacy and equity play important roles in determining the quality of education [9]. While efficacy refers to how well an institution helps students maximize their academic performance, equity refers to equality of opportunities, the notion that all individuals should have a chance to receive education under similar circumstances, which helps promote distributive justice. As a commendable education market is typically one that strikes a good balance between efficacy and equity, the extent to which the privatized education market in the LEDC is efficacious in generating learning outcomes while catering to the needs of all students regardless of their background and ability will be the criteria against which the market is assessed.

As stated in the previous section, it is the positive externalities of education that lead governments to monitor and even control it, and that it is now a consensus that education has the potential to benefit not only the individuals that receive it, but society at large, in terms of social cohesion, law and order, and economic prosperity. From there, the inference that education is capable of benefitting society when being supplied at an optimal level, or, in other words, rendered available to all who wants to receive it, brings higher marginal social benefit (MSB) than marginal private benefit (MPB) can be made.

At last, it is argued that a totally private education sector could either exacerbate inequality or lead to imperfect competition, but the outcome would be unpredictable if it was to take place in real-life due to the multitude of uncontrollable and even imperceptible variables that have the potential to influence economic agents' decisions and actions. The

result that the education sector would change if governments were no longer involved, however, is worthy of exploring and will be demonstrated in the next few sections of this paper.

3.2 Theoretical Framework

The theoretical foundation of this thought experiment can be explained in a nutshell. To form an education market, it is argued that the two forces of demand and supply are indispensable, as the former and latter respectively refer to the level of households' and education provisioners' willingness and ability to afford education and to provide the public with educational opportunities. Therefore, in a socially optimal education market, the level of quantity demanded should equate to that of quantity supplied, so that excess demand or supply does not exist in the education sector, which indicates that the needs and wants of all economic agents can be fulfilled.

In addition to microeconomic equilibrium, this paper incorporates the concept of market failure. This is primarily because, from an economic perspective, education is a commodity that generates externalities for society, which includes third-party members who are not directly involved in the provision or reception of education. Therefore, the ideas of marginal private benefit (MPB), marginal private cost (MPC), marginal social benefit (MSB), and marginal social cost (MSC) come into play, and it is argued that only when $MSB = MSC$ that the positive externalities of education are maximized for society, not only for a limited number of private individuals. To achieve this, this paper contends that it is essential to ensure that educational institutions strike a balance between efficacy and equity, nurturing competent students while catering to the demands of the poor.

Ultimately, this thought experiment explores the potential market structure, or the ways in which firms, or in this case provisioners of education, are differentiated and categorized, of a totally private education sector of a LEDC. This allows for the exploration of a purely economic education market and bases the thought experiment upon deductive reasoning, which permits more arguments to be effectively substantiated.

3.3 Private Education and Efficiency

Conventional wisdom suggests that private educational institutions are often good at nurturing academically competent students but are less willing to promote equity in education [10]. Hence, one possible outcome of a totally private education market is the exacerbation of social inequality and inequity, as private institutions would take an elite approach that helps them maximize profit and prestige.

Figure 1 demonstrates the education sector in the context of a free and private market. In the figure, demand (D) for education equates to the marginal private benefit of education (MPB), as consumers only take private benefits into account, and the supply of education is at S, where $MPC = MPB$, which is not at the socially optimum level because it takes time for private institutions to fully replace the public sector after the government's withdrawal, and that suppliers are reluctant to raise output beyond the private equilibrium ($MPB = MPC$) due to uncertainty and fear of losing out to their competitors. This implies that the private education sector only benefits a number of

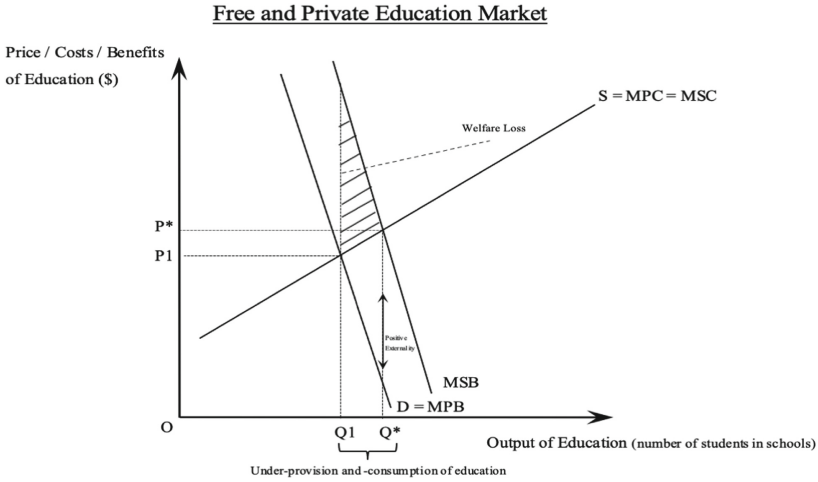


Fig. 1. Market failure diagram showing the underprovision of education

private individuals, and as the socially optimum level of output ($MSC = MSB$) is not achieved, the positive externalities of education are not maximized for society.

Due to the fact the allocation of educational resources does not achieve Pareto efficiency, the situation in which all economic agents are being satisfied with the limited resources and that no individual or group of people can be made better-off without making others worse-off, market failure occurs in the totally private education sector [11]. The under-provision of education also means that distributive justice is not achieved, which results in collateral issues around equity, as not every individual has a chance to receive education [12].

It certainly is a misconception that demand for education is not high in LEDCs, as households regard education, which is capable of helping its recipients earn higher incomes in the future, as the most valuable investment in their children [13]. This leads to a high demand for education in the imaginary LEDC, indicating that an equally high level of supply is needed to clear the shortage in the education sector and, more importantly, that private educational institutions are granted a relatively high degree of market power.

A high demand allows private schools to be selective when it comes to recruiting students. Because they are not funded by the government, private institutions need to charge higher tuition fees (compared to public schools) to cover up the costs of operation, so would target students of well-off background to make sure that the school collects sufficient funds and donations [14]. Given that there is excess demand in the private education sector, private schools also tend to target students of high academic competence to improve their overall competitiveness [3]. Overall, assuming that the classical, commonsensical assumption that the primary objective of the private sector is profit-maximization holds true, only wealthy and competent students would be favored by educational institutions in a totally private market, which means that elitism would prevail at the cost of undermining the welfare of poorer students and those who are not being regarded as “book-smart”.

There is no doubt that selecting students based on their ability and background would exacerbate social inequality. In many Sub-Saharan African countries, for example, approximately 40% of the population live below the US\$1.90-a-day poverty line, and the annual GDP per capita is only around \$1596 [15]. Given that prestigious international schools charge more than \$3000 per year in average, a large number of households that are willing to send their children to schools are unable to afford the tuitions fees charged by private institutions [16]. Researchers have also discovered that socioeconomic background positively correlates with academic ability, especially at an early stage, so that poorer students are also less likely to maximize their academic potential at a young age and be competitive candidates for private schools [17]. The fact that their households are less willing and able to hire private tutors and expose their children to a large variety of other forms of quality educational resources, like textbooks and other EdTech products that foster learning, certainly makes matters worse.

It should be noted that, unlike a monopolistic or collusively oligopolistic market, private institutions within the education sector are unlikely to be incentivized to form cartels [18]. Instead, they would compete against each other for market share, as households' excessive demand gives every educational institution a degree of market power, the magnitude of which depends on the institution's reputation and educational outcomes. Private institutions are also likely to become more selective over time, and schools that are unable to recruit sufficient numbers of academically competent and financially well-off students could face elimination from the market.

It is probable that only schools that are able to recruit favorable students and constantly improve their admission management systems and teaching quality could prosper. Elite schools, which provide high-quality education for only a limited number of students, would therefore prevail in the long-term. Though they might help improve LEDCs' reputation by being competitive on an international level, elite schools exacerbate domestic social inequality by systematically discriminating against students that are less academically competent or well-off. Overall, the under-provision of education as a result of private institution's elite approach would lead to a multitude of societal issues, from a shortage of skilled laborers to social instability [19].

3.4 Private Education and Equity

Nonetheless, it might be imprecise to arrive at the conclusion that the private education sector only exacerbates social inequity, as the identification of the market structure to which the totally private LEDC education market is most similar leads a different conclusion to be established. Given the vicissitudinous nature of the real-world, in which not all variables influencing education markets can controlled, the arrival at a seemingly paradoxical conclusion actually has the potential to give policymakers more insight into the nature of private education, showing its multifaceted nature.

To understand the possible market structure of the hypothetically private education sector, the the four most prominent features of the private education market should be introduced in a nutshell: first of all, the exit of governments renders education a commodity, which means that the education sector would be transformed into a market in which there are many buyers and sellers; second, private schools offer products (education) that are similar but differ in location, quality of service, extent of service, target

audience, and brand image, which leads to product differentiation; third, the withdrawal of governments allows private institutions to enter and leave the education market freely with limited legal barriers; fourth, due to the inelastic demand for education in LEDCs as a result of millions of households' belief that education is a necessary and profitable investment in their children, private schools has a degree of market power [20].

Overall, these characteristics indicate that the private education sector of LEDCs is most similar to a monopolistically competitive market, which can be exemplified by Vietnam's private education sector. Studies show that Vietnamese private schools offer differentiated products for their customers, in that high schools and universities respectively specialize in the fields of humanities, mathematics, science, law, and business, allowing students to specialize in a particular field of academics at a young age [21]. The market share of private education is also equally distributed, and a monopoly never emerged, which adds to the competitive nature of the education market. Moreover, despite the fact that the Vietnamese government is not totally absent from the country's education sector, its involvement in private education is minimal, which makes it possible for this example to demonstrate the market structure of a totally private education sector.

Given that the hypothetically totally private education market is most like a monopolistically competitive market, the education sector is, at least in theory, less likely to systematically discriminate against particular groups of students. This is because monopolistic competition involves different institutions that have varying purposes, from maximizing private financial gains to accommodating students of a particular religion. Hence, unlike a monopolistic or collusively oligopolistic market, monopolistically competitive institutions are likely to target different consumers, the implication of which is that, given the multitude of private institutions present in the education sector, private schools are able to cater to the demands of a diverse range of customers. More importantly, as there are a number of private institutions that aim at upholding corporate social responsibility (CSR), private schools may sometimes be willing and able to promote equity [22].

A variety of examples can be used to validate and demonstrate private institutions' potential to generate positive externalities for society. In real-life context, private schools in Pakistan generate better learning outcomes and are more cost-efficient, and over 67% of poorer households enroll their children in those private schools [23]. In Vietnam, only 1 in 10 students can be accepted into prestigious public institutions, and it is the private schools that accommodate ordinary students [24]. Low-cost private schools have also emerged in India, which are often supported by philanthropic organizations that aim at providing poorer students with quality education [25]. Researchers also indicate that grassroots private schools are "mushrooming" in poor areas of sub-Saharan Africa, South Asia, and other parts of the world, catering to the demands of poorer households [5]. In spite of the fact that the examples listed are not in the context of an entirely privatized education sector, as the aforementioned countries all have a relatively free education sector, they are able to give the reader a sense of how private institutions could contribute to promoting equality of opportunities, rendering the assumption that all private institutions are profit-maximizers contributing to inequality untenable.

From a theoretical perspective, a monopolistically competitive education market has the potential to bring more benefits to its customers [26]. As there are different types

of institutions that offer heterogeneous products (different types of schools), parents and student have a higher degree of consumer choice. Non-price competition takes place in a monopolistically competitive market, which incentivizes private schools to constantly refine their systems, pursue higher efficiency, and lower the costs of operation. This would not only lead to improvements in the quality of education, but also lower tuition fees for consumers and eliminate education failure. The privatization of education also establishes a buyer-seller relationship between parents and schools, despite the fact that some private institutions might have a relatively high degree of market power, as competition means that private schools need to constantly implement parents' and students' feedback in order to stay in business, and this chain of accountability helps schools operate and grow according to societal demands. Furthermore, educational entrepreneurs would prosper in a totally privatized education sector, which gives them a high degree of freedom, and their innovations could lead to advancements in education. The withdrawal of the private sector would also enable governments to spend more on other aspects of society, such as healthcare or national defense, generating positive externalities. Hence, with the establishment of a monopolistically competitive market, the privatization of education in fact benefits consumers and contributes to promoting equity.

4 Conclusion

How the education sector would change if governments were no longer involved is unpredictable. Nevertheless, this thought experiment demonstrates that a totally private education sector would lead to imperfect competition, which might play a role in exacerbating social inequity or benefiting a variety of economic agents.

Due to the existence of many sellers, the supply of education tends to be higher than expected, maybe even capable of meeting households' rising demand. The emergence of low-cost schools in LEDCs also demonstrates that private agents could aim at promoting equality of opportunities. Fundamentally, a totally private education sector enables parents and students to achieve *laissez-faire* in education, as they now have the freedom to choose what schools to attend, despite that some private schools might be selective. However, in spite of the fact that the private education sector is likely to share common characteristics with a monopolistic competitive market, monopolies could be formed, and elite schools might prevail. This would lead some individuals to face systematic discrimination from schooling, thus resulting in inequality of opportunities. In this type of scenario, elite schools in LEDCs could become prestigious on a global level but education would be unable to maximize its potential in raising human capital and leading to economic growth.

Due to the hypothetical nature of this investigation, two seemingly paradoxical conclusions have been reached, which in turn mirrors the vicissitudinous nature of the real-world. Nonetheless, with the help of real-world examples and inductive reasoning, it can be shown that a private education sector without government involvement could impact society chiefly in two ways: promoting elitism and exacerbating inequality or establishing monopolistic competition. From there, policymakers can see that private education has the potential to benefit society as a whole and educational policies should be directed towards fostering the formation of a dynamic yet equitable monopolistically

competitive educational market, in which there are a multitude of buyers and sellers. Policymakers need to ponder over the extent to which privatization should take place in a LEDC and how to incentivize private institutions to be efficient and equitable, while having faith in a free market in which government intervention is minimal. Ultimately, policymakers ought to strive to maximize education's potential in raising human capital and generative positive externalities for society for the benefit of their countries.

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Does the Serious Illness Insurance in the New Rural Cooperative Medical System Reduce Poverty?

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Abstract. This paper investigates the impacts of the serious illness insurance (SII) introduced into the New Rural Cooperative Medical System (NRCMS) since 2013. Employing DID method on data from China Family Panel Studies, this work finds that the SII improves self-rated health status and people choose to go to bigger hospitals with better medical resources when they get sick after initiating SII. But the results indicate that SII decreases family income and aggravates poverty.

Keywords: New Rural Cooperative Medical System · Poverty alleviation · Differences-in-Differences

1 Introduction: Research Topic

Medical insurance provided by the government is an important public policy that helps residents to pay for medical expenditure. It is designed to reduce the heavy burden of patients and improve residents' health. However, the effectiveness and efficiency of medical insurance system are not clear. The effect of medical insurance on health improvement is certainly one aspect that we pay attention to. The economic effect is another aspect that we attach importance to. Catastrophic health expenditure is a main factor that leads to poverty in China. The percentage of health-payment poverty out of total poverty has been over 40% since 2015 [1]. Medical insurance is supposed to reduce household expenditure on medical care and therefore alleviate health-payment poverty. Besides, health is an important part of human capital. By improving health condition and income, medical insurance can also reduce poverty. Examining effects of current medical insurance on poverty reduction provides guidance for improving medical insurance mechanism design and reducing poverty in the future. Limited existing literature explores the effect of China's medical insurance on reducing poverty. This paper provides evidence on whether medical insurance can reduce poverty by examining the *serious illness insurance (SII)* introduced in the New Rural Cooperative Medical System (NRCMS) since 2012.

2 Literature Review

The effect of medical insurance on health has been extensively studied all over the world. Positive effects are found in many papers. Hanratty finds that the Canadian national health insurance improves infant health outcomes [2]. The incidence of low birth weight decreased by an average of 1.3% for the population, and by 8.9% for single parents since the introduction of Canadian national health insurance from 1960 to 1974. Cheng and Zhang find that the New Rural Cooperative Medical Scheme increases residents' access to medical services and improves their health status [3]. However, few effect is found in other cases. Hu and Liu find that China's Urban Resident Basic Medical Insurance improves the health level of people in lower health instead of the whole urban residents' health status [4]. Chen and Jin find that NCMS does not affect rural child mortality and maternal mortality using 2006 China Agricultural Census [5]. The effect of medical insurance on consumption is also widely studied. For example, Cheng and Zhang do not find evidence that NRCMS alleviates medical expense significantly [3].

Health is an important part of human capital, and it contributes a lot to economic development and poverty reduction. According to Fogel, improvement of nutrition and health accounts for 20%–30% of UK's rapid economic growth between 1780 and 1979 [6]. Gao and Yao show that a health shock-hit household falls short of its normal income trajectory by 5%–6% on average in the first 12 years after a shock and health shocks have a larger effect on poorer households [7]. Therefore, medical insurance could alleviate poverty through directly reducing medical expenditure as well as improving health condition.

There is literature on the poverty-reducing effect of medical insurance. According to Sommers and Oellerich, Medicaid in the U.S. reduces out-of-pocket medical spending from \$871 to \$376 per beneficiary, and decreases poverty rates by 1% among children, 2.2% among disabled adults, and 0.7% among elderly individuals [8]. Fang and Zhou find that in the long run, NRCMS significantly reduces poverty due to illness through the increase of agricultural investment, reduction of children's drop-out under health shock, increase of income, and reduction of medical expenditure [1]. They use data from CHNS 1997–2015 and a fuzzy Regression Discontinuity design. This paper uses more recent survey data and employs the different timing of SII in NRCMS to provide more evidence on its effect on poverty alleviation.

3 Data

This paper employs China Family Panel Studies (CFPS) conducted by the Institute of Social Science Survey (ISSS) of Peking University. CFPS is a nationally representative, annual longitudinal survey which is designed to collect individual-, family-, and community-level longitudinal data in contemporary China. The studies focus on the economic, as well as the non-economic, wellbeing of the Chinese population, with a wealth of information covering such topics as economic activities, education outcomes, family dynamics and relationships, migration, and health. The baseline survey was conducted in 2010. Almost 15,000 families and more than 40,000 individuals within these families were interviewed. 25 provinces in China are covered. The respondents are tracked through annual follow-up surveys in 2012, 2014, 2016, and 2018.

Questionnaires include community part, family member part and family part in household-level, adult part and child part in individual-level. There is information about family income, family expenditure, health condition, and characteristics such as age, gender, education attainment, family asset, and so on. Both health and financial outcomes are examined to see whether the policy helps to improve health and alleviate poverty. Outcome variables are listed as follows.

1. self-health: self-rated health status
2. illness: whether feel sick in the past two weeks
3. hospital_expense: total expenditure on hospitalization last year
4. self_expense: self-paid direct health expenditure, i.e. except for reimbursement
5. med_choice: go to general hospital/specialty hospital/township hospital/village clinic/private clinic/none when feeling sick
6. faminc: total family income last year
7. indinc: family income per capita last year
8. poverty: poverty index based on national poverty line
9. expense: total family expenditure

The *serious illness insurance (SII)* was introduced into the New Rural Cooperative Medical System (NRCMS) at different times in different provinces. Fujian, Liaoning, Jilin, Zhejiang, Hubei, Chongqing, and Qinghai initiated SII all over the whole province in 2013. Since Qinghai was not covered in CFPS, the treatment group includes 6 provinces, i.e. Fujian, Liaoning, Jilin, Zhejiang, Hubei, and Chongqing. Control group includes other provinces, which initiated SII in whole province after 2014, in CFPS dataset. Time period is from 2010 to 2014 since all provinces have already initiated SII in 2015. Table 1 shows descriptive statistics.

4 Methodology: DID

This paper employs Difference-in-Difference (DID) method as identification strategy. Different timing of initiating SII in different provinces provides the opportunity to use the following DID model:

$$y_{ipt} = \alpha + \gamma_p + \lambda_t + \delta Treat_p * T_t + X'_{ipt} \beta + \varepsilon_{ipt} \quad (1)$$

where y_{ipt} is the outcome variable for individual i in province p and time period t , γ_p is the fixed effect for province p , λ_t is the time trend, $Treat_p = 1$ if in treatment group and $Treat_p = 0$ if in control group, $T_t = 1$ if in 2014 and $T_t = 0$ otherwise, X_{ipt} is the individual characteristic matrix for individual i in province p and time period t , ε_{ipt} is the error term.

5 Empirical Results

This section discusses the regression results. Table 2 shows the results on health outcomes. It indicates that the serious illness insurance (SII) improves self-rated health

Table 1. Descriptive statistics

Variables	Observations	Mean	Standard deviation	Min	Max
self_health	106,393	2.65	1.30	1	5
illness	97,298	0.29	0.45	0	1
hospital_expense	97,354	963.28	6,892.34	0	491,000
self_expense	102,904	746.54	4,847.21	0	360,000
med_choice	74,256	3.12	1.49	1	5
faminc	156,240	46,142.77	63,241.52	1	3,036,046
indinc	148,664	10,536.63	18,790.5	0.2	1,518,023
poverty	167,683	0.16	0.36	0	1
expense	138,407	40,689.99	55,897.49	0	1,628,100
age	106,464	44.94	16.95	0	110
gender	72,856	0.50	0.50	0	1
edu	104,400	7.66	3.80	3	24
total_asset	157,841	332,662.5	817,919.5	-1,959,200	3.41e+07

Table 2. Regression results on health outcomes

Variables	(1) self_health	(2) illness	(3) med_choice
treat_post	0.028* (0.017)	-0.011 (0.008)	-0.158*** (0.029)
Constant	1.739*** (0.004)	0.255*** (0.002)	3.551*** (0.012)
Observations	106,393	97,298	74,256
R-squared	0.430	0.006	0.041
Number of pid	47,663	44,626	40,519

Robust standard errors in parentheses, ***p < 0.01, **p < 0.05, *p < 0.1.

status at the significance level of 0.1. It is also statistically significant that with the help of SII, people choose to go to hospitals that are bigger and have better medical resources for medical care when they get sick.

Table 3 shows the results on financial outcomes. It is statistically significant that the serious illness insurance (SII) improves poverty, decreases family income, and reduces family expenditure. The result is in contract with what we would expect from SII.

Table 3. Regression results on financial outcomes

Variables	(1) poverty	(2) hospital_expense	(3) self_expense	(4) faminc	(5) indinc	(6) expense
treat_post	0.013*** (0.002)	29.163 (133.342)	167.521 (106.259)	−3,730.006*** (395.112)	−656.625*** (110.938)	−2,066.132*** (307.464)
Constant	0.127*** (0.001)	595.248*** (31.090)	399.272*** (22.030)	37,192.162*** (227.331)	9,002.713*** (67.943)	32,337.976*** (200.069)
Observations	167,683	97,354	102,904	156,240	148,664	138,407
R-squared	0.009	0.004	0.039	0.034	0.012	0.046
Number of pid	62,621	44,638	46,835	60,124	59,548	57,589

Robust standard errors in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

6 Discussion

The result that SII does not alleviate poverty but aggravates it is somewhat shocking. We need to find out the reason. Is it just a bias because of specific dataset? Other national datasets should be employed to check. If SII does worsen poverty, what is the mechanism? This phenomenon requires more careful research. In addition, the following improvements can be made on this research paper. First of all, DID model assumes the interaction term $Treat_p * T_t$ is random, which could be violated. Secondly, the common trends assumption should also be checked. Thirdly, although provinces in the control group did not initiate SII over the whole province in 2012, they did conduct SII in some pilot cities. Jiangsu, Jiangxi, Anhui, Guangdong, and Shanxi, which have a large number of pilot cities, are deleted from the control group as a robustness check. Finally, a placebo test could be done as a robustness check. No significant effect should be found if the placebo treatment group is not affected by SII.

7 Conclusion

This paper examines the effect of introducing Serious Illness Insurance (SII) into the New Rural Cooperative Medical System (NRCMS) on both health and poverty reduction. DID method is employed on data from China Family Panel Studies (CFPS) to identify the causal relationship. The results indicate that SII does improve self-rated health status as well as medical choice when facing illness. However, it is out of expectation that SII decreases family income and aggravates poverty. The negative financial effects require further study.

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Research on the Countermeasures of Enterprises' Financing Constraints Under the Financial Intelligence Transformation

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Abstract. In order to deal with the financing constraints of enterprises under the condition of financial intelligence, and to solve the problem that enterprises in our country need to apply intelligent technology, the degree of intelligent application of each functional module of financial information system is strengthened. Based on the background of financial intelligence, this paper puts forward relevant countermeasures and suggestions on corporate financing by integrating the financing constraints and intelligence in the previous literature, and provides reference for relevant institutions and enterprises, so as to make Chinese enterprises more resistant and ease the financing constraints under the transformation of financial intelligence. At the same time, we hope this paper can encourage and guide enterprises, help improve the financing constraints faced by enterprises, and promote more enterprises to successfully ease the financing constraints. This study provides relevant institutions and enterprises with coping strategies from both the enterprise itself and government policies.

Keywords: Financial intelligence · Financing constraints · Digital intelligence · Small · Medium and micro-sized enterprises

1 Introduction

1.1 Research Background

At present, under the background of big data era, the value creation and role positioning of traditional enterprise's financial management will be greatly changed. The intelligent degree of the financial information system functional modules is generally low, and the functional modules with higher intelligent degree are mainly concentrated in accounting, expense reimbursement and bank-enterprise interconnection, which is matched with the degree of adoption of the financial information system functional modules. The degree of adoption of each functional module of financial information system is significantly higher than the degree of intelligence, indicating that Chinese enterprises urgently need to apply intelligent technology to strengthen the degree of intelligent application of each functional module of financial information system.

Dredging the financing channels of small and medium-sized enterprises, developing a multi-level market financing model and establishing a long-term financing supply mechanism for small and medium-sized enterprises have extremely important practical significance for the development of small and medium-sized enterprises in our country, which is also an inevitable requirement for the government to stabilize employment and expectations at this stage. At present, China's small and medium-sized scientific and technological enterprises are basically in the initial stage and growing stage. Their operation scale is small and they devote most of their energy and capital to technological research and development. The operation and management of the enterprises are lack of standardization, the internal control system is not perfect, and the financial management is not standardized enough. These deficiencies make financial institutions unable to obtain true feedback through the financial information disclosed by these small and medium-sized technology-based enterprises, and financial institutions are extremely strict in credit funds.

Financial intelligence refers to the comprehensive collection of financial and business data through AI and other technologies. Intelligent technology can improve the processing level of financial automation and lay the foundation for digital transformation. Financial intelligence is the introduction of more scientific and reliable corporate decision-making by improving the quality of accounting information and work efficiency, so that financial intelligence can be achieved. Enterprise financing is a movement process that takes the enterprise as the main body to finance capital and makes the supply and demand of capital between the enterprise and its internal links from imbalance to balance. When there is a shortage of funds, an appropriate period of time and an appropriate amount of funds are raised at the least cost. When the fund is in surplus, it is released with the lowest risk and for an appropriate period of time in order to obtain the maximum return and thus realize the balance between the supply and demand of the fund. Emerging technologies such as big data intelligence and mobile internet can help enterprises find more appropriate ways to reduce the problem of corporate financing constraints.

1.2 Research Significance

In order to explore the coping strategies of enterprise financing under financial intelligence, this paper, based on the background of financial intelligence, puts forward relevant countermeasures and suggestions on enterprise financing by integrating the financing constraints and numerology in the original literature, which can provide reference for relevant institutions and enterprises, so as to make Chinese enterprises more resistant under the transformation of financial intelligence and ease financing constraints using financial intelligence. At the same time, enterprises can be encouraged to guide enterprises to help them to improve the financing constraints, which can promote more enterprises to successfully overcome the financing constraints. Professor Lang Xianping, an economist in our country, pointed out that small and micro enterprises include small enterprises, micro enterprises, family-owned enterprises and individual industrial and commercial households, and small and micro enterprises have become an important force supporting economic and social development. China's classification of small,

medium and micro-sized enterprises is gradually refined to various comprehensive indicators, such as the number of employees, sales, etc. According to the latest data, China's small and medium-sized enterprises account for 94% of the total number of enterprises (2011).

1.3 Research Innovation

First, it enriches the relevant research on the transformation of corporate financial intelligence that the research on financial intelligence helps enterprises to deal with financing constraints. At the same time, it also enriches the relevant research on corporate financing constraint coping strategies that financial intelligence enables enterprises to have more ways to deal with financing constraints. Secondly, it enriches the relevant research on the transformation of corporate financial intelligence that the research on financial intelligence helps enterprises to deal with financing constraints. Finally, it also enriches the relevant research on corporate financing constraint coping strategies that financial intelligence enables enterprises to have more ways to deal with financing constraints. Through extensive collection of data and information, we can understand the current situation of financing constraints and the reasons for their impact. Starting from the background of financial intelligence and numerical economy, we can collect relevant policies, development models and cases. We can combine the literature with China's current national conditions, and specifically analyze corporate financing under the transformation of financial intelligence, as well as coping strategies.

2 Literature Review

2.1 Relevant Literature on the Status Quo of Financing Constraints

At present, China's small and medium-sized scientific and technological enterprises are basically in the initial stage and growing stage. Their operation scale is small and they devote most of their energy and capital to technological research and development. The operation and management of the enterprises are lack of standardization, the internal control system is not perfect, and the financial management is not standardized enough. These deficiencies make financial institutions unable to obtain true feedback from the financial information disclosed by these small and medium-sized technology-based enterprises, and financial institutions are extremely strict in credit funds [1–3]. In China's banking credit market, large and medium-sized commercial banks are forced by policy pressure to meet the loan demand of small and medium-sized enterprises in the short term. Once the economy goes down, the capital supply of small and medium-sized enterprises will also drop significantly. Therefore, small and medium-sized enterprises are short of professional small and medium-sized banks with equal status to provide them with credit services. Inadequate protection of property rights leads to short-term behavior of private enterprises. The present situation of certain industrial structures with signs of monopoly has led to fierce competition among small and medium-sized enterprises. Structural defects in basic financial markets are unfavorable to financing of small and medium-sized enterprises [4]. As China's financial market is not developed, the

capital market starts later than that of European and American countries, and the system is still imperfect, which results in most enterprises choosing bank credit for external financing. In addition, most of China's banks are state-owned in nature, and the lack of relevant assessment system leads to difficulties in borrowing. Many problems make the party holding the capital unable to obtain the accurate information of the enterprise in a timely manner and can not measure the risks, thus giving up the investment and causing the enterprise to be unable to obtain the external financing in a timely manner. When the enterprise carries out the external financing, the management selects the financing channel according to the level of the capital cost. Due to the cost problem, the additional value paid for the cost borne by the compensation of the external fund provider is different. Shareholders and creditors respectively increase the cost of the external financing for their own interests. In addition, when the shareholders of the company disagree with the management, the enterprise will be forced to give up some valuable investment and financing opportunities, which will damage the value of the company and further lead to the formation of financing constraints.

2.2 Literature Research on Influencing Factors of Financing Constraints

First, the financial institutions and systems are unreasonable. At present, China's financial system is more and more perfect than before, and there are more and more institutions that can provide financing services, such as local small banks, national banks, small loan companies and so on. However, the most important is the state-owned commercial banks. As mentioned above, there are a large number of small and medium-sized technology-based enterprises in our country and their distribution is extremely wide. However, there are very few institutions that can provide financing services for these enterprises. Therefore, this is not in line with the actual needs. At the same time, many financial institutions in our country all hope to develop their own business to a greater extent. They all hope to cooperate with some large enterprises. Their cooperation with small and medium-sized technological enterprises is becoming less and less. Many factors, such as higher loan authority, extremely complicated procedures and longer approval time, have made the financing constraints of these enterprises more and more serious.

Secondly, the information between banks and enterprises is asymmetric. Small and medium-sized technology-based enterprises in the early days of their startup are very difficult to obtain bank loans. Especially when there is an urgent need for capital turnover, they often "close the door". The actual reasons for this phenomenon are often the problems of long bank borrowing cycle, high threshold and great uncertainty. In addition, small and medium-sized technology-based enterprises need to go back and forth to many banking institutions when lending to banks, resulting in low efficiency and high cost. Therefore, many small and medium-sized technology-based enterprises, due to the above-mentioned problems, often choose private loans with higher interest rates to tide over the difficulties. At the same time, for banking institutions, information asymmetry between technology-based small and medium-sized enterprises and financial institutions arises due to the inability to accurately find target customers when lending to small and medium-sized enterprises.

Finally, the empirical analysis of the influencing factors of financing constraints takes 172 small and medium-sized technology-based enterprises in Hunan Province as

the research sample of this paper, and studies which factors will have certain impact on the financing needs of these enterprises, mainly from the following two aspects. On the one hand, financing need is an abstract concept, and it is necessary to choose a better indicator to express it, which depends on whether an enterprise has financing needs in the last year or not. Financing need includes two situations. One is both demand and substantive financing behavior, and the other is demand. On the other hand, using the Logit model, the impact of basic characteristics of small and medium-sized technology-based enterprises on financing demand is verified by empirical methods [5].

2.3 Relevant Research on the Economic Consequences of Financing Constraints

The financialization of enterprises will seriously squeeze out future capital investment, and the crowding-out effect of long-term financial assets is more serious. According to the research on heterogeneity of enterprise financing constraints, it is found that when the enterprise financing constraints are low, managers are more willing to use financial assets for speculation and arbitrage. Therefore, the crowding-out effect on future capital investment is more serious when enterprises with low financing constraints invest in financial assets, especially long-term financial assets. Further research finds that the excess return from investment in financial assets will significantly squeeze out the future capital investment, indicating that the entity enterprises have a serious dependence on the profit from financial channels. Compared with the capital investment, the enterprises are more inclined to invest their capital in the financial field, which again proves the speculative arbitrage motivation of the enterprise financialization. In addition, when enterprises and private enterprises that are not supported by industrial policies invest in financial assets, they will seriously squeeze out the future capital investment of the enterprises, and the significant squeezing effect of long-term financial assets on the future capital investment of the enterprises will not change with the heterogeneity of the enterprises.

2.4 Relevant Research on the Development of Financial Intelligence

The concept of artificial intelligence was first proposed in 1956. At the beginning of this concept, it was intended to create an intelligent machine that can not only think independently, but also think independently beyond human beings. After more than 60 years of long-term development, although major breakthroughs have been made in many aspects, a similar machine that has been recognized by everyone has not yet been developed. Artificial intelligence has been greatly developed and applied in image recognition, text recognition, data identification, voice distinction, etc. However, it has not reached the level expected by people in analysis and thinking, logical reasoning, value judgment, etc. Relatively speaking, the expert system has been more successful in solving logical reasoning and analyzing and judging problems.

Expert System (ES) was produced in the 1970s and is the product of the specific application of artificial intelligence technology to a certain professional field. It has solidified the expert wisdom into the software system and formed a series of application systems that can replace human repetitive mental work. Currently, the mainstream artificial intelligence software (machine learning platform), such as Python language

and Tensor Flow, are essentially an expert system, a system in which experts solidify various models, algorithms, parameters and their selection and adjustment methods into software for everyone to select, configure, adjust and use. Machine learning is not the learning of the machine itself, but the models and algorithms solidified into the artificial intelligence system platform by experts. New application models and algorithms are generated in the continuous data training and iterative updating. Whether these algorithms and models are valuable or not still depends on the experts and engineers who are engaged in the artificial intelligence model, algorithm training and generation. On the whole, relying on the automatic recognition, automatic classification and automatic calculation model solidified into the machine, good results have been achieved in the stratification and classification issues, but no major breakthrough has been achieved in analysis, judgment, decision-making and early warning [6].

According to the paradigm of academic research, the construction of a development system in the research field needs to clarify the academic logic and social logic of its construction, and should fully reflect its core concepts, research objects, development laws, knowledge structure, role relationship, governance system, social value and other contents. Therefore, to construct the development system of intelligent finance, we should carefully analyze its theoretical basis, supporting technology, research and development links, product structure, application model, resource requirements, development objectives, etc. in combination with the characteristics of the financial accounting field, and identify and screen many elements in the development system, so as to finally clarify its core links and the relationship between them [7].

3 Analysis of the Current Situation Under the Transformation of Financial Intelligence

3.1 Status of Corporate Financing Constraints

In recent years, the problem of financing constraints has become one of the major obstacles to China's economic development, transformation and upgrading, and has attracted more and more attention from the practical and academic circles. According to the World Bank's 2012 Enterprise Surveys, 22.4% of China's private enterprises ranked the financing difficulty first. Take the investment in fixed assets as an example. 89.6% of the capital needed for the investment in fixed assets of private enterprises in China comes from internal financing, far higher than the world average of 71.3%. Only 4.5% came from bank borrowings, well below the world average of 14.6%. Another 3.2% came from equity issuance, slightly lower than the world's 4.7%. From this set of data, it can be intuitively felt that the investment of private enterprises in China is too dependent on internal capital, the financing cost of external capital is higher than that of internal capital, and the enterprises are constrained by financing [8]. The competitiveness of the enterprise itself is no longer the point that most enterprises need to compete, but the competition of the capital supply chain. In this way, the shortage of enterprise capital will directly affect the efficiency and competitiveness of the capital supply chain. The capital constraint of the capital supply chain system comes from the difference in capital strength between the core enterprises and the small and medium-sized enterprises. Judging from the current

situation in our country, the core enterprise is the leader of the supply chain. They have strong capital strength and credit incentives, but there are many stringent requirements for small and medium-sized enterprises in terms of financing credit, which leads to the problem of insufficient capital chain for small and medium-sized enterprises, and eventually collapse due to this factor. In recent years, most small and medium-sized enterprises have suffered huge economic losses due to improper control of financing risks. There is a statement in the accounting standards that the use of off-balance-sheet financing and economic leasing features can effectively broaden the financing channels, which is a favorite financing method for many small and medium-sized enterprises. This model can promote the further stable development of small and medium-sized enterprises [9].

3.2 Status of Financial Intelligence Transformation

The digital transformation of China Merchants Group takes “based on the long term, grasping the present, science and technology leading, embracing change” as the strategic guidance, and continuously improves the mechanism to fully guarantee the construction of digital China Merchants. During the “13th Five-Year Plan” period, the operating results of China Merchants Group continued to reach a record high. In 2020, it realized operating income of 813.7 billion yuan, net profit of 137.1 billion yuan and total assets of 10.3 trillion yuan. With China’s economy entering a new stage of development, the global technological revolution is pushing forward the industrial chain adjustment and industrial transformation, and traditional industries are facing challenges. Accelerating industrial upgrading and business model restructuring with digital innovation technology will become a necessary option for enterprises to achieve high-quality development. Relying on the digital transformation, China Merchants Group will focus on improving its business capabilities in two aspects, namely, the principal business and strategic emerging industries, to gain new momentum for the Group to become a world-class enterprise [10]. At the same time, the National Energy Group regards information construction as an important means to build and upgrade a modern corporate governance system and builds an intelligent management platform with ERP system as the core. In January 2021, the new ERP system achieved great unity and full coverage across the Group. The implementation scope covered 73 secondary units and 1,393 implementing units under the management scope of the Group. The new ERP system can manage in real time about 40,000 organizations, 296,000 employees, 399,000 cooperative suppliers, 2,665 types of required materials, as well as about 1.9 million purchase and sales orders, 10 million financial vouchers, 3 million consolidated statements and other data and information throughout the Group. A digital management model for business interoperability and data sharing has initially taken shape. Big data application governance should be implemented and security risks should be well protected [11].

4 Financial Intelligence Transformation of Corporate Financing Constraints Under the Coping Strategies

4.1 Enterprise Level

At present, many well-known domestic enterprises are listed abroad through equity financing. With the rise of the new internet finance model, the development of internet

finance will bring more help to the small and medium-sized technology-based enterprises. At present, more and more Internet financial investors will pay more attention to the small and medium-sized enterprises of science and technology when they invest in enterprises. The increase of attention will further increase the favorable impression of investors on the small and medium-sized enterprises of science and technology. Therefore, while paying attention to Internet financial financing, small and medium-sized enterprises of science and technology need to innovate their financing structure in order to better achieve the purpose of financing. Although internet finance has been developed for many years now, it may still be in the stage of ineffective cognition for many small and medium-sized technology-based enterprises in our country, which makes them unable to participate in internet finance and causes related enterprises to lose a good financing channel. The reality has proved that its support for small and medium-sized technology-based enterprises has been increasing. The effective implementation of Internet financial financing can ease the overall financing pressure of small and medium-sized technology-based enterprises in the short term.

4.2 Government Policy Level

Internet finance improves the efficiency of financial resources allocation, but its potential risks are relatively strong, which requires the government to strengthen supervision of internet finance. In 2017, China's regulatory authorities carried out a series of renovations on "school loans", "cash loans" and ICO chaos, which further purified the development environment of the industry and promoted the healthy development of the industry. The specific regulatory measures are as follows. First, vigorously promote infrastructure construction in the industry. At present, China's Internet financial registration and disclosure service platform has been put on line. The application for individual credit investigation business of "Credit Union" has been approved by the central bank. At the same time, relevant measures such as heavy rewards and penalties, award-based reporting and other related measures have been implemented in the construction of infrastructure platforms such as Internet financial credit information sharing and information disclosure. These measures will be more conducive to preventing the risk of long-term borrowing, realizing the sharing of data between platforms, and also conducive to improving the effectiveness of internet financial platforms and reducing costs. Second, plug loopholes and further improve the regulatory system. Internet finance has achieved initial results in terms of regulation, from information disclosure standards, guidelines for fund depository business to comprehensive guidance and other special rectification actions, but there are still inevitably some problems in the process of industry development. Therefore, with the rapid development of technology and finance, it is extremely urgent for the government to optimize the market access system and behavior supervision to return it to the origin of serving the real economy [5].

5 Conclusion

The research conclusion of this paper has the following policy implications. First, under the premise of controllable risks, we should continue to promote the deep integration

of information technologies such as artificial intelligence and big data with the financial sector. While expanding the coverage of digital finance, the depth of application of digital finance is more worthy of attention. We will accelerate the improvement of supporting industries related to digital finance, promote the efficient flow of information, remove the barriers to connectivity between digital technology and real enterprises, and lay a solid foundation for further releasing digital finance services to the real economy and enabling enterprises to export. Secondly, as far as the substance of digital finance is concerned, its main contribution lies in supplementing and expanding the traditional financial development model, especially under the financial structure in which our country is still dominated by banks. Traditional financial institutions should conform to the development trend of digital economy, accurately identify export enterprises with good production and operation conditions and strong capital demand by virtue of the advantages of universal benefits and information identification of digital finance, and then use digital technology to formulate targeted financial services for enterprise production and export activities. Thirdly, in order to strike a balance between controllable financial risks and serving the real economy, the financial supervision system urgently needs to be reformed. Scientific and technological innovation is continuously enabling the incremental expansion of financial services. The development model and operation mechanism of new financial services are also different from those of traditional finance. Under such circumstances, it is necessary to formulate regulatory policies with certain pertinence and flexibility according to the technical characteristics of digital finance, so as to give full play to the function of financial supervision in improving the quality and efficiency of digital finance.

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Regional Inequality of Higher Educational Resources' Distribution in China

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Abstract. Educational equality is very important to the economic and social development of a country and region. This paper reviews the current situation of higher education development in China, studies the situation of unequal geographical distribution of higher education, demonstrates the evidence of regional inequality, and examines the regional differences in the rate of return to education. The results show that the rate of return to higher education in the eastern and middle region is generally lower than that in the western region. Possible solutions and countermeasures like government support, university autonomy tapping social resources, and universities' autonomy to enhance satisfaction are proposed in the hope of solving the problem of regional inequality in the allocation of education resources in China.

Keywords: Higher education · Regional distribution · Education equality

1 Introduction

1.1 Current Situation of Chinese Education

In recent decades, under the active promotion of the Chinese government, the number of enrollments, fixed assets, faculty, and higher education financial funds of Chinese universities have maintained rapid growth each year. From the elite stage to the popularization stage of higher education, it is not just a quantitative increase, but a qualitative change. However, China has a huge, educated group and a significant economic gap. This has caused China to be in a vicious circle of “poor countries do big education” for many years.

China's rise to become the world's second economic power in decades is a success that shocked the world. However, since 2012, China has been in a period of transition, and economic development has increasingly relied on the accumulation of human capital. In the modern production process, technological transformation and equipment renewal must be completed by scientific and technical personnel applying the results to the production process. A high level of production and economic efficiency depends on the management activities of a large number of high-level managers. “One basic

determinant of innovative development is human capital [1].” Carrying out complex innovation activities in mature companies requires highly-skilled labor to generate new ideas of complexity that transcend the boundaries of existing companies [2]. To promote equitable economic development in different regions, the expansion of human resources based on advanced knowledge and skills can be considered as a relevant policy tool [3].

1.2 Development of Chinese Higher Education

Higher education resources are the monetary performance of material and human resources used to maintain, form, participate and serve the entire education system, and are the “material basis and guarantee for various educational activities [4]”. Science and technology are the primary productive forces, so education is the mother machine of the primary productive forces [5]. Chinese sociologist [6]. Sheng proposed that the allocation of higher education resources is generally affected by three factors: the government, the market, and universities. Therefore, the adjustment and transformation of the allocation of educational resources is “a gradual process of constant conflict and compromise between the main forces” [6]. In order to better allocate resources, the writing collaboration between them should be vigorously promoted and a good balance should be achieved.

The generally accepted method of allocation refers to “through a certain mechanism, the publicly designated allocator decides to allocate different types and amounts of resources to certain fields” [5]. In the four categories of objects, topics, mechanisms, and allocation methods. With the participation and coordination of the elements, the distribution of educational resources has flourished. Once the distribution method is formed, as long as the environment and conditions on which it depends remain unchanged, it is difficult to disappear, and it will continue to play its basic role thereafter. The overall arrangement of the distribution of educational resources involves four main parts: government, society and market, universities and individuals [7]. A decisive part is the government’s support for higher education and the allocation of resources under political interference. But school funding only depends on government financial appropriations, and even rich countries cannot afford huge financial expenditures. The social and market investment in higher education is also the most basic, for the public interest. At the same time, colleges and universities should strive to obtain the academic resources needed for teaching and clarify how to allocate and utilize these inflowing resources. Finally, when and where everyone accepts a certain level of higher education is of the same fundamental importance.

Thanks to the economic and social momentum brought about by reform and opening up, the scale of higher education in China has been significantly expanded. Both the number of universities and the number of students receiving education are increasing significantly. The number of universities increased by 393 from 1949 to 1978, and 798 from 1978 to 2002; from the founding of the country to the reform and opening up, the number of higher education students increased by 7398,000, and the number of university students increased from 1978 to 2002. There are 8.17 million people, an increase of nearly 10 times compared with the past 50 years [8]. The gross enrollment rate of school-age youth reached 11% in 2000 and 15% in 2010 [9]. With the support of reform and opening up and China’s economic development, the proportion of the population

with a high degree of education has increased from 0.41% in 1964 to 3.61% in 2000 [8]. This growth can also be measured by evaluating the world university rankings. In 2010, only two Chinese universities entered the top 100. At present, there are 12 Chinese universities in the top 100, among which Tsinghua University is ranked 15th. According to the 2020 ranking of higher education in the Times, 7 of the top 10 universities in emerging economies are Chinese universities [9].

The management system of Chinese universities has undergone tremendous reforms in the past 50 years. The competent departments of universities “transformed from the centralized management in the past to the framework of local hierarchical management” [8]. In addition to large cities, secondary cities in rural areas have also established different forms of higher education colleges. From 1985 to 2001, the proportion of local universities in the total number of schools rose from 62.5% to 90.94%. In recent years, the proportion of undergraduates and postgraduates has gradually increased, while the proportion of students in professional schools has declined. By 2000, the proportion of education appropriations in the fiscal budget had dropped to 53.88%, and investment in higher education had increased rapidly, approaching half of the total funds. In 2000, ordinary colleges and universities added 30 million square meters of building area for teaching buildings, of which 7.14 billion was invested by the government, accounting for 20% of the construction funds, and the remaining 80% was raised by market mechanisms [8].

1.3 Education Inequality in China

However, China still faces a serious problem. For many years, “education inequality in China has been a hot topic among academics, policy makers, and the public. Since the 1990s, general education, especially higher education, has become one of the core policy priorities of the Chinese government, and the exploration and discussion of this topic has been further expanded and deepened [10]. Educational resources in different regions of China are unevenly distributed between urban and rural areas, eastern and western China, and coastal and inland areas. This unbalanced distribution not only affects the long-term development of China’s educational resources, but also exacerbates the economic and civilization gaps between different regions in China.

Regional inequality in the distribution of educational resources can also be counted as a regional economic gap. The economic environment of the family plays a key role in determining whether they can afford tuition and whether their children can go to school. Therefore, the regional economic gap largely determines the distribution of higher education resources in certain regions [10]. Chinese sociologist Sheng proposed that students from high-income families who are usually located in the coastal areas of eastern China are more likely to enter national universities and have more resources for higher education. And students from poor families, usually from Northwest China, often receive lower-quality education in local colleges and universities. In addition to economic reasons, moral differences between different regions and cultures of China may also become a major source of inequality in higher education in China. In this regard, gender can play an important role. For example, if the family cannot send all their children to school due to financial conditions, they may prefer to send their sons

to school rather than their daughters. This may be due to cultural reasons, because in China, sons are traditionally more responsible for taking care of their elders [11].

In the work, the existence and systemic problems of regional inequality from the economic and human aspects are sorted out. Also, this article provides theoretical basis and practical guidance for the better organization and allocation of Chinese higher education.

2 Model and Analysis

2.1 Model One

To find the determinant factors shaping the uneven distribution, I applied the generalized Theil index here, featured as:

$$T^{wr} = \sum_{i=1}^I W_i \frac{\frac{X_i}{\prod_1}}{\sum_{i=1}^I W_i \frac{X_i}{\prod_i}} \ln \left(\frac{\frac{X_i}{\prod_i}}{\sum_{i=1}^I W_i \frac{X_i}{\prod_i}} \right) \tag{1}$$

I represents the number of provinces; X_i ($i = 1, \dots, I$) represents the variable of higher education resources of the province i ; \prod_i as province-specific reference; W_i as province-specific weight) to measure and determine the general index of regional inequality regarding educational resource distribution. The *Theil index* would be positive (featured by an increasing positive figure) that emphasizes the intense inequity in certain regions if the ratio of higher education resources (e.g., college stuffs) and reference (e.g., college students) differs across all provinces.

Otherwise, the number would be zero if the ratio stays the same, marking an absolute equal distribution of educational resources. The work utilized *Theil index* to investigate two dividing parts: The teaching personnel & the teaching resources, to help explain and articulate the key factors featuring unequal distribution across the provinces clearly and reasonably.

The data of Table 1 and Table 2 are based on the statistics from China's provincial panel dataset of China's National Bureau of Statistics from 2010 to 2020 and the calculation of *Theil index*, the work detected a remarkable increase of higher education resources from 2010 to 2020 all across the provinces in China. During the ten years, the number of teaching personnel doubled, and financial resources (fixed assets & educational expense) even tripled.

Even though the growth rate of educational resources differs among provinces, the overall trend marks a substantial increase all over the country.

2.2 Model Two

Data Source. This article selects data from the China Family Panel Survey (CFPS) to conduct empirical research. CFPS is a large-scale micro-survey database conducted by the China Social Science Survey Center (ISSS) of Peking University. It collects data at the three levels of community, family, and individual, reflecting the dynamic characteristics of important indicators of China's society, economy, population, education and so force. The work use individual survey databases for our research, which cover the whole country with a large sample base and strong representativeness. The work got 37354 original samples, and after clearing, 16088 samples needed for our research were obtained.

Table 1. Distribution of higher education teacher resources by region (2010 and 2020)

	Teachers (thousand persons)		Senior teachers (thousand persons)	
	2010	2020	2010	2020
East	296.8 (41.0%)	610.3 (40.8%)	123.1 (43.0%)	266.1 (43.3%)
Central	180.4 (24.9%)	384.7 (25.7%)	67.5 (23.6%)	144.4 (23.5%)
West	159.0 (21.9%)	354.9 (23.7%)	57.4 (20.0%)	136.2 (22.2%)
Northeast	88.4 (12.2%)	146.9 (9.8%)	38.2 (13.4%)	67.2 (11.0%)
Total	724.7 (100%)	1496.9 (100%)	286.2 (100%)	613.9 (100%)

Table 2. Distribution of higher education teaching resources by region (2010 and 2020)

	Books (million)		PCs (thousand)		FA (billion RMB)		Eduexp (billion RMB)	
	2010	2020	2010	2020	2010	2020	2010	2020
East	350.2 (41.9%)	938.2 (42.4%)	969.7 (44.9%)	3327.0 (45.9%)	173.7 (48.5%)	717.8 (48.0%)	89.8 (52.5%)	375.0 (49.7%)
Central	204.4 (24.4%)	564.2 (25.5%)	508.6 (23.6%)	1691.8 (23.3%)	75.6 (21.1%)	306.8 (20.5%)	35.1 (20.5%)	153.5 (20.3%)
West	187.6 (22.4%)	501.1 (22.6%)	434.4 (20.1%)	1510.6 (20.8%)	64.8 (18.1%)	322.9 (21.6%)	29.4 (17.1%)	158.2 (21.0%)
Northeast	94.3 (11.3%)	209.5 (9.5%)	245.4 (11.4%)	717.7 (9.9%)	43.9 (12.3%)	148.8 (9.9%)	17.0 (9.9%)	68.0 (9.0%)
Total	836.5 (100%)	2213.0 (100%)	2158.2 (100%)	7247.1 (100%)	358.0 (100%)	1496.4 (100%)	171.2 (100%)	754.7 (100%)

Model Setting. The article uses Mincer's equation as the basic model and also expands it. The basic Mincer equation is

$$\ln(w) = c + \beta_1 \text{education} + \beta_2 \text{experience} + \beta_3 \text{experience}^2 + \varepsilon$$

$\ln(w)$ is the logarithm of monthly salary income, c is a constant term, education is the number of years of education, calculated from elementary school, and experience means work experience. The work use the international mainstream way to calculate it, by using the age minus the number of years of education and subtracting 6. Experience² represents the square of experience. The reason for adding the Square Project is that personal income and working years present an inverted U-shaped relationship, which means that people's income rises with the increase of working years, however after certain number of years, income will show a downward trend.

Basing on this, since the focus of this article is on the inequality of higher education in China, the work divide education into two parts, "edua" means compulsory education and senior high school stage, and edub means higher education stage. Besides, male is

added as a dummy variable, male = 1 means that the respondent is male, male = 0 means non-male group, in order to control the wage inequality caused by gender differences.

Therefore, the modified Mincer equation is:

$$\ln(w) = c + \beta_1 edua + \beta_2 edub + \beta_3 experience + \beta_4 experience^2 + \beta_5 Male + \varepsilon$$

The basic idea of the research is to divide the samples into three different parts, the east, middle and west, according to provinces, and then use the modified Mincer equation to conduct regression analysis to explore the regional differences in higher education return rates in different regions. According to the division of the Seventh Five-Year Plan announced by the National People's Congress in 1986, the eastern region includes 11 provinces and cities in Beijing, Hebei, Tianjin, Liaoning, Shandong, Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong, and Hainan; the central region includes Inner Mongolia, Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, Hunan, and Guangxi, in a total of 10 provinces and municipality; the western region includes Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, and Chongqing municipality is added later. In this division, Northeast province Liaoning belongs to the east coast, while Jilin and Heilongjiang belong to the middle part. There are significant differences of development between the east, central and west regions of China.

The significant gap covers from the level of economic development to the level of educational development. It is expected that this difference to be reflected in the rate of return to education.

Regression Analysis. The results of regression analysis using OLS least squares method are as follows, $\ln w$ represents the logarithm of monthly salary income, \exp represents experience, and \exp_2 is the square of experience.

The R-squares of the three equations in the east, middle and west are 0.350, 0.364, and 0.344 respectively. Considering the large sample size and the selection of micro-statistical data, the better fitting prediction result is obtained. The explanatory variables of the three equations have all passed the T test and are very significant.

2.3 Report Analysis and Inference

The concentration of higher educational resources is much higher in developed cities or regions compared with that of suburban areas. For instance, the number of universities and colleges is much higher in developed cities such as Beijing, Shanghai, and East-coast regions. Figure 1 shows the number of universities of every province of China in 2020, with all the data coming from China's National Bureau of Statistics. According to the statistics provided by China's Educational Department in 2020, 40% of the "985&211 Project" universities are centralized in Beijing, Shanghai, and Jiangsu Province. The rest of the key universities are mostly located in relatively developed cities, whereas very few of them are based in underdeveloped regions like Middle-west and South-west China.

At the same time, there is a remarkable distinction in the allocation of human resources, mostly manifested by the reputable teachers and faculty, among different regions. Take an example of Jiangsu Province and Xizang Autonomous Region, representing the range (Jiangsu is the most resourceful in higher education while Xizang has

Table 3. Robust standard errors in parentheses

Variables	(1) East lw	(2) Middle lw	(3) West lw
exp_2	-0.000642*** (4.68e-05)	-0.000605*** (4.90e-05)	-0.000286*** (5.30e-05)
exp	0.0128*** (0.00284)	0.00847*** (0.00315)	-0.00866** (0.00377)
edua	0.0145*** (0.00545)	0.0190*** (0.00554)	0.0552*** (0.00545)
edub	0.0416*** (0.00392)	0.0399*** (0.00419)	0.0720*** (0.00438)
male	0.498*** (0.0237)	0.523*** (0.0277)	0.400*** (0.0347)
Constant	7.473*** (0.0656)	7.302*** (0.0724)	6.970*** (0.0841)
Observations	6,770	5,138	4,280
R-squared	0.350	0.364	0.344

***p < 0.01, **p < 0.05, *p < 0.1.

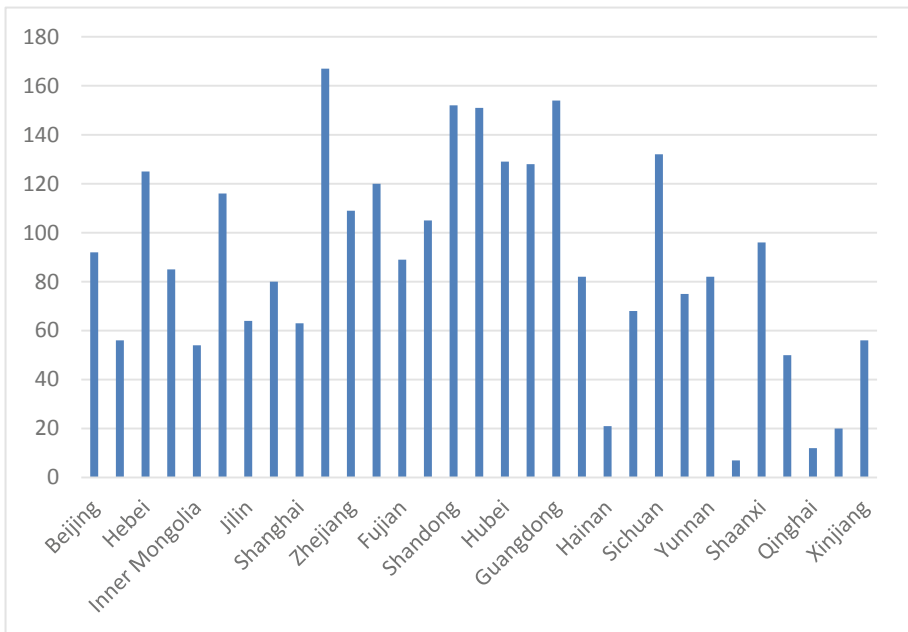


Fig. 1. Chinese Universities distribution each province in 2020

the fewest universities and colleges) of the number of higher educational institutions in certain area in China, the number of senior teachers in Jiangsu Province is more than 4 million, whereas there are only over one thousand senior teachers in Tibet. To summarize, the quality of the teaching groups is largely proportional to the unbalanced economic condition and the differentiated quantity of higher educational institutions among regions.

The Fig. 2 shows the imbalance of educational expenditure in provinces. Also, It can be seen from the Table 3 that in the eastern and central regions the rates of return to former university education and higher education are basically at the same level. The rate of return to higher education in the central region is even slightly lower than that in the eastern region. The rate of return to education in the western region is significantly higher. In the west regions, especially in higher education, the rate of return reached 7.2%, which is much higher than the 4.16% in the eastern region and 3.99% in the central region. This means that people of the western region receiving higher education can enjoy more returns.

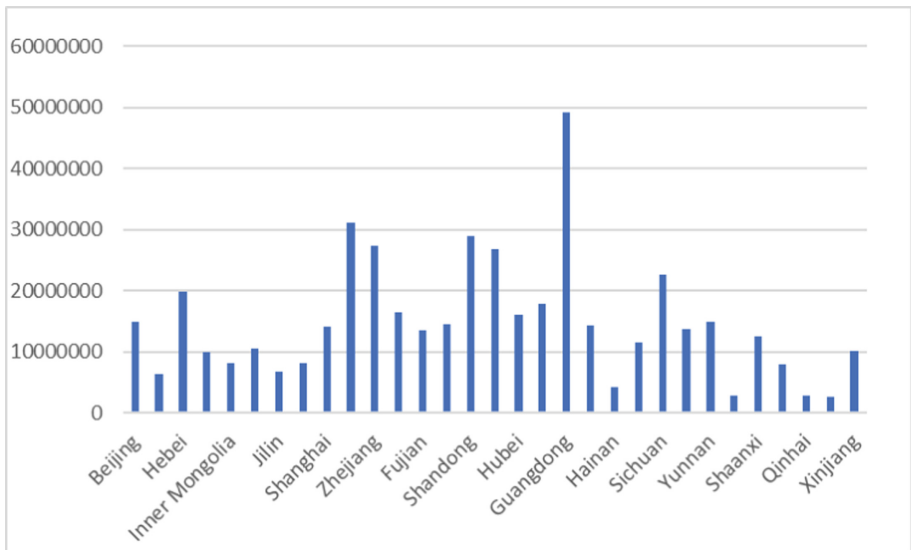


Fig. 2. Comparison of educational expenditure among provinces in China, 2019

2.4 Inference and Policy

As a country that adopts mass higher education as its strategy, the Chinese government has been vigorously supporting college education. However, with the rapid development of higher education, the problem of the unbalanced distribution of educational resources has deepened. As pointed out in the previous article, there are significant gaps in resource stocks in various regions. Then, does the college entrance examination system, which is known as an important channel for the free flow of talents, play a role in this. Although

the college entrance examination is a national unified examination, in terms of admission rules, it is divided into provinces.

Generally speaking, universities in the province tend to be local when drafting admission plans, which means that students from regions with richer educational resources have more opportunities to receive higher education [12]. Research confirms this point. In view of the unfair experience of residents in underdeveloped areas with regard to the availability of higher education, it is necessary to take measures to reduce this inequality and maintain educational equity. Therefore, the government should strengthen its support for certain regions with disadvantaged resources. For example, the results of regression analysis show that the western region has a higher rate of return to education, allowing more people in the western region to receive higher education, which can significantly improve their wages and living standards.

However, as the main provider of education resources in China, it is difficult for the education administration department to provide sufficient education resources for all institutions in various regions like the scale of China's higher education. In this case, the support of the local government is extremely important. The development of universities is of great significance to promote the development of the regions to which they belong. From the perspective of educational resource support, the government can provide assistance in two ways: one is to strengthen the construction of soft resources in colleges and universities through financial investment. One way to help is to support the teacher's overall life and teaching conditions. The government can increase the remuneration and income of teachers through financial funds, and provide more effective educational resource support for colleges and universities. The second is to actively guide colleges and universities to accurately locate and understand the role of educational development in promoting the regional and social economy. On this basis, the government should provide comprehensive preferential policies to support universities in creating favorable conditions.

Universities train talents, but how to retain them is a point. There is a serious brain drain problem in the central and western regions, so the central government should provide targeted compensation to the underdeveloped regions in the central and western regions. Since the reform and opening up, the eastern region has taken the lead in development by virtue of its geographical location and economic policy advantages, attracting a large number of talents from the central and western regions to the eastern coastal areas. The loss of human resources, which were not already abundant, has brought adverse effects to the underdeveloped areas in the central and western regions. How to cultivate more talents, retain more talents, and introduce more talents in underdeveloped regions requires the central government to give necessary policy inclination in macro-control.

2.5 Limitations and Deficiencies

The model of research used in this article has some shortcomings. First, Mincer's equation is a rough model, and the explanatory variables used in this article are also very limited. There is no breakdown of the industry that the sample is engaged in, but different industries do have different requirements for wage levels and labor skills. Besides, this article may ignore the correlation between explanatory variables. Looking back at

previous studies, it is not difficult to find that center on return to education of China, women's rate of return to education is higher than men, rural population's rate of return to education is higher than urban population. The disadvantaged group seems enjoy higher returns to education. Some scholars believe that this is related to the marginal diminishing effect of resources. Education is a kind of resource, and there are also other resource like region, gender, big city, background and so on. The interaction effects may have something to do with the model. The interaction of region, gender, background could be the marginal effect of resource accumulation. When people have other resources, like living in east and big city, then the resource education is weaken. Additionally, astricted by the data and difficulty of measuring variables like intelligence, attitude and hard-working, which is highly related to signal effect, such factors can't be ruled out basing on credentialism.

3 Conclusion

Judging from the current situation of the unbalanced allocation and flawed distributive mode of higher educational resources in China, there are large gaps among different regions and different types of universities in absorbing educational resources, which has caused certain obstacles to the overall social and educational development. Therefore, possible solutions and countermeasures are proposed from the aspects of government's support, universities autonomously mining social resources, and universities autonomously strengthening satisfaction construction throughout the research paper, hoping to solve the problems of regional inequality in China's educational resource allocation. From the perspective of long-term sustainable development, the optimization of educational resource allocation should mainly be undertaken by the educational administrative department. However, the realization of this goal would be time-consuming. Therefore, colleges and universities should rely more on themselves to optimize resource conditions for themselves to stand out in a short-term development.

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Narrow Range 4 Inside Bar Strategy for Forex Trading with G10 Currencies in Chinese Market

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Abstract. This paper introduces the result of forex trading using narrow range 4 inside bar (NR4 IB) strategy. The background is Chinese market. Total trading period is 12 years, includes in sample and out of sample period. The paper would deliberate on signal generation, portfolio construction and evaluation. Firstly, the signal generation addresses whether longing, shorting, or holding cash. And then the portfolio construction part emphasizes transaction cost and interest rate. In the evaluation part, this paper uses simple daily profit and loss and some other statistics to discuss the results of the NR4 IB strategy. Finally, this paper would give a trading recommendation based on the statistical results.

Keywords: Narrow Range 4 inside Bar · Chinese market · In sample test · Out of sample test

1 Introduction

Narrow range 4 inside bar (NR4 IB) is a popular terminology in the forex trading. A NR4 is a bar with smaller price range than previous three bars [1]. An inside bar is a bar whereas the high is lower than the prior day's high and the low is higher than the prior day's low [2]. The economic intuition of NR4 IB is that it could be the signal for volatility contraction and indicate the direction of the next momentum swing [3]. But there's no documentation of how following only the narrow range 4 inside bar sign in forex trading would perform in the real market. The effectiveness of the narrow range 4 inside bar sign in indicating market trends has been verified by some cases of historical research, but there is no summary of its profitability in the long term. In this paper, NR4 IB is the only benchmark for longing and shorting decisions, and the trading happens only in the Chinese market. One sentence summary of the strategy: Longing when the bars following the NR4 IB breaks the prior day's high, shorting when the bars following the NR4 IB breaks the prior day's low, and use engulfing bullish pattern to determine when both long and short signs appear [4]. In the work, the profitability of simplified NR4 IB strategy in the daily trading of currency is tested.

2 Specification

2.1 Strategy Overview

Signal generation: when the high/low of the bar following NR4 IB breaks the prior day's high/low.

Portfolio Construction: Our notional is \$100,000,000 and universe is G10 currencies. The work would invest 10% of notional for every currency that shows the breakout signal and rebalance our portfolio daily.

2.2 Performance Expectation

The annualized return this work estimated is 3%. The expected volatility is 0.2. The estimate of 99% Var is $-100,000$ and 99% ETL is $-200,000$. The largest peak to trough drawdown the work estimated is 1million and the Sharpe ratio the work estimated is 1%. Analysis.

2.3 Economic Intuition

Market goes through regular contraction and expansion cycle. The principle of contraction and expansion is a market phenomenon where prices go from a period of coiling to a period of uncoiling [5]. The significance of NR4 IB patterns is that they represent a decrease in price volatility. A volatility contraction is always followed by a volatility expansion. Range Expansion and an increase in Price Volatility tend to follow an NR Day. If the bar following the NR4 IB has breakout, it could indicate the direction of the new momentum. Since the contraction and expansion is a market general rule, NR4IB candlestick is very powerful [6]. The candlestick is also very important to the engulfing pattern that helps to deal with the situation when the day following NR4 IB is an inside bar. It decides when people begin to buy and sell [7].

2.4 Statistics

This paper would calculate annualized return, Sharpe ratio, volatility, 99%Var, 99%ETL and largest peak to trough drawdown to evaluate the strategy.

2.5 Data

Universe: G10 Currencies

This paper aims to trade G10 currencies with CNY. The G10 currencies are selected because they are ten of the most liquid currencies of all around the world, which include Australian dollar (AUD), Canadian dollar (CAD), Euro (EUR), Japanese yen (JPY), New Zealand dollar (NZD), Norwegian krone (NOK), Pound sterling (GBP), Swedish krona (SEK), Swiss franc (CHF), and United States dollar (USD).

Data Sets. The high, low, open, and close prices of each currency in CNY at every trading day are needed for signal generation and portfolio construction. The bid-ask spread and annual interest rates of all 11 currencies are used to estimate transaction costs.

Data Source. The daily high, low, open, and close prices are downloaded from <https://www.tradingview.com>. The annual interest rates are retrieved from <https://tradingeconomics.com>. The bid-ask spread of each currency pair is obtained from <https://www.investing.com/currencies>.

Data Range. Since this strategy focuses on a variation of volatility and it takes time to identify the trend of volatility, long-term evaluations are needed for the in-sample test. During the research, our in-sample test starts from July 30, 2009 to July 30, 2019 and out-of-sample test starts from August 1, 2019 to July 30, 2021.

2.6 Strategy Details

Signal Generation. Let the current day be day 0 and the n -th day before the current day be day $-n$. High $_m$, low $_m$, open $_m$ and close $_m$ are used to denote the high price, low price, open price, and close price of day m . P_0 is used to denote the current price.

The signal S is defined by

$$S = \begin{cases} 1, & \text{if } P = 1 \text{ or } N_{-2} \times E_{-1} \times EP = 1, \\ -1, & \text{if } P = -1 \text{ or } N_{-2} \times E_{-1} \times EP = -1, \\ 0, & \text{otherwise.} \end{cases} \quad (1)$$

N_{-n} is used to represent a NR4 IB bar at day $-n$, which is defined by

$$N_{-n} = \begin{cases} 1, & \text{if } \text{High}_{-n} - \text{low}_{-n} < \min\{\text{High}_{-(n+i)} - \text{low}_{-(n+i)}; i = 1, 2, 3\} \text{ and} \\ & \text{high}_{-n}(\text{high}_{-(n+1)} \text{ and } \text{low}_{-n})\text{low}_{-(n+1)}, \\ 0, & \text{otherwise.} \end{cases} \quad (2)$$

P is used to represent if P_0 breaks the high or low of N_{-1} , which is defined by

$$P = \begin{cases} 1, & \text{if } P_0 \text{ reaches the high of } N_{-1}, \\ -1, & \text{if } P_0 \text{ reaches the low of } N_{-1}, \\ 0, & \text{otherwise.} \end{cases} \quad (3)$$

E_{-n} is used to represent an engulfing bar at day $-n$, which is defined by

$$E_{-n} = \begin{cases} 1, & \text{if } \text{high}_{-n} > \text{high}_{-(n+1)} \text{ and } \text{low}_{-n} < \text{low}_{-(n+1)}, \\ 0, & \text{otherwise.} \end{cases} \quad (4)$$

EP is used to represent bullish and bearish engulfing pattern at day $-n$, which is defined by

$$EP = \begin{cases} 1, & \text{if } \text{open}_{-2} > \text{close}_{-2} \text{ and } \text{open}_{-1} < \text{close}_{-1}, \\ -1, & \text{if } \text{open}_{-2}(\text{close}_{-2} \text{ and } \text{open}_{-1})\text{close}_{-1}, \\ 0, & \text{otherwise.} \end{cases} \quad (5)$$

If $EP = 1$, it indicates bullish engulfing pattern. If $EP = -1$, it indicates bearish engulfing pattern.

Portfolio Construction. A total of 100 million Chinese yuan is used for trading. 10% of total notional (10 million), is allocated to each currency in G10. Each currency is traded independently in this strategy. The rebalance frequency is daily.

$$\begin{cases} \text{if } S = 1, \text{ Longing using 10 million Yuan, stop order} = \text{low}_{-1}, \\ \text{if } S = -1, \text{ Shorting using 10 million Yuan, stop order} = \text{High}_{-1} \end{cases} \quad (6)$$

This work chooses to observe 10 daily candlestick bars following the NR4IB as the work assume it's enough to identify and invest in a new momentum [8]. Long or short position is liquidated once the stop order is triggered or at the end of the tenth day after the NR4 IB if stop order is never triggered. There is a possibility that a new narrow range 4 inside bar appears before liquidation of the previous long or short position. In this case, new position should be initiated after the stop order of the previous trading is triggered [9].

Trade Execution. In trading of currencies, bid ask spread and interest rates would be considered. When buying and selling a certain currency, transaction costs mainly arise from the bid-ask spread. This paper takes fixed bid ask spread for each currency during both the in-sample and out-of-sample test period. When holding G10 currencies in long positions, currency holders can get interests from banks they deposit money in. When making short decisions, traders would hold Chinese Yuan until returning the borrowed money and therefore get paid of interests from Chinese bank. Borrow rate is not considered here.

3 Implementation

3.1 PnL Results

Figure 1 is the PnL graph of daily cumulative returns of this strategy during the in-sample period. The total simple money return over ten years is about ¥705885.6. As can be seen, the cumulative return shows an upward trend. There are small fluctuations between contiguous days. In a few years, there may be loss, but the amount of loss is small and acceptable, and the duration of loss is relatively short.

3.2 Summary Statistics

Table 1 shows that the annualized return is about 0.64%, which is much smaller than the risk-free rate of the market. The Sharpe ratio is -1.94 . The 99% VaR is about $-153,875$ CNY, which accounts for 0.15% of notional. This means the probability that the largest loss of this strategy exceeds 153,875 CNY in a trading day is 1%. The 99% ETL is about $-252,798$ CNY, which accounts for around 0.25% of notional. This means that the expected loss at 1% of the time is 252,798 CNY. The largest peak to trough drawdown is about 1,151,717 CNY, accounting for about 1.15% of notional. Overall, the return and Sharpe ratio are not satisfactory, and the strategy loss is not well-controlled.



Fig. 1. In-sample PnL results

Table 1. In-sample test result

Annualized return	Sharpe ratio with risk-free rate (one year deposit rate) = 2.35%	Volatility	99% VaR	99% ETL	Maximum drawdown
0.64%	-1.94	0.88%	¥-153875	¥-252798	¥1151717

3.3 Differences from Expectation

Annualized return is smaller than our 3% expectation. Sharpe ratio is negative and lower than our expectation which indicates that pure NR4 IB strategy performs poorly with low trading frequency and does not have excess return. Value at risk and estimated tail loss are higher than our expectation, thus the strategy might loss more than the research originally expected. But the volatility is in the accepted range.

3.4 Out-of-Sample PnL Results

Figure 2 shows the daily cumulative profit and loss of this strategy during the out-of-sample period. At the beginning, the strategy return is around 0 but it goes up slowly with small fluctuations in several months. There are two dramatic growths in this graph, which are both in a very short period. The first jump in March is caused by at least 100 pips increase in the value of AUD, GBP, JPY, NOK, SEK as shown in Table 2. Especially for NOK, its price increased from 0.636086 to 0.680228 in three days, which would generate about 7,000,000. The second jump in May is caused by longing EUR, NOK, NZD, USD, and SEK as data shows in Table 3. These three currencies increased steadily during holding periods. For NOK, its value increased for 10 days and generated positive return in every holding day.

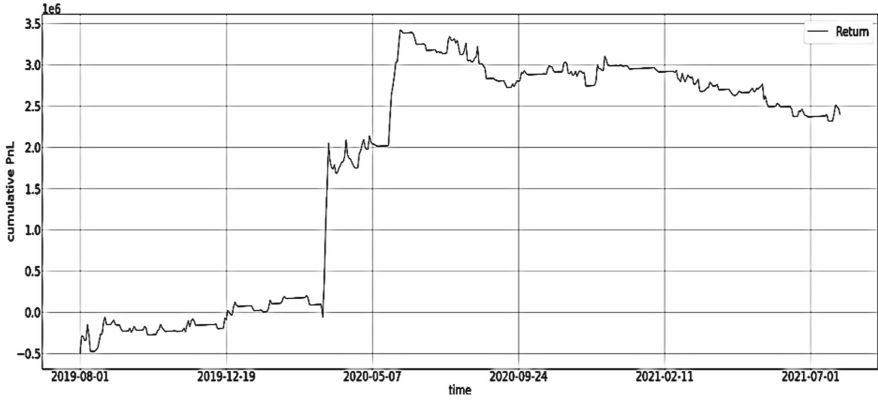


Fig. 2. Out-of-sample PnL results

Table 2. Promising currencies in May 2020

Currency	Time	Daily return (%)
AUDCNY	2020-03-23	0.018446
	2020-03-24	0.005626
NOKCNY	2020-03-23	0.006171
SEKCNY	2020-03-23	0.019255
	2020-03-24	0.010747
GBPCNY	2020-03-24	0.017347
JPYCNY	2020-03-25	0.006971

Table 3. Promising currencies in March 2020

Currency	Time	Daily return (%)
EURCNY	2020-05-26	0.007548
NOKCNY	2020-05-26	0.007305
SEKCNY	2020-05-26	0.007001
NZDCNY	2020-05-26	0.003172
USDCNY	2020-05-26	0.004345

3.5 Summary Statistics

As shown in Table 4, the 99% VaR is about -190169 CNY, which accounts for 0.19% of notional. This means the probability that the largest loss of this strategy exceeds 190169 CNY in a trading day is 1%. The 99% ETL is about -253945 CNY, which accounts for around 0.25% of notional. This means that the expected loss at 1% of the time is

Table 4. Out-of-sample test result

Annualized return	Sharpe ratio with risk-free rate (one year deposit rate) = 1.75%	Volatility	99% VaR	99% ETL	Maximum drawdown
0.8%	-0.51	1.88%	¥-190169	¥-253945	¥1181107

253945 CNY. The largest peak to trough drawdown is about 1181107 CNY, accounting for about 1.18% of notional. In conclusion, the annualized strategy return during the out-of-sample period is larger than that during the in-sample period.

4 Conclusion

4.1 Additional Considerations

Risk. Liquidity risk: In this strategy, currencies should be bought or sold as soon as the real-time price reaches some point. As the forex market is very liquid, in the real world, currencies may be sold at a discount or the buy in price is more than expected, which leads to the risk that the strategy return will narrow.

Environment. Inflation: The foreign exchange rate is affected by the inflation rates of the corresponding currencies. If a country or region is under high inflation, the return of currency trading would be affected. However, the inflation rate is not considered in this strategy.

4.2 Trading Recommendation

This strategy is based on the market dynamic of the NR4IB and engulfing pattern. And it is easy to implement the strategy in actual transactions as the work has stop and buy-in orders. Long and short decisions are both considered in this strategy, and the most liquid currencies are included in the portfolio. So, the strategy return would not be highly damaged by bid-ask spread. The out-of-sample strategy performance is also satisfactory. In conclusion, this research recommends NR4 IB for currency trading. However, there are still possibilities to make it better. First, money could be utilized more sufficiently by modifying the investment portfolio. In this strategy, the total money is equally divided into ten parts to trade each currency pair independently. The NR4IB usually appears 1 to 3 times per month. Assume the work trade on average for 5 days after each appearance of the NR4IB, the number of trading days each is 5 to 15 per month. For the other 15 to 25 days, the return only comes from interests. If more money can be invested for each trading day, the strategy return may be higher. Second, there may be other methods to predict the price trend more accurately after a NR4IB appears. This strategy adopts engulfing patterns to predict the future trend. There are cases that the condition does not satisfy engulfing patterns, but the price trend after a NR4IB keeps going up or

down. More return would be earned if the trend can be predicted in some way under this circumstance. Third, the return may be higher if the trading frequency is hourly or minutely. Since it is difficult for us to get high frequency data, the trading frequency in this research is set to be daily. If currencies are traded hourly or minutely, there would be more trading opportunities because there are much more hourly or minutely NR4IBs than daily NR4IBs.

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Forecasting MCDONALD'S Corporation Performance of 2022–2031 Based on Forecasting Financial Statements and Valuation Models

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Abstract. McDonald's has been developing steadily since its establishment and has gradually grown as a leader in the fast food industry for many years. People may wonder if the company will keep growing in the future? This paper estimates the value of McDonald's Corporation over the next decade (2022–2031). This paper is mainly divided into three parts: McDonald's overall development as well as its market competitiveness; forecast of the company's financial statements based on historical 10-k reports; several financial ratios calculated according to forecasting financial data and common valuation models. In this work, McDonald's is considered to have a good financial performance in the next ten years. This paper provides some views to readers about whether or not McDonald's is worth investing in in the future.

Keywords: McDonald's · Forecast · Valuation · Investment

1 Introduction

McDonald's Co. ("MCD", "McDonald's", the corporation", "the company"), a world-renowned American fast-food corporation that leads the industry. The corporation is the largest restaurant chain by revenue in the world. As of 2021, McDonald's has the 157th highest ranking in the Fortune 500 list [1] and the 46th highest ranking in the S&P 500 Components list [2].

Researching leading companies in an industry helps to study the development status of the entire industry. As a leader in the fast-food industry, McDonald's businesses involve many countries around the world. For example, the company can occupy a leading position in both the United States and China, two markets with different circumstances. Therefore, we want to predict the financial performance of McDonald's in the next ten years through forecasting financial statements, so as to measure the future market value of McDonald's and the sustainability of its successful model.

The current research focus on predicting the future direction of the company's income statements, balance sheets, and cash flow statements based on historical financial data [3]

and use the obtained predicted financial statements for valuations that rely on financial valuation models.

The unresolved issues at this stage include that failure to predict the future investment measures of McDonald's. In recent years, management of McDonald's has committed to integrating artificial intelligence technology into restaurant operations and has successively acquired and invested in several companies to facilitate the strategic transformation. Whether McDonald's will continue to acquire or invest in other companies during 2022–2031, or accelerate the speed of strategic transformation? These issues have not yet been studied.

This work is helpful for all parties to study the financial situation of McDonald's, especially as an auxiliary material for investors to study McDonald's future market value to determine their investment plans.

In this work, we analyze the development status and competitiveness of McDonald's, the forecast of McDonald's financial statements in 2022–2031 and the valuation of the company's future financial performance through financial models to achieve our study purpose that estimates McDonald's financial status in 2022–2031.

2 Corporation Background

2.1 Operating Model

McDonald's operates with a franchise strategy. As of June 30, 2021, as much as 93% of MCD restaurants are franchisees [4]. MCD owns the restaurants and property, and it stably and continually earns income from rent fees, franchise fees, menu fees, technical fees, and a certain percentage of dynamic operating income from franchisees [4]. The franchise strategy helps MCD to reduce the pressure and risk of operation and management and decrease operating expenditures while increasing overall income at the same time. This strategy is successful because the initiative of the franchisees is greatly stimulated, and each restaurant can be well integrated into local environment.

2.2 Future Development Strategy

In 2020, the company announced a strategy "Accelerating the Arches", mainly to increase the company's digital sales scale [5]. This included "Double Down on the 3D's" which focuses on three areas, digital, delivery and drive thru [5]. Additionally, MCD still develops the loyalty program "My McDonald's Rewards" by letting customers build food by themselves to improve customers' satisfaction and the brand image [5].

In 2019, McDonald's acquired Apprente Inc., a startup building conversational agents, to build an automate voice-based ordering system in multiple languages [6]. Earlier that year, MCD acquired another startup company Dynamic Yield also to help create a drive-thru experience based on things like weather and restaurant traffic. The company also invested in mobile app company Plexure which helps clients to develop personalized plans that build sticky and more profitable relationships with consumers [6].

2.3 Market Competitiveness

McDonald's market competitiveness is analyzed based on Porter's Five Forces [7] Classification Framework, which includes five factors, rivalry among existing competitors, threat of new entrants, threat of substitutes, bargaining power of buyers, and bargaining power of suppliers. McDonald's has been a global leader in the industry for many years, thus only a few leading companies in the industry can compete with it. Therefore, new entrants in the industry will not pose a threat to MCD. With the life space become faster, there is a great demand for fast food in the catering market. MCD's dishes have been in the fast food industry for many years and are still hot. Therefore, the threat of alternatives to McDonald's is also very low. The price of dishes and raw materials are low, so high bargaining power of both buyers and suppliers is not required. Therefore, from an overall point of view, McDonald's threats in all aspects are relatively small, and the market competitiveness will remain strong in the next decade.

3 Forecasting Financial Statements

All financial data used in financial projections are derived from McDonald's historical 10-K financial statements, which are taken from the SEC official website. Since McDonald's Co. has launched new marketing strategies in recent years, coupled with the impact of investment, acquisition, and other strategies, the trend forecasted for the next ten years is mainly based on data from year 2015 to 2021. Due to the Covid-19, reasonable estimation is made on the data of year 2020 and 2021 in all forecasts, to predict the general financial performance of the two years under non-epidemic conditions. McDonald's financial statements are forecasted based on Percentage Change Analysis Method [8] and Common size analysis Method [9] combining with financial ratios. For easy comparison, the forecast results are finally presented as line figures at the beginning of each sub section. Each figure mainly shows the trends of several key financial indicators from 2020 to 2031. All financial data is calculated in millions of U.S. dollars.

In general, due to the global epidemic is gradually under control, and MCD has acquired technology companies and is transforming into technology restaurants, the overall financial situation of MCD is expected to rise steadily in the next decade.

3.1 Income Statements

The historical data of income statements shows that the annual net income amount was in an increasing trend. According to the net income formula, the forecasting revenues as well as expenses are analyzed here.

Result. MCD's net income will keep growth in the next decade. Figure 1 shows trends of forecasting total revenues, forecasting total expenses, and gross profit from 2020 to 2031.

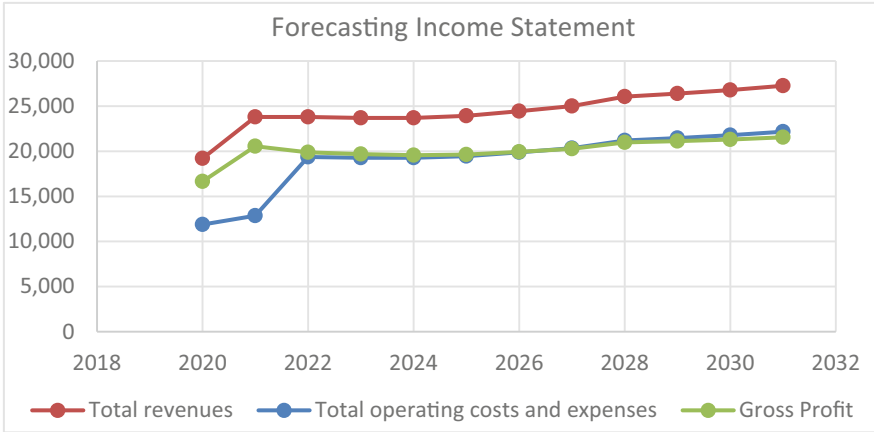


Fig. 1. Forecasting trends of Income statements 2020–2031

Discussion

Forecasting Total Revenues. McDonald’s total revenues is derived from Sales by company-Operated Restaurants, Revenues from Franchised Restaurants, and Other Revenues. According to the historical data from 2010 to 2021, MCD’s revenues showed an increasing trend. Based on the forecast of several organizations (Reuters, The Economist, and health line), Covid-19 will be controlled within around two years [10], thus MCD will not be impact. Combined with MCD’s “3D” strategy, it is conservatively estimated that McDonald’s revenues will rise in the next decade.

Forecasting Total Expenses. McDonald’s operating costs and expenses consisted of six parts, Company-Operated Restaurant Expenses, Franchised Restaurants Occupancy Expenses, Other Expenses, Depreciation, Depletion and Amortization, Other Selling, General and Administrative Expenses, and Net of Other Operating (Income) Expenses. MCD acquired several companies, and it is transforming into technology restaurants, so restaurants operating expenses, depreciation, depletion and amortization and other related expenses will increase, which leads to the overall operating costs and expenses grow in the next ten years.

3.2 Balance Sheets

Result. Data in balance sheets is expected to increase in the next decade. Figure 2 shows the trends of main data from 2020 to 2031.

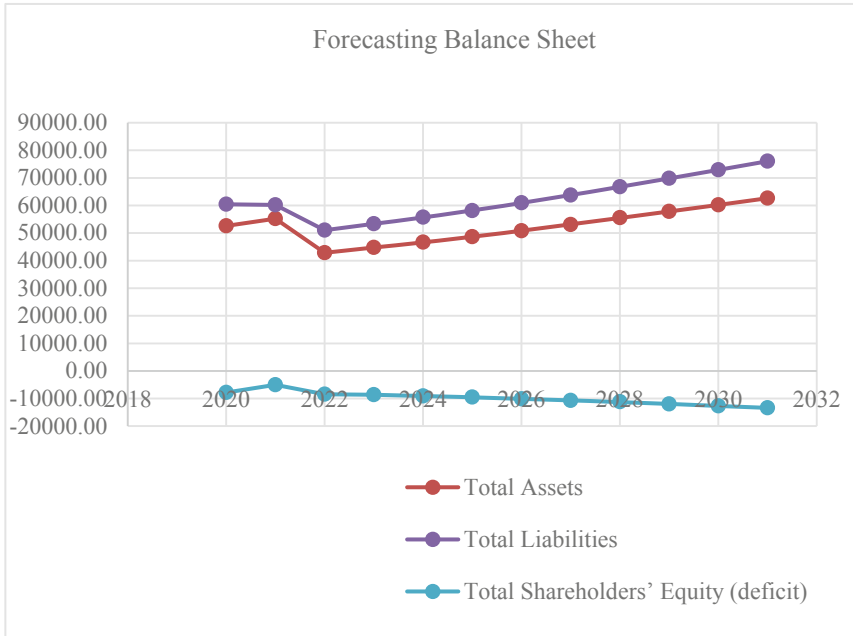


Fig. 2. Forecasting trends of balance sheets 2020–2031

Discussion

Total Assets. In the next decade, most of asset items will keep increasing with the development of the whole company. MCD decreased the amount of Current Assets significantly in 2016. After that, the data slowly decreased each year. The key reason of the decrease is that MCD changed the business strategy that develops logistics digital management to reduce inventories amount. In the future, fixed assets will increase absolutely. It is assumed that MCD will still acquire other high-tech companies to realize the transforming strategy in the future.

Total Liabilities. Similar with Total Asset, Total Liabilities increase in the forecast. In 2019, Long-Term Debt and Long-Term Lease Liability increased significantly because MCD needed more capital to achieve its operating goal that transforms to be a high-tech restaurant corporation. It is still McDonald's current goal; thus it is assumed that MCD will increase liabilities to raise capital for development in the next decade.

Shareholders' Equity. MCD's Total Shareholders' Equity is assumed in a decrease trend in the next decade. MCD only has common stocks without preferred stock. As mentioned above, MCD finances capital for its digital strategy, thus its Common Stock in Treasury will continue decrease in 2022–2031 as before. MCD insisted to increase dividends gradually, and the company will maintain this trend in the future.

3.3 Cash Flow Statement

Different from the estimation of Income Statements and Balance Sheets which are forecasted based on historical data, the estimation of Cash Flow Statements data is calculated based on the relationships between items that are predicted in the forecasting Income Statements and forecasting Balance Statements.

Result. McDonald’s operating activities cash flow will maintain in positive values, but its investing activities and financing activities cash flow will maintain in negative values. These trends are also in line with McDonald’s mature life cycle. Figure 3 shows the trends of main data from 2020 to 2031.

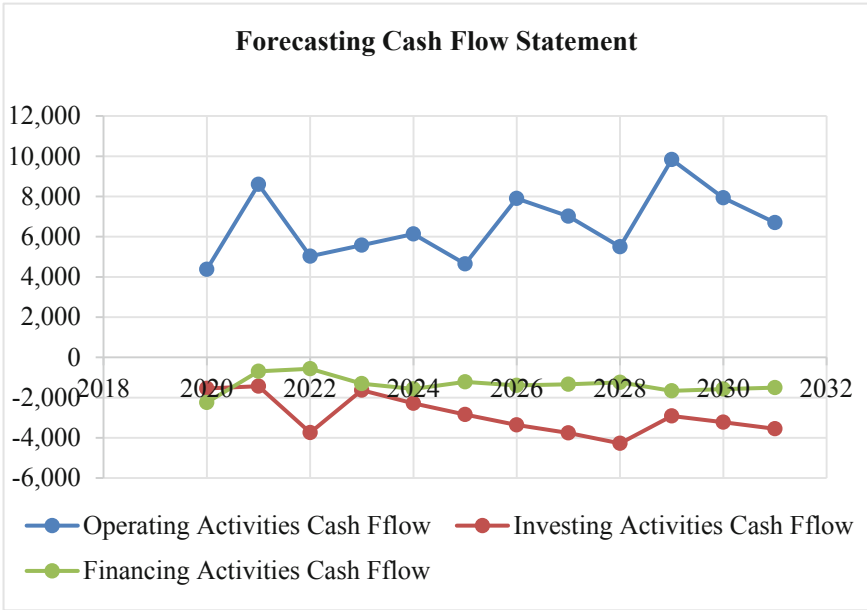


Fig. 3. Forecasting trends of cash flow statements 2020–2031

Discussion

Cash Flow of Operating Activities. Cash flow of operating activities is obtained after adjusting some of the cash provided by the operation since Net Income. According to MCD’s historical financial performance, the forecasting data of operating activities cash flow will continue maintaining in the trend that fluctuates periodically. As mentioned above, MCD’s Net Income will maintain in a stable value in the next ten years. McDonald’s adjustments cash provided by the operation consists of two parts, Charges and Credits as well as Changes in Working Capital. Total Charges and Credits will maintain

in a steady upward trend, but total Changes in Working Capital will fluctuate periodically, which is the reason caused the periodical fluctuations of operating activities cash flow.

Cash Flow of Investing Activities. Investing activities is held for investing capital in outside of the corporation. Considering the MCD's transformation strategy and its investment in high-tech company Plexure, it is expected that MCD will continue to invest in small high-tech companies in the future. Therefore, MCD's investing activities cash flow will remain at a relatively small value in the future.

Cash Flow of Financing Activities. Financing activities is held for raising capital from investors and creditors. As mentioned above, McDonald's need to finance capital for its development strategy, thus the company's funds will be concentrated on supporting its own development and will not be divided to investors. Thus, it is not easy for McDonald's to continue raising capital. MCD's financial activities cash flow will maintain in a small value close to zero in the future.

4 Valuation Models and Result

Three stock valuation models are used in the paper, including Dividends Discount Model, Free Cash Flow Model and Residual Earnings.

4.1 Dividends Discount Model

Table 1. Shows DDM related data based on the forecasting data of MCD from 2022 to 2031.

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	After 2031
P									388.35		
Dividends	5.04	6.04	6.04	6.04	6.04	7.04	7.04	7.04	8.00	8.00	
g(perpetuity)	-	-	-	-	-	-	-	-	-	-	5.92%
r	7.98%	7.98%	7.98%	7.98%	7.98%	7.98%	7.98%	7.98%	7.98%	7.98%	
$(1 + r)^n$	1.08	1.17	1.26	1.36	1.47	1.59	1.71	1.85	2.00	2.15	
$D/(1 + r)^n$	4.67	5.18	4.80	4.44	4.11	4.44	4.11	3.81	4.01	3.71	
$P/(1 + r)^n$									194.60		
DDM	237.88										

DDM Related Data 2022–2031

Assuming perpetuity growth rate: 5.92%.

Formula (perpetuity):

$$P_0 = \frac{Div_1}{(1+r)} + \frac{Div_2}{(1+r)^2} + \frac{Div_3}{(1+r)^3} + \frac{Div_4}{(1+r)^4} + \frac{Div_5}{(1+r)^5} + \frac{Div_6}{(1+r)^6} \\
 + \frac{Div_7}{(1+r)^7} + \frac{Div_8}{(1+r)^8} + \frac{Div_9}{(1+r)^9} + \frac{Div_{10}}{(1+r)^{10}} \\
 + \frac{Div_{10}}{(r-g) * (1+r)^9}$$

Formula1: Perpetuity DDM Formula

Then get the data from Table above and substitute them into t formula to get the result.

$$Div_1 \sim Div_{10} \\
 r = 7.98\% \\
 g = 5.92\% \\
 \text{Result :} \\
 P_o = 237.88$$

Dividend Payment Model. McDonald’s pays annual dividends for 34 years ago. The trends of Dividends per share and Net Profit per share over the past six years is shown in Fig. 4.

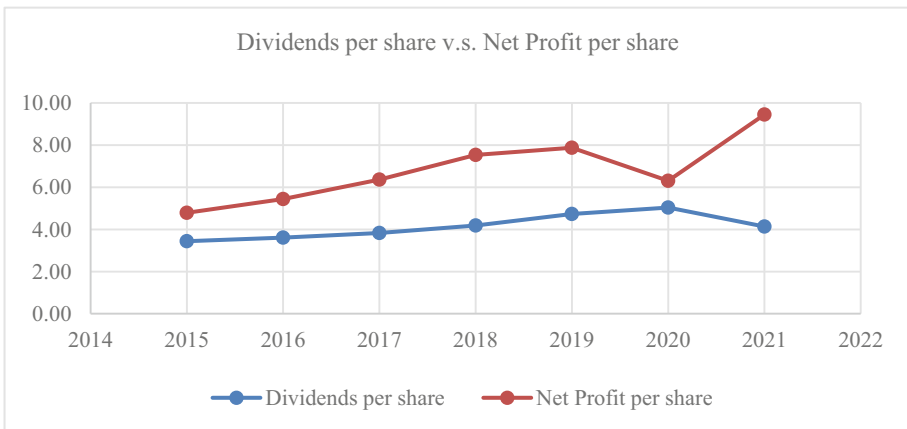


Fig. 4 McDonald’s dividends per share and net income per share 2015–2021

Although dividends are paid every year, there is no direct relationship between dividends per share and net profit per share according to Fig. 4. However, this does not mean that McDonald’s has a clear dividend policy.

Comparison Between Free Cash Flow and Net Income. Figure 5 shows the comparison of Free Cash Flow and Net Income from 2016 to 2020

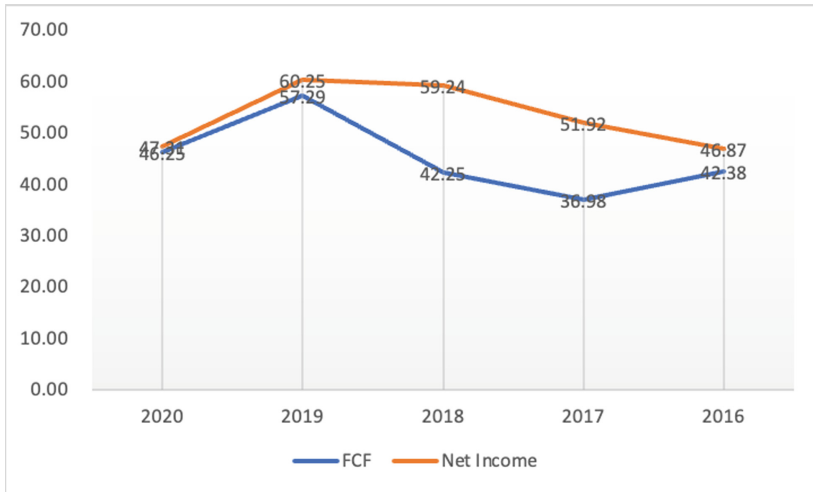


Fig. 5. McDonald's Free Cash Flow and Net Profit Comparison 2016–2020

Except for 2017 and 2018, the figures of McDonald's Free Cash Flow and Net Profit during the period of 2015–2021 basically matched. This is mainly related to the business McDonald's model. In addition, as a corporation in the catering industry, MCD has relatively simple financial accounting as well as short survival cycle. McDonald's is still relatively cautious in capital investment. There is no blind expansion in capital expenditure. More is to determine the company's investment strategy based on its profitability [11].

According to the observation, both DDM Model and FCF Model are suitable for McDonald's valuation. However, McDonald's will continue to expand market share especially Chinese market. Therefore, FCF Model is better for McDonald's at this stage. The DDM Model is better for those relatively stable companies [12].

4.2 Weighted Average Cost of Capital

Weighted average cost of capital (WACC) reflects the expected return of capital market on capital occupation and is mainly used here as the discount rate for future free cash flow. It is mainly weighted by McDonald's expected investment return and Debt to Asset Ratio. The company's main operation logic is as follows:

- a. $WACC = \text{proportion of McDonald's equity} \times \text{Expected return on McDonald's equity } (E(R)) + \text{proportion of McDonald's debt} \times \text{interest rate of McDonald's debt}$
- b. $R = RF + \text{beta} \times (RM - RF)$

- c. $\beta(MCD) = \frac{\text{Covariance}(MCD, NYC)}{\text{Variance}(NYC)}$
- d. A single state model is used to predict the growth rate of free cash flow in a perpetual state after five years.
- e. WACC calculates the total discounted free cash inflow, subtracts the existing liabilities to get the final cash inflow, and divides by the current shares to get the expected stock price.

MCDonald's Forecasting WACC

$$\begin{aligned} \text{Equity} &= \text{Number of common shares outstanding} \times \text{current share price} \\ &= 747,245,427 \times \$252,65 \\ &= \$188,791,551,131.55 \end{aligned}$$

$$\text{Debt} = \$43,700,00$$

Estimate average effective income tax

$$\begin{aligned} &= \frac{(0.230 + 0.249 + 0.257 + 0.317)}{5} \times 100\% \\ &= 25.70\% \end{aligned}$$

$$\text{WACC} = 5.79\%$$

FF Growth Rate

$$\begin{aligned} \text{Growth rate}(g) &= (\text{initial company market price} * \text{WACC} \\ &\quad - \text{Initial free cash flow}) / (\text{Initial company market price} \\ &\quad + \text{Initial free cash flow}) \\ &= 2.17\% \end{aligned}$$

The fair value of liabilities is applied as the value of total liabilities, but the difference is not obviously after calculation. Thus, book value from audit reports is directly used here.

Price-to-Earnings Valuation Model. Price-to-Earnings ratio (“P/E ratio”), the ratio of current stock price to earnings per share (“EPS”), is a method of company valuation. P/E ratio is sometimes called price multiple or earnings multiple.

The stock price calculated below is in U.S. dollars.

$$\begin{aligned} \text{stock price} &= \text{PE ratio} \times \text{EPS} \\ &= 9.60 \times \$26.1 \\ &= \$250.56 \end{aligned}$$

Table 2. The expectations of expected future discounted cash flows and stock price in the next decade.

Unit Millions Of DOLLARS	WACC		5.79%
Year	FCFF	(1 + the discount rate) ^T	PV
2022	5,319.74	105.79%	5,028.58
2023	5,172.62	108.49%	4,767.70
2024	5,313.23	107.94%	4,922.33
2025	5,303.33	108.41%	4,891.78
2026	5,525.98	109.17%	5,061.86
2027	5,798.28	110.06%	5,268.42
2028	6,212.00	110.98%	5,597.18
2029	6,395.29	112.03%	5,708.59
2030	6,631.81	113.03%	5,867.42
2031	6,887.13	114.12%	6,034.73
Sustainable	6,887.13	114.12%	166,705.25
Total free cash inflow			219,853.84
Total liabilities			(57,569.98)
Company market price forecast			277,423.82
Total number of shares outstanding			7,47.2
Company stock price forecast			274.75
The current share price			371.28

The McDonald's market value is calculated in Billions of U.S. dollars.

$$\begin{aligned}
 \text{market value} &= \text{Number of common shares outstanding} \\
 &\quad \times \text{current share price} \\
 &= 250.56 \times 7.472 \\
 &= 1872.18 \\
 &= \$ 187.218
 \end{aligned}$$

5 Conclusion

In the past six years, McDonald's financial data performed well with stably increasing [13]. McDonald's complete operation system plays a crucial role in production and operation, which ensures the company's leading position in the industry. In addition, McDonald's rapid development in recent years benefits from the implementation of its clear and sustainable development strategy. Moreover, McDonald's will have sufficient cash flows in the future. McDonald's main profit growth in the future will come from

two parts: the opening of new restaurants and the expanding market share from new restaurants as well as new development strategy.

McDonald's is a well-run company with premium brands, industry-leading margins and a recession-proof business model. Still, McDonald's future growth could be more difficult. FCFE estimates McDonald's share price at \$274.75, DDM estimates \$291.80, and PE estimates \$250.56. The stock is currently trading at \$371.28. By comparing the stock price with the real price, it shows that the company's stock price is affected by the short-term market in a certain period, and the real price is higher than the stock price.

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13. According to the above financial data, it can be seen that McDonald's has a stable growth



A Survey of Research on the Costs of Financial Distress

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Abstract. This paper provides an overview of the literature that connects capital structure with financial distress costs. These works contain elements from the trade-off theory to the modern financial theory, direct and indirect costs of financial distress, corporate performance, reorganization, and management turnover. Several questions have received a great deal of attention in the literature. First, how should the costs of financial distress be measured? Second, what effects would financial distress have on corporate performance? Third, what is the magnitude of the financial distress costs? Fourth, what are some benefits and costs regarding management changes? This work has analysed and organized the effects of financial distress from the perspective of firms to employees. This literature review aims to create an index for the existing discoveries to guide researchers for their further investigations.

Keywords: Costs of financial distress · Magnitude of financial distress costs · Corporate performance · Reorganization · Management turnover

1 Introduction

The issues of capital structure theories have attracted considerable attention from economists in recent decades. Leland [1] introduced the trade-off theory that firms with more tangibility are eligible to issue more debt since they have greater second-market value assets. The theory was developed in the western economic environment; this paper testified this theory in the eastern economy, for instance, China. An investigation on tangibility and leverage ratio in China has been completed, as shown in Tangibility Table 1 and Tangibility Table 2, which contains two public Chinese companies and two private Chinese companies with significant differences in capital structure. As the result is consistent with the trade-off theory, questions arise, what firm-specific factors might account for the difference in their capital structure? The test results are being presented in Sect. 6 (see Tangibility Table 1 and Tangibility Table 2).

Modigliani and Miller [2] argued that capital structure has no impact on firms' performance (value) and the weighted average cost of capital when markets are perfect. Unfortunately, most researchers have not accepted this model since markets are not perfect in reality. An increase in debt issuance would increase the probability of default.

Leland [1] and others have discovered and proven valid that a rise in financial costs would be the consequence. According to the trade-off theory, managers should consider the trade-off of bankruptcy costs and the tax benefit when making capital structure decisions since bankruptcy costs have been argued around 10–23% of the value of firms. Cumulative results suggest that defaults on debts would eventually force firms into bankruptcy under reorganization or liquidation. In addition, numerous researchers argue the benefits and costs of financial distress from the reorganization and corporate performance perspective.

These works can be categorized into four sections of literature. The first is measurements of costs and financial distress. Starting from the Z-score model developed by Altman [3], Almeida and Philippon [4] and other theorists made some improvements over Altman's equations and have significant contributions regarding the magnitude of costs of financial distress.

The second point is effects on corporate performance under financial distress based on different leverage. Opler and Titman [5] found that firms with high leverage would be more likely to enter financial distress, which may suffer greater under this circumstance. Even though the works eliminate the problem of endogeneity between firms' performance and financial distress in previous works such as Altman [3], the problem with the degree of financial distress costs is still non-negligible leads to our third point.

The third point is the magnitude of the "pure" financial (not economic) distress and direct costs. Andrade and Kaplan [6] showed that costs of financial distress are non-negligible for the shocked samples, which the "pure" financial distress is minor. Moreover, the sample firms earn a mean return of 8% and a median return of 5% adjusted for market returns while comparing with other financial or non-financial distressed firms; thus, high leveraged firms do not necessarily lose more than low leveraged firms, which is consistent with Jensen [7]. In addition, some works related to direct costs magnitude that varies from 1–8% are worth mentioning.

The fourth point is the benefits and costs of reorganization and management turnover. Andrade and Kaplan [6] and Wruck [8] have proven that firms under a successful reorganization tend to increase their value. However, Gilson [9] testified that senior management turnovers have non-negligible costs in terms of total financial costs, either forced or departure, which is also costly to firms. This paper highlights that nearly 36% of all turnovers are resulted from financial distress. In addition, Brown and Masta [10] have verified both qualitatively and quantitatively that application attractiveness drop has high costs to distressed firms.

These four approaches give an integral view regarding possible links between costs of financial distress, capital structure, corporate performance, and management changes.

In this paper, financial leverage can be defined as book leverage, and financial distress can be defined as the present value of the firms' cash flows being less than its total obligations, which is stock basis.

The remainder of the paper is organized as follows. Section 2 provides an overview of the financial distress costs measurements; Sects. 3, 4, 5 provide an overall summary of corporate performance under financial distress, the magnitude of "pure" financial distress, and benefits and costs of reorganization and management turnover, respectively.

Section 6 provides a data table regarding the relationship between tangibility and leverage ratio mentioned in the introduction. Finally, Sect. 7 summarizes and concludes.

2 Measurements and Magnitude of Indirect and Direct Financial Distress Cost

This series of literature emphasizes the possible measurement standard of bankruptcy costs and their proportions in the value of the company. According to these studies, bankruptcy costs can be affected by abnormal loss of sales and profits, higher cost of credit, or possibly the enterprises' inability to obtain credit or issue securities to finance new opportunities. Therefore, the paper focuses on the direct costs paid by the debtor in the process of liquidation/organization and those illusive indirect costs.

Baxter [11] was the first person who divided the bankruptcy costs into direct costs and indirect costs. He believed that excessive leverage is associated with "the risk of ruin", namely the increasing probability of bankruptcy, which is expected to raise the capital costs and further reduce firms' total value. He also argued that the bankruptcy costs caused by increasing leverage appear in the firm's administrative costs and a decline in its net operating earnings.

Warner [12] studied the direct bankruptcy costs in 11 railway companies. He found that the average direct costs of bankruptcy were about 1% of market value seven years prior and increased to 5.3% of market value just before the filing date. The result is different from Baxter's [11], as he suggested that the percentage of direct bankruptcy costs was 20% of the firm's value. Warner thought Baxter's sample companies had a smaller market value than the railroads. He inferred that the percentages of bankruptcy costs are relatively small. Thus, it would not be the major part when assessing optimum capital structure decisions.

Meanwhile, he also suggested that the higher the firm's market value, the higher bankruptcy costs. Warner's work has several problems. First, his sample of the bankruptcies of 11 railroads was too small to indicate the population of all companies. Second, the study lacked standardization and measurement of indirect costs. Warner did list the managerial opportunity costs as a direct bankruptcy cost, but he still did not measure this elusive cost. Although there are some shortcomings in his study and a complete lack of empirical research on this issue, it is still an essential first step to formulate a method to measure and evaluate those bankruptcy-related costs.

In order to further prove the magnitude of bankruptcy costs, Edward Altman [3] first put forward a methodology, which made an outstanding contribution to the issue of bankruptcy cost. His study sample included twelve retailers and seven other industrial companies that went bankrupt from 1970 to 1978. Furthermore, he investigated the following items: (1) direct costs documented in the bankruptcy records in the U.S. District Bankruptcy Courts; (2) indirect costs, namely the loss of future profits due to the probability of bankruptcy and (3) the probability of bankruptcy for those sample companies. He used a regression technique and security analyst forecasts to estimate the expected profits of a firm.

Moreover, he proposed a Z-score formula which was later amended to a ZETA model to measure the probability of bankruptcy through the firm's financial reports. The

results were convincing that bankruptcy is not trivial. Bankruptcy costs averaged from 11% to 17% of the value of the company three years prior to the bankruptcy. Although Altman's work was more comprehensive and accurate than the previous studies, it still had several problems. First, his sample did not include those firms that keep running. At the same time, bankruptcy costs exist whenever there is a probability of financial distress. In addition, this method may raise the endogeneity problem since it would be hard to distinguish whether poor performance by a company in financial distress is caused by financial distress itself or by the same factors that initially pushed the firm into financial distress.

To minimize the problem of reverse causality, Opler and Titman [5] select firms in industries that have experienced economic distress as their sample. Instead of calculating the exact amount of indirect costs, they investigated the link between financial distress and the performance of companies. The findings indicated that companies with high leverage are likely to lose market share and gain lower operating profits than their less leveraged competitors in industry downturns. And this relationship between leverage and performance is extremely noticeable for companies with large R&D expenditures and in more concentrated industries. However, as Opler and Titman investigate distressed industries rather than distressed firms, their sample probably includes a substantial number of firms that do not go into financial distress while excluding some that are financially distressed. Therefore, their testing procedure is not as strong as those that simply investigate distressed firms. Moreover, such sample selection confused economic distress with financial distress, so the result is not pure financial distress costs.

In subsequent studies, Andrade and Kaplan [6] attempted to separate the pure distress costs. They chose firms in the HLTs (highly leveraged transactions) that later went into financial distress in the 1980s. They measured the distress costs as the difference between the value of total pre-distress capital and the total capital realized during distress. The results show that the net financial distress costs account for 10%–20% of the value of the company, with a maximum reaching 25%, which suggests that these costs exist as significant in magnitude.

Graham and Carlos [13, 14] multiplied the historical probabilities of default by the ex-post costs measured by Andrade and Kaplan to figure out ex-ante financial distress costs. The results suggested that the costs are insignificant to offset the tax benefits from increasing leverage. It is not consistent with companies' performances; thus, their conclusion is that enterprises might be too conservative in using debt.

However, Almeida and Philippon [4] argued that the calculation of Molina and Carlos [13] ignores capitalization and discounting. Moreover, they believed that there is a common defect in the previous studies; people ignore the relationship between financial distress and macroeconomics, thus failing to think about the systematic risk of financial distress. They quantified the impact of distress risk premia and proposed a new method to calculate the net present value of financial distress costs. The formula they used is similar to the one used by Graham [14]. The essential difference is that Molina and Carlos used historical default probability, while Almeida and Philippon used a risk-adjusted financial distress probability estimated from yield spreads and recovery rates. Their results suggest that the risk-adjusted default probabilities and the risk-adjusted NPV of financial distress costs are much larger than historical default probabilities and

the non-risk-adjusted NPV of financial distress, respectively. As a result, the marginal risk-adjusted financial distress costs can be the same magnitude as the marginal tax benefits of debt, which helps explain why those U.S. enterprises were conservative in using debt.

3 Corporate Performance Under Financial Distress

A fact that is well known is that when firms are in financial distress, it would be challenging for them to access credit. Potential aggressive responses from their competitors would be costly to them. Opler and Titman [5] predicted that the possibility of losing market share, sales, and operating profit would be significant, especially for highly leveraged firms. Their data was gathered from 1992 standards & poor COMPUSTAT, and cross-sectional regression was used to prove their hypothesis, “higher leveraged firms would perform worse than lower leveraged firms during financial distress,” as well as t-tests to verify the coefficient of main explanatory variables.

Ignorable results were achieved from their study of corporate performance and financial distress. Their empirical tests verified their hypothesis, and the coefficients are highly significant. The results can be concluded as firms with high R & D expenditure intensity in a concentration industry may suffer more from financial distress. Some related works have supported this result, such as studies of Garcia-Appendini [15] and Tan [16] regarding corporate performance under financial distress. In addition, they discovered some potential weaknesses in Altman’s theory [3]. The relationship between corporate performance and financial distress may have an endogeneity issue. A sample selection bias was developed to solve this problem by choosing industries as samples rather than firms. However, this sample bias may only observe the effect of the bankruptcy costs, but not its cause.

4 Magnitude of “PURE” Financial Distress

The Opler and Titman [5] sample bias also leads to another issue: the financial distress was mainly economic distress. The problem has caught the attention of Andrade and Kaplan [6]; they analyzed high leveraged transactions in the 1980s and tried to separate the financial costs with economic costs. The data was gathered from 31 HLTs out of 124 firms from Kaplan’s paper (1993–1995). Both time-series variation and cross-sectional regression were used to test their hypothesis that costs are not exceptionally high on HLTs and would result in a positive impact in value; dummy variables were considered.

Their findings were quite interesting: “adjusted for market returns, the sample firms earn a mean return of 8% and a median return of 5%.” This verified their hypothesis that highly leveraged firms do not necessarily lose more than non-financial distressed firms, which is consistent with Jensen’s theory [7]. Furthermore, these firms earn average cumulative market-adjusted returns of 26.7%. In other words, the sample firms do unexpectedly well after emerging from Chapter 11 or restructuring, which confirmed that their value increased after financial distress. They did successfully separate the costs of financial distress from economic distress since “the sample firms have positive operating margins at the time of distress which exceed the median industry operating margins.”, in

other words, these firms are primarily financially distressed, not economically distressed. However, the costs of financial distress are negligible for the non-shocked samples, while the “pure” financial distress costs would be minimal. Even though they have not solved the problem from Opler and Titman’s paper [5], an improvement was made by finding the cause of financial distress, which was mostly done by having poor capital structure and high leverage.

Another finding worth mentioning was that financial costs were insignificant when the samples entered Chapter 11 or any direct costs. LoPucki [17] had similar results, in which they reported direct bankruptcy costs of about 1.4%. Whereas Warner [12] reports 4% and other works reported a more significant degree of direct costs as high as 7.5% by Betker [18]. Chen and Merville [19] came up with the theory that firms with higher leverage and smaller size may suffer greater during financial distress. Weiss [20] investigated expected costs of bankruptcy since the optimal capital structure depends on it.

5 Benefit and Costs of Management Change

5.1 Benefit of Reorganization

Benefit within financial distress has been a controversial topic in finance. Wruck [8] has done some research regarding reorganization and corporate efficiency since benefits may exist by forcing managers and directors to reduce capacity and rethink operating policies and strategy decisions under financial distress. Conflicts of interests may exist when resolving distresses. They argued that financial distress affects more than just the capital structure. Samples’ data was gathered from four previous studies by Altman, Weiss, and Warner [3, 12, 20] and cross-sectional regression was tested.

Even though they did not find any quantitative data regarding benefits from financial distress, they discovered that combining the firm’s financing policy, governance structure, and compensation policies would align interests between claim holders and managers and form the ultimate optimal structure rather than adjusting their debt and equities issuances. The quantitative benefit was discovered by Andrade and Kaplan [6], as mentioned in previous pages. Since reorganization involves management change, especially for top management, some costs are inevitable.

Whitaker’s [21] and Choy’s [22] works showed consistent results with Wruck [8]. The paper also mentioned that US firms often enter legal bankruptcy, whereas German and Japanese firms prefer private workouts. Some works such as John [23] found that firms have low liquidity value and high cost of asset sales file for Chapter 11, whereas firms with low cost of asset sales and high second market value assets tend to sell assets and restructure privately. Bris [24] argues that Chapter 7 liquidations appear to be no faster or cheaper in a direct expense perspective than Chapter 11 reorganizations.

5.2 Costs of Management Turnovers

Since firms experienced high personnel costs during financial distress, management turnover costs cannot be ignored; Gilson [9] investigated management turnover and

financial distress. 381 firms experiencing significant common stock price declines (1979–1984) were chosen to do an empirical test involving cross-sectional regression and dummy variables. Gilson argued that firms experiencing financial distress are more likely to have management turnover, including forced and departure, which was proven by his results that nearly 36% were caused by firms' poor financial condition. Moreover, 52% firms in financial distress have turnover costs, only 19% for non-financial distress firms, and firms in financial distress condition have only 34% of managers remaining, where firms successfully restructure their debt has 40%, original managers. Once again, prove that reorganization is hugely beneficial to firms in financial distress.

Iqbal and French [25] provide a possible solution to decrease the costs of management turnover by allowing managers to own a large quantity of equity stakes; this would decrease the likelihood of them being replaced or departure.

5.3 Costs of Applications Attractiveness Drop

The impact of financial distress on applications is unignorable since financial distress can decrease the number of applications. Job seekers do not just apply to corporations they desire; they value the companies before applying. Their decisions are largely determined by the financial conditions of those corporations, and they use companies' credit default swap prices and accounting data to gauge the company's financial position. The cost of financial distress can be seen as companies attract significantly fewer applications per job opening during periods of corporate distress. Financial distress harms a negative impact on applications since losing a job is hugely costly to workers, which as a result, workers may avoid distressed firms. In addition, data has pointed out that managers who left distressed firms do not get employed after at least three years. Unless distressed firms can offer a sufficient compensatory wage premium, otherwise they may have difficulty recruiting new talent, especially for positions that require firm-specific investments. It is well-known that the solution for a company to get out of financial trouble is to cut employment. Therefore, job seekers will avoid companies in financial distress.

Brown and Masta [10] provided a quantitative correlation between the financial distress and the number of applications, which they measure the relationship of CDS (Credit default swap) price and the number of applications. They concluded that "On average, a 1,000-basis point increase in a firm's CDS price is associated with about 20% fewer applications to a given position".

Pindado and Rodrigues [26] stated that "Financial distress costs are determined by both the probability of financial distress and the ex-post financial distress costs, proxied by leverage, holding of liquid assets, and changes in investment and employment policies".

From their financial distress costs model, it is obvious that the relationship between financial distress cost and holding current assets is negative, which means that insolvent companies can choose to maintain a large inventory of current assets. Having more liquid assets is one way to avoid financial distress and the costs of financial distress. A negative investment rate means that the problem of underinvestment has a bigger impact on financial policy than the problem of overinvestment. The negative correlation between the employment variable and the cost of financial distress suggests that labour legislation prevents employment reduction from becoming an economically viable policy in

the face of financial distress. Tobin's Q theory supports the need to control investment opportunities to explain the costs of financial distress, which a company would be able to reduce the cost of financial distress if it has better investment opportunities than its industry. Sectoral variables are designed to capture the impact of the economic performance of an industry on the performance of an individual firm. If the coefficient of this variable is positive, it indicates that the cost of financial distress is lower in growing, declining, and mature industries. Finally, a negative sign on the coefficient of the size variable will confirm that larger firms are more likely to cope with financial distress.

6 Tangibility Data Table

Computation regarding market leverage is total debts divided by the sum of the market value of equity and book value of debt. Computation regarding book leverage is total debts divided by total assets. Tangibility for real estate business is computed by non-current assets divided by total assets. Net Property Plant Equipment calculated other industries' tangibility divided by total assets.

Table 1. Tangibility Table 1

Comparison of Public Limited Corporations					
VanKe Corporation (Real estate business/tangible assets)			XiaoMi Corporation (Smartphone business/intangible assets)		
Tangibility	17.22%		Tangibility	2.83%	
Market share (2020)	4.03% The largest individual share in the Chinese real estate market		Market share (2020)	13.06% The third individual share in Chinese smartphone market [just behind Apple and Samsung]	
	Book leverage	Market leverage		Book leverage	Market leverage
Mid 2021	15.93%	63.46%	Mid 2021	6.52%	3.40%
2020	15.99%	57.08%	2020	7.28%	2.66%
2019	16.24%	51.58%	2019	10.12%	8.61%
2018	18.21%	64.77%	2018	7.53%	64.77%
2017	17.34%	43.61%	2017	12.08%	4.27%
2016	16.33%	44.30%	2016		

Table 2. Tangibility Table 2

Comparison of Private Limited Corporations			
DingChen Corporation (Industrial Co., Ltd./tangible assets)		MakeSens (Energy efficiency & Technology Ltd/intangible assets)	
Tangibility	34%	Tangibility	21%
Book leverage			
Mid 2021	18.28%	Mid 2021	18.18%
2020	17.84%	2020	17.89%
2019	22.17%	2019	17.14%
2018	23.12%	2018	17.43%
2017	21.97%	2017	20.78%
2016	20.09%		

7 Conclusion

This study discusses the four branches of discoveries that link costs of financial distress, capital structure, corporate performance, and management changes.

First, the paper begins with the measurements of financial distress costs. Altman [3] first proposed a proxy methodology to measure the indirect costs. He found that the financial distress costs made up a large proportion of the firm’s value. Other theorists made some adjustments to his method, and they argued that the costs account for 10–23% of the value of firms.

Second, the paper highlights work regarding effects on corporate performance under financial distress. The discovery of Opler and Titman [5] is important as they argued that higher leveraged corporations tend to perform worse under financial distress than lower leveraged corporations.

The work eliminated the problem of endogeneity between bankruptcy costs and corporate performance by selecting industries as a sample instead of firms. However, the validity is questionable since they may include some non-financial distressed firms and exclude some distressed firms. In addition, the financial distress was more of economic distress due to the sample selection bias.

Third, the magnitude of “pure” costs of financial distress and the court-related costs of Chapter 11 has been proven to be extremely small by Andrade and Kaplan [6]. They also noticed that most firms were distressed due to high leverage. Moreover, empirical tests showed that bankruptcy costs are not particularly costly for highly leveraged firms. Other works argued that direct costs are significant to firms, and Chapter 11 costs cannot be ignored.

Fourth, benefits exist and may be greater than costs for distressed firms under a successful reorganization has been proven with quantitative and qualitative data by both

Andrade and Kaplan [6] and Wruck [8], Gilson [9] and Brown and Masta [10] have provided evidence that management turnovers and application attractiveness drops would be costly to firms.

Finally, this paper also includes some verification of the trade-off model. In order to verify the trade-off theory over the past five years, data analysis on the amount of debt issued between corporates with more tangible assets and corporates with more intangible assets is completed.

Both public and private corporations' results are consistent with the trade-off theory since Vanke and DingChen have a higher leverage ratio than XiaoMi and MakeSens by having more tangibility.

Acknowledgement. The names of authors are in alphabetical order. They are both first authors.

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New Business Model of Furniture from Recycled Plastic Waste

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Abstract. The alarming rate at which the amount of plastic is growing in the ocean potentially results in major environmental issues. Environmentally friendly firms nowadays are all focused on creating awareness on recycling since it is much more efficient, reliable, and cheap to recycle by doing so. By discovering a new sustainable methodology ensures that the amount of plastic entering the ocean dramatically reduces. For this same reason, a group of locals in Hong Kong who have massively settled across the Shing Mun River have collected plastic wastes from the river before it enters the oceans and recycles them to make furniture. It is not just an effective way of sustaining ocean pollution but has also proved to be a reliable source of income for the locals. Consequently, for the purpose of this research paper, it will further elaborate on the various ways through which plastic waste has been recycled to make public furniture in Hong Kong and the various measures taken to strengthen the market on buying furniture made from recycled furniture plastic waste.

Keywords: Solve plastic waste · Personalized furniture · Sustainable waste recycling · New business model · Furniture production process

1 Introduction

Over the years, the movement on the recycling of waste materials has been on the rise. It has greatly been attributed to the fact that over 90% of the world's waste products enter the ocean through rivers and other inlets. When it comes to governmental policies, even though it is possible that governments control this dumping and depositing of plastics, it is applicable only if we can remove the plastic waste from the rivers before it enters the ocean. Through this, the population along the Shin Mun River in Sha Tin Hong Kong has majored in the business of making public furniture from recycled plastic waste [1]. Although the campaign on recycling has been going on for several years now, it has been successful. While plastic may be put into recycling, they are only turned into items such as plastic bags and containers as it has a shorter lifespan [1]. Thereby, the recycling span of the plastic is just one year instead of making long-lasting products such as tables and chairs.

2 Discussion

In Sha Tin River only, the amount of waste into rivers has been turned into very fancy furniture used in public and private spaces. This has fully stretched the lifespan of recycled plastic for longer years than recycling the plastic into trash cans. It is also vital to note that fantastic plastic must be put together through the production process for the fancy benches to be made, thereby reducing the amount of plastic waste by many tonnes. This method has proved to be more sustainable and reliable than recycling plastic waste in small batches. Organizations and private companies worldwide also search for sustainable approaches to reduce plastic waste dumping into the river. According to a study course in 2019, sustainable recycling of plastic waste could boost the economy up to 120 billion dollars every year. It is also estimated that this only constitutes about 14% of the world's plastic waste. The data elaborated above implies that over 86% of the world's plastic waste still ends up dumped in oceans and landfills. It is recommended that plastic recycling is intended to make more money for companies that invest in it [2]. Subsequently, the creation of economic value will also be achieved by creating jobs through all the production processes of the recycling up to the supply chain and logistics part of the final product. Already said, Hong Kong has made massive employment for the locals regarding collectors and plant workers.

Over fifty corporations in the world have come together to ensure that plastic waste is managed well, pumping over 1.5 billion dollars into ensuring that plastic waste is made worthy and returned to the public. Major companies such as Starbucks and Amazon have championed recycled plastic waste as furniture in their office space. This has dramatically created a boost for the up-cycled plastic waste on the table. They are well designed to ensure that they give a unique antique look that is more appealing to the eye. It is right to say that the up-cycling of plastic waste into fancy antique-like furniture has caught the eye of several corporations in the world, hence the billion-dollar investment [3]. A popular European-based company, pentatonic, has also made the record in up-cycling plastic waste into chairs and tables and pillows, gearing the furniture world from not using just the traditional wood but also to venture into a more challenging world of plastic waste for furniture. There is a Mexican furniture brand called Luken, this brand designed a range of child-friendly furniture by using plastic bottles and valchromat styled sheets, it stands out from the market with its unique design style, and they can be easily assembled just like inserting a toy, which opens a new field in this piece of the market and also provides a new way of thinking to those latecomers in this industry field [4] (Table 1).

The table one indicates that Hong Kong has been importing sizable amounts of plastic waste from countries such as Germany and Japan Over the years. This is in addition to the numerous debris that is already in production in Hong Kong. For instance, the country imported over sixty-three thousand tones while managing to get over thirty-eight thousand tones from Japan. Consequently, this data demonstrates that Hong Kong has tapped into a great potential while ensuring that it employs sustainability in managing plastic wastes. For example, in 2019, a German company ALBA worked with a local company in Hong Kong, Baguio waste management limited, and Coca Cola to open a recycling plant: polyethylene terephthalate (PET) at Eco Park, Tuen Mun, which can recycle over thirty-five thousand tonnes of plastic per year [5].

Table 1. The data of plastic waste growth in Hongkong from 1950s to 1980s.

	Population (mio. inhabitants)	Proportional increase since previous decade	Waste production (tonnes/year)	Proportional increase since previous decade
1950s	2,360,000 (1950)		322,000 (1952)	
1960s	3,133,131 (1961)	32%	568,600 (1968)	76%
1970s	3,936,795 (1971)	25%	877,400 (1972)	54%
1980s	5,524,600 (1986)	40%	>2,190,000 (1982)	149%

It is through this motivation that we came up without our product line. Luxury furniture is made from the same recycled material of plastic waste and metal. Properly recycled and turned into a great piece of furniture that is more appealing and captivating to the eye. It is also vital to note that the introduction of furniture from recycled waste has not been easy, so many clients are still attracted to traditional wood furniture. The difference between these products and Sha Tin is that it is specifically designed to look like a sofa couch instead of the plastic bench in the town hall. The product is made from type 2 plastic and is, therefore, one of the best product lines that we will produce. The personal sofa is meant to create both an aesthetic and antique look for the clients. With the constant expansion of local recycling and importation of plastic into the country, it is right to say that we will have the right amount of plastic material for our product while majoring in on the growing market and long of fancy furniture from recycled plastic [1].

3 Methodology

The research was primarily conducted using secondary sources of information. The sources used were study journals, research papers, and websites with published information on plastic waste to make furniture. Another data collection technique that was used was through interview methods. Most of the companies that have majored in furniture creation from plastic were available online to participate in a series of questions and answers. The resources produced valuable data that will be used in the study. Finally, the paper will discuss six key components which have been investigated to formulate the relation of this company and its stakeholders.

There is a clear market gap when it comes to furniture made from plastic. This is because the furniture we have is clearly made from wood. We barely acknowledge that plastic waste could be used to make something more than just paper bag that they have been recycled. It is vital to note that a very quality type of plastic is created through the various recycling processed, good enough that’s meant to last you years after its manufacture. After studying for research papers and construction interviews both online and in-person, it is evident that there is a clear market gap when it comes to the production of furniture from recycled plastic. There has been confirmation that most of the market, especially in the American and European continents, yearns for a new form of furniture while ensuring that the plastic they buy is put into use. Several environmentalists replied

that they would be regular buyers of the furniture we intend to produce in large quantities. It is vital to note that this applies to almost every other environmentalist across the world.

Nevertheless, this challenge is not just to the environmentalist; it cuts across the board. Shopping for furniture that we produce exquisitely, we realize that most of the plastic furniture that has been adapted is mostly in offices, public places, and hotel lobbies. Suppose we can penetrate the market by ensuring that we also attract homeowners and interior designers to embrace the new furniture model in our production. According to the design that we have managed to create and the current response that we are getting from our customers, the adoption of furniture made from recycled plastic is greatly welcomed globally, creating a whole new leeway for our company. The profitability of their venture is since several other companies are yet to venture into this type of furniture manufacturing and distribution, leaving the whole wide market to us and few others that have tapped into this business. To bridge the market gap because we are not yet an established enterprise, we intend to partner with several other major furniture distributors such as Ikea. This will give us access to a larger market, increasing the company's chances of expansion and profitability.

3.1 Methodology-Key Partners

Some of the significant key partners we are looking to work with while recycling plastic to make furniture include furniture moguls such as IKEA, as mentioned earlier. IKEA presents our company with an international market and a brand to identify with. While we may not be looking to be bought by IKEA, we are looking to partner with them in supply chain and logistics and ensure that we can distribute our products through their outlets in America and Europe. We are also looking to partner with other stakeholders of the recycling business, such as Baguio in Honk Kong, to ensure that we have a constant supply of plastic waste material to facilitate our production business. With the production of the first design already out. We intend to start negotiations with significant stakeholders to know the fate of the partnerships. For this purpose, the company has already established a communication, legal, and public relations team to ensure a smooth flow of information and relationships with other companies.

3.2 Methodology-Key Activities

Some of the critical activities that the company will be involved in every day will be the processing of recycled waste, molding it into designs that will be handed over to them by the design team. This will also involve collecting plastic waste from the locals through collection points, paying them, and returning them to the plant. When we are less with plastic waste, we will also require importing plastic from outside countries. This will involve the countries previously mentioned, such as Germany and Vietnam. Key activities will also include the company's daily routine such as marketing of the product, delivery of the furniture to the various clients, and ensuring that the product that is due for export is well shipped and reaches the right client in due time both locally and internationally.

3.3 Methodology-Value Propositions

For now, the company has majored in one design of the furniture as indicated above and in the diagram. We also intend to make more designs that will be suited for the home market. This is because while the corporate market is flooded with furniture from recycled plastic, the home market is barely penetrated hence the whole business plan. With the initial design already out on the market, we intend to produce similar designs. These better strategies will bring an edge to our products, making them uniquely identifiable for the regular homestead. We are also not shying away from making furniture suited for the public space and offices. Once we are well established and duly expanded, we aim to produce more furniture, fitting any situation or any place. We also ensure that we will maintain the same quality throughout the production process. This plan also helps the customer from worrying about recycling. This is because the more customers we make and sell furniture too. The more they need for plastic arises, riding the oceans and the landfills of the plastic garbage deteriorating good land.

3.4 Methodology-Core Structure

The main expenses of the business will come from the cost of production. This will include both the fixed price and the variable cost. The fixed price will arise from expenses such as rent and insurance, while the variable cost will arise from wages and salaries. It is vital to note that the pricing of the furniture we will sell will include the production cost, meaning that we aim to maximize profit-making while ensuring that we maintain standard prices to maintain the customers that we already have.

3.5 Methodology-Access

Customers will have access to our product through the marketing strategy that is set in place. Advertising will be done through major social media platforms such as Instagram, Facebook, and Twitter. Advertising will also be done on mainstream media such as local television channels in countries that have made partnerships within the distribution. Like any other startup, we intend to participate in promotional products and periods such as offering discounts and giveaways. We also plan to participate in Black Friday sales and festive season offers and giveaways. We also intend to have various outlets throughout the country for ease of access for the local customers.

3.6 Methodology-Customer Relations

As mentioned earlier, the company is intensely interested in custom creations, both locally and internationally. Every employee of the organization is tasked with customer care because through interactions with customers, and we can build a brand name for our products. In international markets, partnerships with other stakeholders will ensure that the international aspect of customer relations is well taken care of on behalf of the company. This goes hand in hand with marketing. Hence, we also rely on the clients we already have to bring in more customers through referrals. We also aim to maintain

customer relations by ensuring that the furniture we produce is of excellent quality and that the rate will be consistent throughout the production process.

This is the ideal model for the business plan we have in place. Through the nine significant components, every aspect of the company's business is well taken care of. It also ensures that attention is carefully given to substantial components of the business. Any good business focuses on consumer satisfaction, which is covered by almost every business model component presented. The expansion of this startup does not come without any major challenges. For instance, when the leaders will seek funding, there might be drawbacks because of rejection. This may be attributed to the fact that this is a new type of venture and a new product in the market. This product is not yet popular in the market and may fail to take off depending on the response from the international market. Another challenge is competition; with a proposal such as this to major furniture models, there is a risk that they may refuse a partnership and venture into the same business. This would work as a great competition because these companies have the necessary financial muscle and market. Another major investment will be in customer relations and marketing. Because the two go hand in hand. We will also rely on advertising through word of mouth from our reliable customers to ensure that we maintain the customer base and keep growing the base. Recycling plastic waste is quite a good venture and aims to rid the world of plastic while making money while at it. Creating furniture on a large scale will mean recycling more plastic for the long term, and the furniture will be more durable, ensuring that it will not be phased out for one or two years but decades.

4 Limitations

The study did not provide adequate sap predictions for review. The only available furniture was the semi-gray chocolate soda that was provided. This also produced a biased opinion because there was no room left for review by other people who used the products. We only used images and online reviews in the study for the Sha Tin benches, as shown in Fig. 1, which does not create an accurate picture.

The research of the furniture is also limited to the product we produce. We did not get the chance to test the furniture quality produced by our competitors, giving the research a blind spot when it comes to market competition. We already know that in the country, we are the only company producing such furniture, ultimately giving us a competitive edge or the already available market.

For products such as furniture, quality can only be checked physically, and we did not get enough time or resources to facilitate this hence inadequate financing for the study. This is because recycling waste is only done in specific places globally; visiting such sites would be very costly for the research. There was also inadequate time for the whole study to take place and to understand the whole recycling and production process.

5 Results

The revolution on the recycling of plastic has been going on for ages. The Shing Muni River initiative is one of the most successful stories of plastic waste recycling that has taken over the world. Other places in the world have adopted plastic waste recycling for



Fig. 1. The sample of plastic benches in public places. Picture retrieved from hir-studio.com (“Recycled Plastic Public Seating,” 2021).

making fancy furniture. Companies, especially in the United States of America, have also been doing the same up-cycling projects for furniture. This type of project has also been named to ensure that the recycling process does not just take a few pounds of plastic off the rivers but tonnes. This growing potential also means that if other countries adapted this type of recycling, there would be less plastic waste entering the ocean. It is vital to note that the Hong Kong recycling of plastic waste has caught the attention of several other corporations in the world. Therefore these same companies have been able to pull their resources together, raising over 1.5 billion dollars to be invested into recycling plastic waste. At the same time, many may wonder why several companies are concerned with recycling plastic waste. It is vital to note that most companies produce plastic waste after their production process or as a byproduct of their production process. Therefore, companies have been advised and may be forced to comply with non-plastic material for the packaging of their products. However, this has proven to be quite tricky because the rest of the world has become fully dependent on plastic to pack their product. These companies have also indicated that plastic waste is to be recycled. However, only half of the world population dwells on the recycling bit of the package. It is for this reason that the rivers are still filled with plastic waste. The coming together of several companies is more of corporate social responsibility on a large scale. Their way of ensuring the world is free of plastic while still being able to make money using plastic bags [6].

Up-cycling plastic waste into furniture is not all in vain. The plant project implemented in Hong Kong has created over one thousand jobs for the residents of Shing Mun. This is because the community is tasked with collecting plastic waste and sending it to the recycling plant. It has created jobs in several stages, from the handyman assigned with collection to those working in the processing plants to deliver the final product, the furniture. This project, adopted across the world, is set to create over a million jobs in the recycling business, creating a source of income for millions of households in the

world. With expansion and awareness training into the business, companies and countries with high amounts of plastic waste would build income-generating recycling industries, thereby raising their economic status. As stated earlier, recycling plastic waste has been termed one of the most lucrative initiatives with over 120-billion-dollar industry targets. It has already been witnessed that countries such as Germany, Vietnam, and Japan that have not set up up-cycling plastic plants are already making more money to export plastic waste to other countries. It is done to countries in need of garbage production, such as Hong Kong [7].

As a company, the furniture we make is personalized to fit the various spaces that our esteemed customers may want to fit in. We have ensured that we combine different materials into the production process from the provided sample to ensure that all the material used is from recycled plastic waste and metal.



Fig. 2. The potential outlook of sofa design. Picture retrieved from hir-studio.com (“Recycled Plastic Public Seating,” 2021).

The Sofa idea illustrated in Fig. 2 was primarily inspired by the Sha Tin furniture in the hall and created a potential business Idea. It is also vital to note that the market for recycled plastic waste furniture continues to grow from the world’s awareness created by various companies. For instance, Major furniture company Ikea has zeroed in on using recycled material for making their furniture. With big companies like this joining in the recycling business and producing more recycled material furniture and in the best quality, the overall market will continue to increase and support the product introduction into the market [8]. Our target market for the design of the sofa that we have already created is both corporate and personal households. This is because the design we have come up with and put forth is made of subtle colored gray and chocolate, used both at home and for the office. Another excellent quality that could be a selling point for the product is that it is designed to take up less space than other furniture pieces; for certain pieces of our product, we will follow the Luken brand mentioned above and make it as easy to assemble as inserting toys, this design means it can be assembled without nails and glue, making it environmentally friendly and cheaper to ship on a flat plate. But unlike

Luken, our customers are adults, not children. We will also provide customized services to customers through 3D printing technology on our official website. We are hoping that the design we have created, and the material put forth will also be an attractive piece for major furniture companies worldwide. Hence, we hope that we would be supplying these companies with our finished product for further distribution.

One of the major challenges experienced during market penetration is that most people do not like to accept change. Furthermore, the use of recycled plastic to make exquisite pieces of furniture has come as a great change in furniture. Major furniture companies have greatly refused to adopt recycled material for their furniture, thereby creating an alarming trend in market penetration. It is vital to note that the rest of the world offers polished and high-quality wood such as mahogany for their furniture, both in homes and offices. Hence do not want to shift to the use of plastic furniture for their offices [9]. The slow adoption of the use of this furniture by the corporate world has slowed down the industry's growth because most of the product is meant to occupy large spaces such as office lobbies and waiting places. In our design, which is relatively small and of subtle color, the sofa is intended to fit in small spaces such as offices and even living rooms. However, we still hope that with efforts put forth in market penetration of these products, more would be done to ensure market growth. A company such as Ikea venturing into the market does not pose competition. However, it creates awareness of this type of furniture in the already existing furniture market. Globally, the distribution of such furniture is quite low. Still, with the great investment done and market strategies such as advertising put forth, the market will embrace the product as it is both fancy and a way of ensuring sustainable waste recycling. Another major constraint in the business includes the fact that the quality of the products is still in question [10].

Some of the major strategies that could be implemented to ensure that the industry catches on with the market would include cost differentiation. Meaning that because the furniture we produce is a product of upcycling, it should come at a very affordable price. Low prices are desirable to the market, hence a way to attract the market. It is essential; to note that there are specific customers who largely focus on recycled products only. They are environmentalists that have dedicated all their efforts to ensure a clean world. With these customers already in the pocket, the only task will be moving the rest of the market to embrace furniture from recycled plastic [11]. Another strategy that could be implemented is through major partnerships and advertising. Because we already know that major corporations and furniture gurus such as Ikea are pro recycling. We could pitch them a supply of products for their recycling. Other organizations worldwide would also join in to ensure sustainable recycling procedures, making the world a better place and oceans safer for marine life. The business model can cover the market gap because it is very comprehensive. The model has tackled most of the business problems by addressing every issue as a single entity. Therefore, we can discuss the critical components of the model as follows:

6 Conclusion

From what has been deliberated above, it is accurate to say that plastic waste to make furniture is still new to the market. About two years later, through major corporations,

the world has come together to ensure that more is done to support the recycling industry. This is not just to create jobs for the people working in the recycling plants but also to ensure that recycling products are extended for one life cycle but a longer duration. From Shing Mun River in Hong Kong to Seattle in Washington DC, luxurious chairs, couches, and benches have been used in big corporations, indicating that the world is ready to embrace this new furniture line. Because the market potential for this type of furniture is still untapped, we still have the potential to make the best out of it. Implementation of advertising and cost analysis strategies will attract the target market that we want. This will also mean that more jobs will be created within the industry. There will be tremendous growth in the world economy because every part of the world has plastic waste. Whether they set up recycling plants or export the waste, there is financial gain with the exportation of plastics, like Germany and Japan. The design of the product we are making is meant to ensure that it covers the whole market, ranging from the corporate offices to household furniture; with further growth, we hope to create many other designs, all up-cycling products. This will grow as a business while ensuring that we are part of the movement, changing the world through sustainable recycling.

By combining the literature review of the paper and the business model, it is rational to say that this potential business plan has a great potential for profitability and growth. If the company's leaders greatly adhere to the business plan and put the consumer's needs first, the plan is guaranteed to work. It is also vital to ensure that the company maintains the initial design of the furniture we aim to produce. This will serve as the main basis for design. We also acknowledge the amount of money pumped into the recycling business, meaning that with revenue generation remaining constant, this business will be a major source of income for its employees and the economy.

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The Production Function for New Ideas in China

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Abstract. In this work, our group has applied the endogenous growth model to compute China's production function regarding its everchanging national situations and global backgrounds from 1961 to 2020. We have derived the exact expression of China's idea production and investigated its tendency. Analysis and deductions were made based on aggregate, medical, and agricultural levels respectively. The specific process involves identifying and quantifying various factors that contribute to the production of new ideas in accordance with Romar's growth model. As a result, the general outcome displays a pattern of decreasing return to scale, meaning the lessening efficiency of innovation as time progresses. This essay strives to account for the ongoing technological bottleneck both in China and worldwide. After understanding its possible driven forces, hopefully, improvement methods can be carried out to tackle such challenges and thus achieve sustained economic growth.

Keywords: Endogenous growth model · Ideas production function · Cobb-Douglas production function · Health care · Manufacture · Agriculture

1 Introduction

The production function of new ideas is intensely discussed in the field of economics because of its significance in the research and development (R&D) driven growth model. For instance, Romer's endogenous growth model emphasizes how new ideas lead to technological change, which then contributes to constant economic growth in the long run [1]. Nevertheless, contrary to Romer's theory, more recent studies suggest that as the stock of ideas increases in developed economies, successive innovation is getting harder, Jones [2]. But whether this is the case in emerging economies remains obscure. Therefore, this essay is aimed to investigate ideas production function in China. This essay will first observe the aggregate evidence from a database, which indicates that overall research productivity is declining. Secondly, the essay will assess the idea production in different sectors of the economy, which provides extra evidence towards the conclusion. As a result, outcomes from medication are consistent with the findings revealed at the aggregate level. However, for the agriculture sector, a fall in the number of researchers has led to a different result, although it can be argued that the data used for this sector is not effective for the classification of agriculture researchers is changing over time.

2 Theory

Two functions are adopted in the paper: production function and idea production function, which are essential functions of the Romer Growth Model (1990). The essential idea of our calculation is to compare the outputs with the inputs. At the aggregate level, this process is to use the production function to compute total factor productivity and then compare total factor productivity with the number of researchers over years using the idea production function. For different sectors at the micro-level, different inputs and outputs are selected. R&D expenditure, Researchers, TFP, and the number of patents in different sectors are used as inputs and outputs respectively.

In this paper, the production that is referred to is the Cobb-Douglas production function:

$$Y = A(K^\alpha)(L^\beta)(\alpha + \beta = 1) \tag{1}$$

in which Y represents the output, A represents the total factor productivity, L represents labor, K represents capital, α is the output elasticity of capital, and β is the output elasticity of labor, and $\alpha + \beta = 1$ means it assumes a constant return to scale.

If we move $K^\alpha L^\beta$ to the left side, total factor productivity can be calculated:

$$Y / (K^\alpha L^\beta) = A \tag{2}$$

Another model adopted in the paper is the Romer endogenous growth model. It is the idea production function takes the form of

$$\Delta A_t + 1 = z A_t L_t, \tag{3}$$

where $\Delta A_t + 1$ is the change in the stock of ideas over year, z is a constant, A_t is the existing stock of ideas, and L_t is the number of researchers. This production is Move A_t to the left side of the equation, we get:

$$\frac{\Delta A_{t+1}}{A_t} = z L_t \tag{4}$$

The left side, $\frac{\Delta A_{t+1}}{A_t}$, represents total factor productivity growth, or the growth rate of an economy resulting from idea production. This equation indicates that the TFP growth of an economy is directly proportional to the number of researchers. If we divide the left side of the Eq. (4) by L:

$$\frac{\Delta A_{t+1}/A_t}{L_t} = z \tag{5}$$

In Eq. (5), research productivity is calculated. Theoretically, the research productivity should be constant over time, which means if more researchers are added, the growth rate of the economy will also increase. Data were found in the following passage to test whether this hypothesis applies to China in the real world.

The conclusion and graph of the first section of the essay are based on statistics obtained from the Chinese government statistical site. More specifically, the R&D personnel data come from the Ministry of Science and Technology of the People’s Republic

of China, which is then used as a proxy of labor input for ideas production. Whereas domestic inventive patent application data is collected from the China National Intellectual Property Administration website. This data represents the production of the idea in consecutive years. From those data, a calculation of research productivity at the aggregate level can be conducted.

2.1 Aggregate Level Evidence 1

The characteristics of the Chinese idea production function might be examined initially using aggregate data. To achieve this, a quantitative measure of ideas input and output might be defined. More specifically, the data for the number of effective researchers and new ideas produced might be gathered from the government official sites [3, 4]. For instance, the number of people who engaged in R&D could be used as a proxy for the effective number of researchers, and the number of inventive patent applications to represent the new ideas generated. This allows calculation of research productivity to be conducted, using transformed ideas production function: $(A_t + 1/A_t)/L_{at} = Z$ (5). Moreover, a graph can be derived from joining the results of the calculation. Therefore, the trend of research productivity can be displayed.

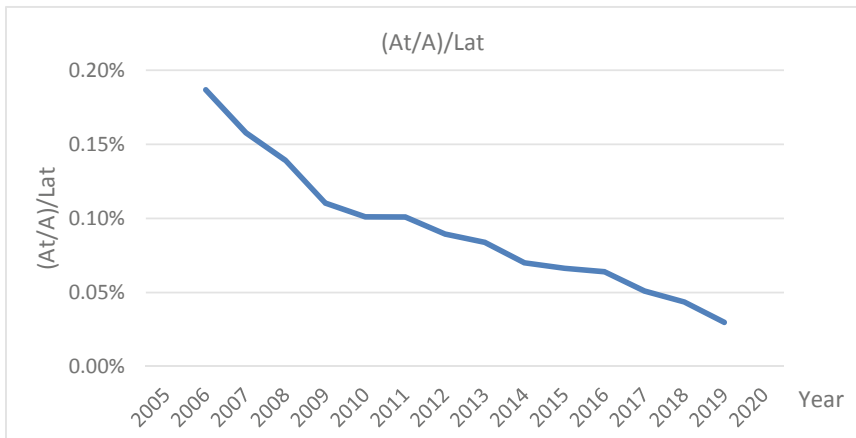


Fig. 1. Research productivity in China

Figure 1 presents a persistent downward trend of research productivity in China, which contradicts the implication of Romer’s idea production function and shows a continuous decrease in research productivity in China. The fall in new idea growth per researcher suggests that constant return to the idea does not hold. A possible explanation might be that the existing stock of ideas exerts a considerable educational burden on new innovators who have extended periods of learning and reducing the scope to innovate, Jones (2009). If this is the case, the return on existing ideas is diminishing, and the index on A_t would be smaller than one. Therefore, ideas are getting harder to find in China from aggregate-level evidence, which means more innovator is needed in China to sustain a constant growth rate.

Nevertheless, the presence of foreign knowledge spillover might affect the validity of these findings. Keller argues that the source of new technology is often foreign instead of domestic [5]. For instance, Eaton and Kortum estimated that approximately 40 percent of productivity growth in the US in 1998 was because of foreign R&D [6]. This might apply to China, it could be that as China moves closer to the global technological frontier, less foreign knowledge spillover it experiences, which slow down the growth rate of its innovation. If this is the case, the results above only reflect China is moving towards the level of research productivity which does not affect by foreign knowledge spillover. Therefore, a fall in idea growth per researcher might not demonstrate declining productivity.

Moreover, the duplication of research can be another concern as to why the findings are not legitimate. As the number of researchers increases in the economy, the area of research might overlap, which means considerable resources are misallocated and do not produce equivalent output. This might explain why percentage growth in R&D personnel is not met with proportional growth in new ideas. In that case, it is difficult to claim there was a fall in research productivity. Hence, diminishing return to labor might be a reason why the rate of new ideas production in China is falling.

2.2 Aggregate Level Evidence 2

Another way approaching aggregate evidence data from a different source and combining it with Cobb Douglas production function also leads to a similar outcome. In this method, total factor productivity is defined as the research “output”, and the number of researchers working in the R&D sector is defined as “input”. The data of China in the Penn World Table (2015) is used to calculate the TFP by plugging the numbers into the production function (2) [7]. The data of the researchers in China is found in the World Bank data and multiply it by the population we get the total number of researchers [8].

Table 1. Data of GDP, labor, capital stock, β and α in China [7]

	rgdpo	emp	rnna	labsh (β)	α
1995	4141247.5	698.6498413	10184369.00	0.567350984	0.432649016
1996	4438913	704.6999512	11224763.00	0.588390589	0.411609411
1997	4485961	711.7207031	12314962.00	0.588529646	0.411470354
1998	4560593	718.5672607	13579676.00	0.59241277	0.40758723
1999	4899273	725.2279053	14873733.00	0.60627687	0.39372313

(continued)

Table 1 shows the GDP, labor, capital stock, β and α in China from 1995 to 2017. RGDP0 is output-side real GDP at chained PPP (in mil. 2011 US dollars), which is the output Y in the production function. Emp represents the number of people engaged in work, which is L. RNNA is the capital stock K at constant 2011 national prices (in mil. 2011 US dollars). LABSH is the share of labor compensation in GDP at current

Table 1. (continued)

	rgdpo	emp	rnna	labsh (β)	α
2000	5271819.5	731.5320435	16228874.00	0.591961801	0.408038199
2001	5708217	737.9927979	17759584.00	0.588033199	0.411966801
2002	6203469	743.7098389	19492872.00	0.603283346	0.396716654
2003	6571744.5	748.4173584	21600040.00	0.598127961	0.401872039
2004	7168588.5	753.40979	23988882.00	0.57288444	0.42711556
2005	8048983	757.9627686	26660154.00	0.568218589	0.431781411
2006	8753839	761.9359131	29667544.00	0.557359457	0.442640543
2007	9430588	765.7720337	33016808.00	0.55308193	0.44691807
2008	10034508	769.218689	36733168.00	0.552076101	0.447923899
2009	10950633	772.4277954	41539428.00	0.552654505	0.447345495
2010	12696429	775.8685303	46890424.00	0.548255086	0.451744914
2011	14028191	779.5727539	52581840.00	0.549982846	0.450017154
2012	14639761	783.1630249	58680084.00	0.560339987	0.439660013
2013	15445157	786.4726563	65261764.00	0.571143866	0.428856134
2014	16414645	789.3400879	72159080.00	0.578006387	0.421993613

national prices, which is used as exponent β , and α , or $1-\beta$, represents the share of capital compensation in GDP.

Table 2. TFP, TFP growth, number of researchers, and research productivity computed [7, 8]

	A	ΔA	$\Delta A/A$	Number of researchers per million people	Population (in millions)	Number of researchers (in millions)	$\Delta A/A/L$ (research productivity)
1995	93.64011069						
1996	117.3865834	23.74647275	25.36%	442.6	1249.981445	0.553198652	0.4584121
1997	113.679912	-3.70667143	-3.16%	472.0	1259.067017	0.594273254	-0.0531348
1998	114.6935247	1.013612669	0.89%	386.8	1267.441528	0.490210473	0.018188
1999	135.5016127	20.80808798	18.14%	420.6	1275.406738	0.536438729	0.3381996
2000	121.4425029	-14.0591098	-10.38%	547.3	1283.198975	0.702299796	-0.1477375

(continued)

Table 2 shows the A, or TFP, computed by substituting the data in Table 1 into the Cobb-Douglas production function (2), the change and the change rate of A over years, the number of researchers per million people obtained from the World Bank [8], the population in millions obtained from the Penn World Table [7], the total number of

Table 2. (continued)

	A	ΔA	$\Delta A/A$	Number of researchers per million people	Population (in millions)	Number of researchers (in millions)	$\Delta A/A/L$ (research productivity)
2001	121.189495	-0.25300782	-0.21%	581.5	1290.937622	0.750721357	-0.0027751
2002	147.3497963	26.16030125	21.59%	631.1	1298.646606	0.819547307	0.2633927
2003	141.5998073	-5.74998900	-3.90%	667.5	1306.343872	0.872026474	-0.0447494
2004	113.5298604	-28.0699469	-19.82%	713.3	1314.007446	0.937261124	-0.2115038
2005	115.6437333	2.113872878	1.86%	856.8	1321.623535	1.132427125	0.0164421
2006	106.7577158	-8.88601746	-7.68%	932.3	1329.209106	1.239240456	-0.0620053
2007	104.5049542	-2.25276165	-2.11%	1078.6	1336.800537	1.441906806	-0.014634
2008	104.6180211	0.113066959	0.11%	1200.3	1344.415283	1.613694837	0.0006704
2009	108.4844671	3.866445932	3.70%	863.9	1352.068115	1.168087163	0.0316395
2010	113.2315078	4.747040757	4.38%	903.0	1359.755127	1.227804187	0.0356390
2011	120.7873835	7.555875679	6.67%	977.7	1367.480225	1.336960894	0.0499112
2012	134.4306083	13.64322484	11.30%	1035.9	1375.198608	1.424539566	0.0792904
2013	152.6075493	18.17694098	13.52%	1089.2	1382.793213	1.506127328	0.0897761
2014	167.6662683	15.058719	9.87%	1113.1	1390.110352	1.547292769	0.0637733

researchers computed by multiplying these two values, and the research productivity z calculated by Eq. (5).

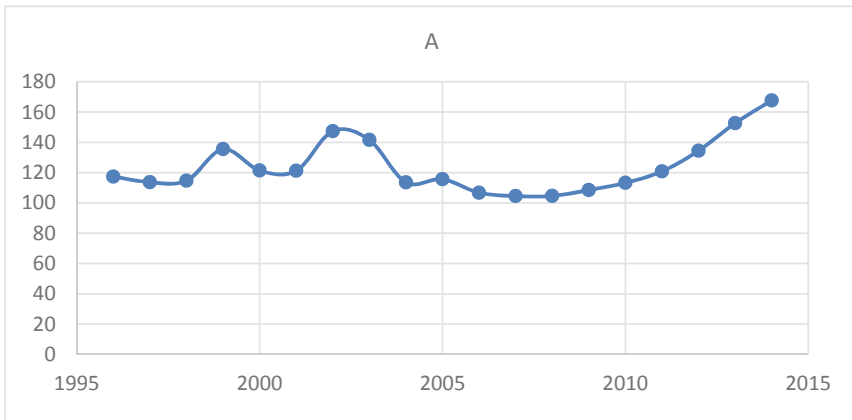


Fig. 2. Total factor productivity

Figures 2 and 3 show the trend of A, or TFP, and the trend of the numbers of researchers per million people respectively. The graphs show that over the time from 1996 to 2014, both TFP and the number of researchers have increased, so the trend of

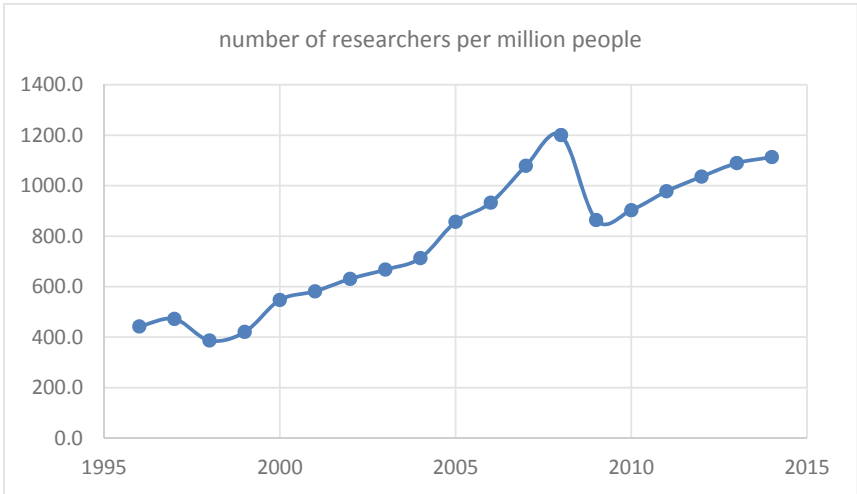


Fig. 3. Number of researchers per million people

research productivity is not evident from merely these two figures. Therefore, the trend of research productivity is graphed in Fig. 4.

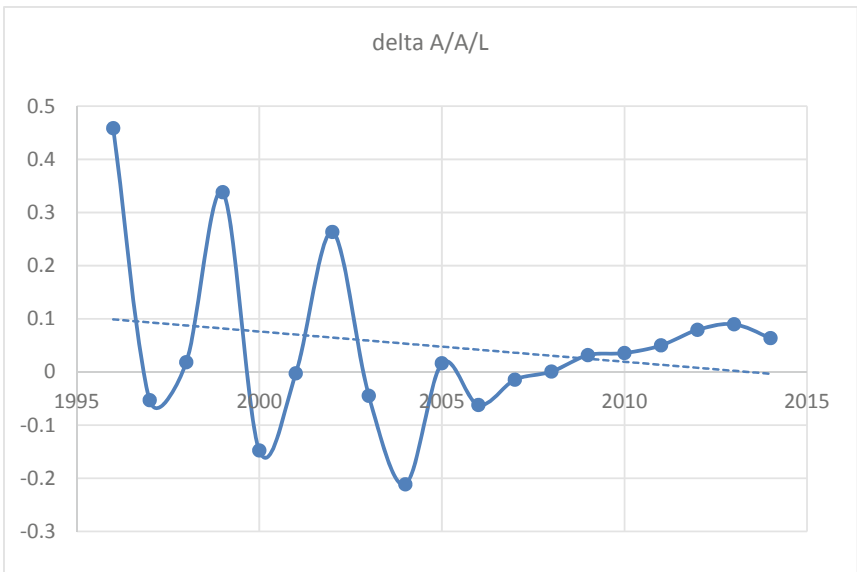


Fig. 4. Research productivity

Figure 4 shows an overall decreasing trend in research productivity, which contradicts the Romer model that the research productivity is constant. Decreasing research productivity indicates that China needs to add more researchers just to sustain the constant research productivity.

Problems may exist in this process of calculation. One is the deflation of the price level. Although we use the data of capital stock as constant price and real GDP to reduce the influence exerted by price level, the exponents β is still calculated based on current national prices, so the final TFP computed will still be partially affected by price level and thus be an imprecise indicator of research output. Also, another problem, as pointed out by Bloom et al. is that the TFP growth can be both caused by innovation and declines in misallocation (reallocation) [9]. One cannot distinguish it in this calculation. It is possible that the TFP growth is more attributed to declines in misallocation instead of innovation.

It is also noticeable that many fluctuations exist in the data and make it very different from the result of research productivity calculated previously by using the number of people who engaged in R&D could as the input, and the amount of inventive patent application as the output. A possible reason for the fluctuations lies in the computation process. In the process of calculating the number of A, the exponent β is not assumed to be a constant, instead, many fluctuations appear in the data of exponent β , causing the result to be fluctuating. Moreover, the selection of inputs and outputs data also makes the difference. Not only that two sets of calculations use different outputs—one is TFP, and another is patent application—but also use the number of researchers who engaged in R&D are found from two different sources. One is found in the Ministry of Science and Technology of the People's Republic of China, and another is found in the World Bank, multiplied by the population over years recorded in Penn World table. Differences in two statistics measurements will lead to differences in results. However, one thing for sure is that the overall conclusion of decreasing research productivity does not change. Besides the aggregate level, certain examinations towards specific economic sectors would provide additional evidence over the characteristics of China's production function. Therefore, in the following part, the health care, manufacturing, and agriculture sectors would be analyzed respectively.

Health Care. Basic health condition for people is one of the most important factors in assessing an economy. Whether an individual's physical and mental status is affirmative or not can largely determine the current productivity of a country and its possible future output. After all, nothing can last long without a healthy body. Therefore, domestic health care is an undoubtedly necessary sector in the government's consideration. For example, the Chinese government has spent about 2 trillion yuan as health care expenditure in 2019, accounting for 6.64% of its GDP [10].

Health care can be divided into multiple sections. Research & Development, for instance, can be the one with the most potential since new ideas and technologies might cure fatal illnesses and save more lives more efficiently. With such significance, the new ideas in the health sector become precious and demanding. In this part will the exact idea production in China's health care sector be computed using the idea production function from Solow Endogenous Growth Model. The specific equation is shown below [9]:

$$\Delta A_{t+1} = z \cdot A_t \cdot L_{at} \quad (6)$$

In this equation A represents the stock of knowledge in the sector examined and A_t represents the stock of knowledge at specific year t . The change in the stock of knowledge between two consecutive years can be then denoted as ΔA_{t+1} . The allocation of labor into researchers who produce new ideas is denoted as L_{at} . This is derived by adding a constant fraction of the total national population $\kappa \cdot \bar{L}$. Lastly, z accounts for the idea of productivity as the final output.

In this way, the equation can be simply transformed into a new order [9]:

$$\frac{\Delta A_{t+1}/A_t}{L_{at}} = z \tag{7}$$

According to this idea production function, the new ideas in China’s health care sector can be quantified by simply looking at the productivity z .

After understanding the basic methodology, the next step is to find appropriate real-life information that can be substituted into the equation. In respect of the health care sector in China, the annual budget for R&D in the medical sector and the annual patents application for the health care sector from 2004 to 2019 in China are collected as raw data. Theoretically speaking, the relationship between R&D expenditure as input and patents can reflect the change in research productivity every year. However, the R&D budget would not be fully converted into the creation of new ideas due to the division of labor. There is part of the workers in charge of basic and low-skill jobs such as transportation, material, and infrastructure. Hence, to minimize such deviation, a new set of data: the average nominal wage for high-skilled workers (the workers who really participated in producing new ideas) is collected. Then, using the total R&D expenditure in one specific year divided by the average nominal wage for high-skilled workers in that year can we get an approximation of a specific amount of the high-skill labor.

Then, by employing this data to compare with the growth rate of patents application, the research productivity can be obtained in a rather more reasonable way. In other words, in this part of the essay, the **input** of idea production is set to be the **R&D expenditure** on the health care sector while the **output** acquires the **annual patent application amount** as the standard.

The raw data is shown in Table 3 and the specific calculation process are listed below:

Table 3. Raw data processing procedure [10]

Year	R&D expenditure (¥10,000)	ΔR&D	Average nominal wage for high skilled workers (¥/PC)	Average labour (person)	Research productivity	Patents	ΔPatents
2001			9638.00				
2002			10738.00				
2003	276665.00		11685.00	23.68		1305.00	
2004	281812.00	1.86%	12960.00	22.59	0.000823436	1696.00	29.96%
2005	399510.00	41.76%	20808.00	19.55	0.021368031	2708.00	59.67%

(continued)

Table 3. (continued)

Year	R&D expenditure (¥10,000)	ΔR&D	Average nominal wage for high skilled workers (¥/PC)	Average labour (person)	Research productivity	Patents	ΔPatents
2006	525856.00	31.63%	23590.00	22.63	0.013977481	2383.00	-12.00%
2007	658836.00	25.29%	27892.00	24.75	0.010215522	3056.00	28.24%
2008	790879.00	20.04%	32185.00	26.02	0.007701682	3917.00	28.17%
2009	996221.00	25.96%	35662.00	27.74	0.009359842	4811.00	22.82%
2010	1226262.00	23.09%	40232.00	31.49	0.007333944	5767.00	19.87%
2011	1809266.90	47.54%	46206.00	41.27	0.011519777	11115.00	92.73%
2012	2833055.00	56.59%	52564.00	55.30	0.010232776	14976.00	34.74%
2013	2833055.00	0.00%	57979.00	50.13	0	14976.00	0.00%
2014	3476553.00	22.71%	63267.00	56.05	0.004052476	17124.00	14.34%
2015	3903161.00	12.27%	71624.00	55.26	0.002220671	19354.00	13.02%
2016	4414576.00	13.10%	80026.00	56.27	0.002328622	16020.00	-17.23%
2017	4884712.00	10.65%	89648.00	55.36	0.001923723	17785.00	11.02%
2018	5341769.00	9.36%	98118.00	55.59	0.00168333	19878.00	11.77%
2019	5808857.00	8.74%	108903.00	54.89	0.001593116	21698.00	9.16%
2020	6095605.00	4.94%				23400.00	7.84%

Noteworthy, the two cells of data marked red in 2013 is an interpolation following the rate of growth of 2012 since these two groups of data are missing. This move aims to make the outcome of the health care sector's idea production more predictive

Finally, the graph of the idea production in China's medical sector can be computed based on the research productivities above.

Figure 5 is a line chart illustrating the variations of China's medical sector's research productivity. The Y-axis represents the quantified productivity over new ideas and the X-axis represents the years being examined. The dots on the chart are specific research productivities in respect from 2004 to 2019 in China. The blue full line connecting the dots reflects the disparity between each data. To present this tendency clearer and provide a better environment for later analysis, a trend line of dashes is fitted into the data of research productivity. Furthermore, the trend line is of logarithmic scale instead of linear relationship, which can reveal the relationship of research productivity over years more accurately with its varying slope.

Undoubtedly, the research productivity shows an obvious falling tendency over the two decades, which effectively demonstrates the premise of our essay—the decreasing return to scale in China's idea production. In particular, the function of the trend line $y = -0.006\ln x + 0.0195$ has a negative slope, meaning the research productivity declines as time progresses. Moreover, due to the characteristics of log function, we can

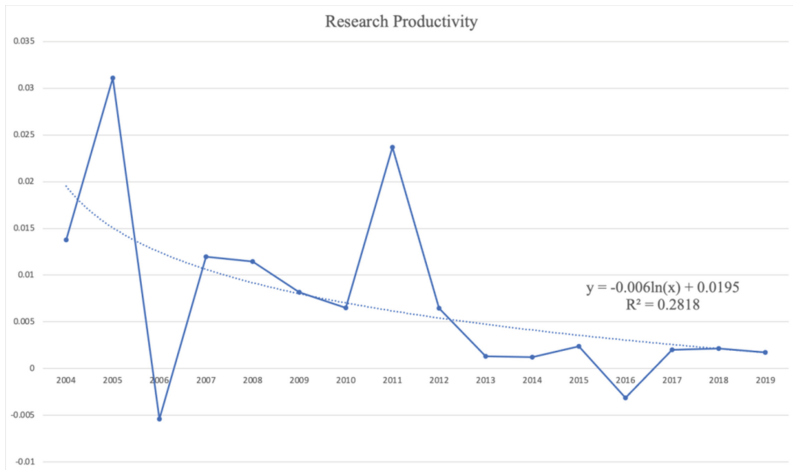


Fig. 5. Research productivities of China's medical sector

also infer the rate of decline of research productivity is also falling. The number R is the correlation coefficient. The more this number is close to 1, the more positively relevant the two sets of data are. Squaring the R can eliminate the possible negative values if the data are negatively correlated. Since we already see the downward trend, there's no need to consider the modulus value of R . Therefore, by extracting the root of R^2 , which is the $\sqrt{0.2818}$, we get approximately 0.531.

Because of the negative slope of the production function, the exact R would be -0.531 , representing a negative medium correlation between the idea production and time.

Based on fore-going statistics, we would be able to have a glance at the variations of China's medical research productivity over years at an aggregate level. Firstly, in the former 5 years, the research productivity fell shockingly, which indicates there might be a technological explosion driving up the initial research productivity in the past. Thus, when the explosion period passed, the research productivity will soon go down smoothly, just like in the later years. Their overall tendency only fluctuates slightly. This might happen due to the consummation of records and relating departments year by year along with the increasingly organized R&D input.

On the other hand, the apparently fluctuant relation in the first few years can be explained by a few outliers within the data, including the years 2005, 2006, and 2011. The research productivity in China's health care sector than either elevated sky-high or dropped to a great extent. It is this inaccurate data that disturbs the correlation between the two factors examined. We can have a glimpse of the reason behind this by checking the raw data in Chart (1). In 2005, the total high-skill labor decreased from 21.74 to 19.20 due to the huge increase of nearly two times in the nominal wage for high-skill workers from ¥12960 to ¥20808. On the contrary, the patents application amount surprisingly raised by 59.67% from 1696 to 2708 [11]. Hence, the decrease in the total labor force and increase in new ideas lead to skyrocketing productivity. However, in 2006, while the R&D expenditure and the nominal wage for high-skill workers raised rather stably and

normally [12]. The patent application was reduced by about 12%, causing the research productivity of this year goes straight down. Lastly, the outlier in 2011 was formed due to the almost doubled patent application as an output [13]. It increased from 5767 in last year to 11115 now, achieving a growth rate of 92.73%. Thus, there's no doubt that research productivity also ascends dramatically.

The three outliers may happen because of various economic, political, or social affairs and activities in the past. More specifically, due to the spreading bird flu in 2004, China had put much effort into the development of related vaccines and clinical trials, which might foster the patent application to rise. In 2006, however, China's medical sector was in a rather mild way of growth that focused mainly on the future and expansion of scope. Resultantly, the final achievements in innovation fell to a bottleneck. As for the booming ideas in 2011, two major events took the burden: the increase in input R&D expenditure in AIDS prevention and the discovery of extraction method of artemisinin by Chinese medical scientist Tu Youyou and her crew winning the Lasker Medical Research Award. These two incidents certainly added many new ideas in the form of new patents regarding China's health care sector.

Despite the above research having successfully presented the decreasing return to scale in Chinese medical research productivity, there are still certain factors influencing its accuracy and reliability. Wage inflation is a major one of them. Since the raw data of wages for high-skill workers is nominal. Its increase does not necessarily mean the actual improvement in productivity for every worker. The inflation of that year can also account for such changes, bringing the status quo into a dilemma. Considering this uncertainty, the measures of average labor should be perfected by calculating the real wage. In this way, the average labor can come in a rather credible manner. Therefore, at the end of the research, a group of data of the real wage index of China from 2001 to 2019 is collected as a compliment. The raw data is shown below in Table 4:

Table 4. Raw data & processing procedure without inflation [10, 14]

Year	R&D expenditure (¥10,000)	ΔR&D	Average nominal wage for high skilled workers (¥/PC)	Average labour (person)	Δ average labour	Research productivity	Patents	Δ Patents	Real wage index (%)	Average real wage for high skilled workers (¥/PC)
2001			9638.00						100.7	
2002			10738.00						99.2	
2003	276665.00		11685.00	23.68			1305.00		101.2	
2004	281812.00	1.86%	12960.00	22.59	-4.58%	0.000823436	1696.00	29.96%	103.9	12473.53
2005	399510.00	41.76%	20808.00	19.55	-13.49%	0.021368031	2708.00	59.67%	101.8	20440.08
2006	525856.00	31.63%	23590.00	22.63	15.76%	0.013977481	2383.00	-12.00%	101.5	23241.38
2007	658836.00	25.29%	27892.00	24.75	9.41%	0.010215522	3056.00	28.24%	104.8	26614.50
2008	790879.00	20.04%	32185.00	26.02	5.12%	0.007701682	3917.00	28.17%	105.9	30391.88
2009	996221.00	25.96%	35662.00	27.74	6.60%	0.009359842	4811.00	22.82%	99.3	35913.39

(continued)

Table 4. (continued)

Year	R&D expenditure (¥10,000)	ΔR&D	Average nominal wage for high skilled workers (¥/PC)	Average labour (person)	Δ average labour	Research productivity	Patents	Δ Patents	Real wage index (%)	Average real wage for high skilled workers (¥/PC)
2010	1226262.00	23.09%	40232.00	31.49	13.50%	0.007333944	5767.00	19.87%	103.3	38946.76
2011	1809266.90	47.54%	46206.00	41.27	31.08%	0.011519777	11115.00	92.73%	105.4	43838.71
2012	2833055.00	56.59%	52564.00	55.30	33.99%	0.010232776	14976.00	34.74%	102.6	51231.97
2013	2833055.00	0.00%	57979.00	50.13	-9.34%	0	14976.00	0.00%	102.6	56509.75
2014	3476553.00	22.71%	63267.00	56.05	11.80%	0.004052476	17124.00	14.34%	102	62026.47
2015	3903161.00	12.27%	71624.00	55.26	-1.41%	0.002220671	19354.00	13.02%	101.4	70635.11
2016	4414576.00	13.10%	80026.00	56.27	1.83%	0.002328622	16020.00	-17.23%	102	78456.86
2017	4884712.00	10.65%	89648.00	55.36	-1.61%	0.001923723	17785.00	11.02%	101.6	88236.22
2018	5341769.00	9.36%	98118.00	55.59	0.41%	0.00168333	19878.00	11.77%	102.1	96099.90
2019	5808857.00	8.74%	108903.00	54.89	-1.26%	0.001593116	21698.00	9.16%	102.9	105833.82
2020	6095605.00	4.94%					23400.00	7.84%	102	

Then, by dividing the nominal average wage by the **real wage index**, the outcome real average wage for high-skilled labor can be obtained. Joining with the original R&D expenditure, the new average labor comes out. Hence, using this new data to calculate the research productivity as previously shown, the newly improved graph can be plotted as Fig. 6:



Fig. 6. Research productivity of China’s medical sector without inflation

Although no major changes are seen, the graph still shows a different fluctuating pattern since its elimination of wage inflation, which also makes the research outcome more reliable. The changes can be shown in the logarithmic trend line $y = -0.004\ln x + 0.0137$ and the correlation coefficient R , which is 0.49, displays a too moderately correlated relationship.

2.3 Agricultural Sector

Another industry we used to measure idea production is agriculture. The Chinese agricultural sector has experienced steady growth since the 20th century, the crop production raised about ten times during the past thirty years. Nevertheless, idea production might not occur as an increasing trend. From the previous study done by U.S. researchers, even though the total agricultural yield maintained a sustainable increase pattern, the idea production is declining in response to R&D expenditure. From 1997 to 2007, the research productivity dropped over this period by a factor of almost four. This result is significant since most people believe that with the increase of investment in research and development, idea production should increase at a constant rate. The government raised its investment in the agricultural sector, but whether it has a positive impact is still unknown. To examine whether the result can be justified in every country, we take China as our case study.

From Fig. 7, throughout the development started in the 20th century, Chinese agricultural outputs showed proliferate expansion. For each wheat, soybeans, and rice, the growth rate seems similar. However, the data of total production only represents the exact output of crops, but not the idea production. To find the relationship between idea production and investment, we need to get a deeper understanding of the situation.

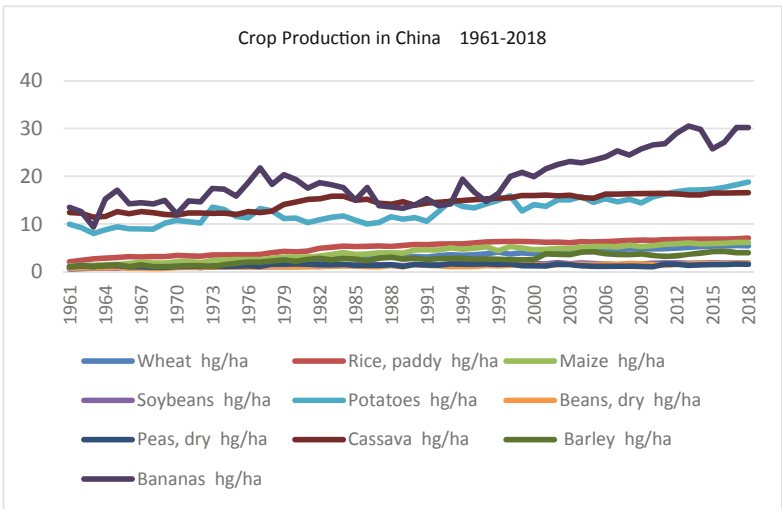


Fig. 7. Crop production in China

In the investigation, we mainly contained data starting from 2008 to 2018. We define the number of researchers as the input of idea production. Ideally, we need to use the R&D expenditure. However, R&D expenditure is only listed in the yearbook of 2009. Then we use the population from China Rural Special Technology Association, people in charge of agricultural research and development, to represent the effective number of researchers. The output is measured by the number of patents.

Formula: $\frac{\dot{A}_t}{A_t} = \alpha S_t$

Research productivity = $\frac{\dot{A}/A}{S_t} = \frac{\text{number of new ideas}}{\text{number of researchers}}$

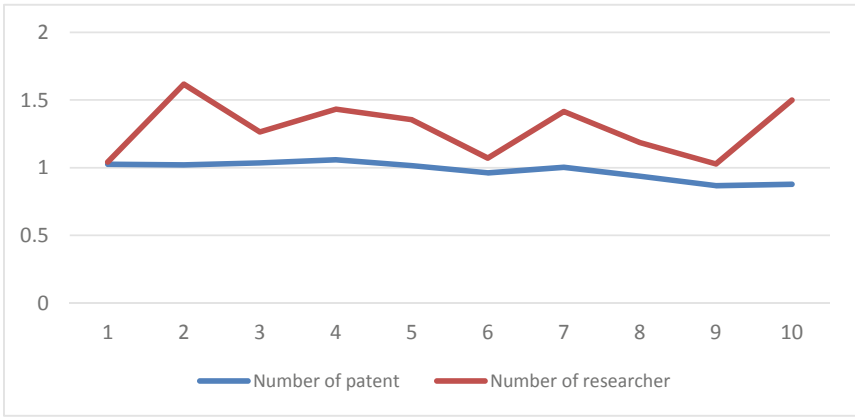


Fig. 8. Change in patent and researcher in the agriculture sector

Figure 8 shows the growth rate of some patents and researchers. According to the dataset, the growth rate for both variables fluctuated without a significant pattern. To this extent, we took the natural logarithm of both variables.

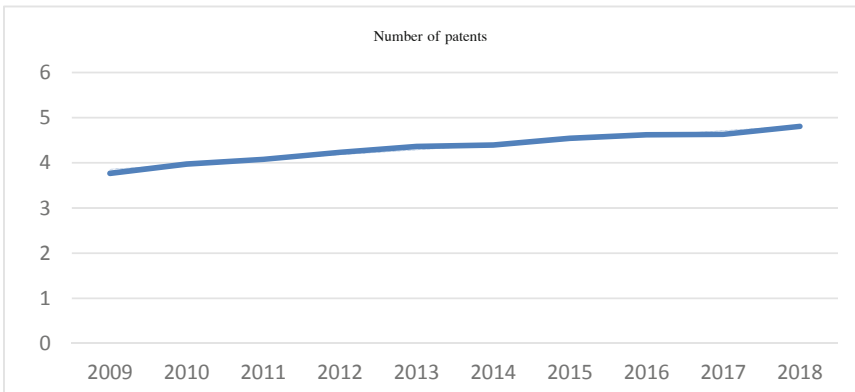


Fig. 9. Rate of change in the patent in the agriculture sector

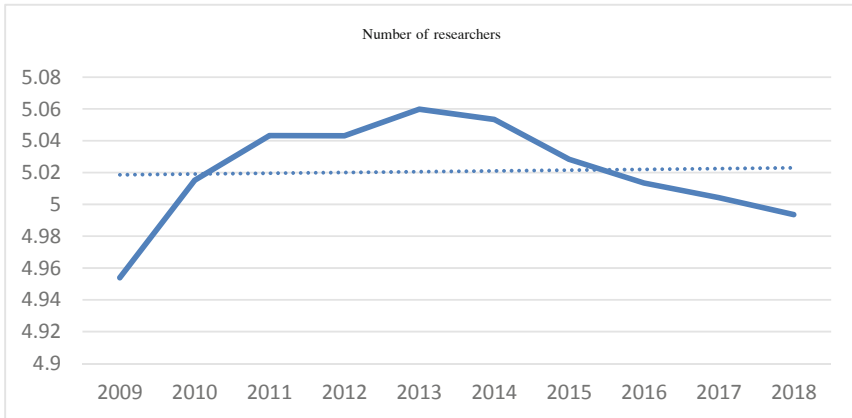


Fig. 10. Number of researchers in agriculture

From Fig. 9 and Fig. 10, we may get a better understanding of China's situation. The number of patents maintained a steady growth pattern. This suggests that the amount of idea production increased over the past 10 years. Scientists invented more techniques and applications to boost agricultural outputs. This seems plausible to match up with the increasing yield since the invention enabled production to continue to rise. Nevertheless, the input part shows a completely different perspective. During the past ten years, the research population expanded at first then declined. The graph depicts an extreme fluctuation. This result is contradicted with the result collected by the U.S. We have come out with several plausible explanations. First, the association may not generalize the total number of researchers since there might be researchers from the private sector in which data are not available. The data may just represent a trend instead of a specific number. Besides, there are several departments of research and development. It is possible that people who used to be categorized in agriculture were classified into another department, as a result, the population dropped significantly.

The investigation may also contain several limitations. The time span is not long enough to form a long-term pattern. The drastic decline may happen as a short-term fluctuation since we only focused on data published during the past ten years. This may also contribute to the difference between our investigation and others. Moreover, the definition of the patent can also lead to this distinction. Based on other research, the patent may not seem to be a good measurement for idea production output. As U.S. researchers had mentioned, the legal setting and what can be patented may alter gradually, which means the measurement of a patent is not stable and believable over time. During the past several years, the requirement for issuing patents may change differently. Plus, there are several new fields of study which may also cause the lack of accuracy.

3 Conclusion

In conclusion, the production function of new ideas in China does not follow Romer's model of constant idea growth. Instead, a downward trend of ideas production can be found. For instance, growth in the total number of researchers has not contributed to a proportional growth in new ideas in China for the last two decades. That said, various factors such as fluctuation in foreign knowledge spillover, price level, and significance of each new idea can impact the result. The second part of the essay has helped to verify the conclusion further, where the medication industry showed uniform outcomes. Although results from the agriculture sector revealed a different trend, as acknowledged in the essay, the data used for labor input in the agriculture sector might no longer be valid as classification criteria changes. Therefore, the rate of new ideas production in China is falling as contrary to being constant, and this might be already reflected in the slowing down of Chinese economic growth.

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The Detection and Prediction of Financial Frauds

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Abstract. This research aims to introduce and analyze different methods used to detect and predict financial frauds. Many methods and models were designed for preventing and detecting accounting frauds, by reviewing and discussing M-Score model, F-Score model, and Red Flags on existing fraud companies, the effectiveness of each method is analyzed and evaluated in this paper. According to the analysis of the three methods, M-Score Model and F-Score Model are effective regarding calculating the probability of financial frauds, and by using Red Flag analysis, some potential financial fraudulent behaviors could be detected by the investors. The evaluation of these methods could help investors to make better investing decisions since it enables a better prediction and prevention regarding financial frauds.

Keywords: Fraud · Detection · M-score · F-score · Red Flag

1 Introduction

With the development of market economy and the increase of listed companies, the phenomenon of financial fraud in these listed companies is gradually serious and the form of financial fraud also presents concealment and diversity.

In recent years, a series of accounting fraud incidents have occurred in the American market of Chinese listed companies. From the reports of domestic and foreign media as well as the administrative penalty column on the official website of CSRC, we can find a lot of news reports and punishment decisions about the company's financial fraud. These news and punishment all reflect the financial fraud problem as a very early emergence but never faded issue, which plays a particularly important role in the market.

Financial fraud will lead to accounting information distortion, and bring huge losses and harm to the country and the majority of investors. So how to identify the financial fraud of a company and how to see the possibility of a company's financial fraud is particularly important.

In the work, this paper selected 3 groups (15 In total) of American listed companies as examples, analyzed how to identify the financial fraud of listed companies through

cases and data, and how to estimate whether a company has carried out financial fraud by using different models and the potential fraud behavior of the company's daily operation. Our research aims to help majority of investors to recognize the financial fraud of listed companies and the article uses cases to explain the actual use of each model so that readers can better understand and actually use these methods to identify financial fraud.

2 Research Design

This work use M-Score model, F-score model, and red flag method on three selected U.S. listed companies who were accused doing frauds, which are Luckin Coffee, LongTop Finance, and General Electric.

2.1 M-Score Model

M-score model is a mathematical model that was created by Professor Messod Beneish. This model uses 8 variables related to financial ratios to calculate the M-score. As a result, if M-Score is less than -2.22 , it means the company did not manipulate financial statement; if M-Score is greater than 2.22 , it means the company may manipulate its account.

The formula for M-score model is:

$$\begin{aligned} M - \text{score} = & -4.84 + 0.92 \text{ DSRI} + 0.528 \text{ GMI} + 0.404 \text{ AQI} + 0.892 \text{ SGI} + 0.115 \text{ DEPI} \\ & - 0.172 \text{ SGAI} + 4.679 \text{ TATA} - 0.327 \text{ LVGI}. \end{aligned} \quad (1)$$

In this formula DSRI is the ratio of days sales in receivables in a year with respect to the previous year. The large increase in the value of DSR is an indicator of revenue inflation. GMI is the ratio of gross margin of a year with respect to the previous year. AQI is the ratio of non-current assets to total assets of a year versus the prior year. SGI is the ratio of sales of a year with respect to the previous year. ($\text{SGI} = \text{Salest}/\text{Salest}-1$). DEPI It is the ratio of the rate of depreciation of a year with respect to the previous year. SGAI is the ratio of SG&A expenses of a year with respect to the previous year. LVGI is the ratio of total debt to total assets of a year with respect to the previous year. TATA is calculated as the change in the accounts of working capital other than the cashless depreciation [1, 2].

2.2 F-Score Analysis

F-score model was carried out by Dechow with the objective to determine the probability of detecting and forecasting material misstatements in the financial statements.

The formular for F-score model is:

$$\begin{aligned} \text{Predicted value} = & -7.893 + 0.790rsst_acc + 2.518ch_rec + 1.191ch_inv \\ & + 1.979soft_assets + 0.171ch_cs - 0.932ch_roa + 1.029issue. \end{aligned} \quad (2)$$

In this formula, the seven variables represent change in noncash net operating assets (rsst_acc), change in receivables (ch_rec), change in inventories (ch_inv), soft assets (soft_assets), change in sales (ch_cs), change in return on assets (ch_roa) and debt or equity issuance (issue) [3, 4].

The output is an indicator of the probability of financial reporting having material misstatements. If $F > 1$, it means the company is above normal risk to fraud; if $F > 2.45$, it indicates the company has high risk to manipulate the financial statement.

2.3 Red Flag Analysis

Albrecht and Romney published their study indicating the major role of red flags, which are a variety of ex-ante warning signs to predict frauds. In this part, the red flag analysis is conducted on the selected three companies [5].

3 Data, Sample Selection and Statistics

In this research, three companies are selected as the sample for analysis, they are Luckin Coffee, LongTop Finance, and General electrics. For F-Score and M-Score analysis, three groups were made based on the selected three companies. Each group contains one company who did frauds and other five companies who did not do frauds. All of the six companies are in the same industry with little difference in market value, so it is clearer to compare the results since they are in the same industry and have the same size.

3.1 Luckin Coffee

Luckin coffee was founded in 2017 in China and its main business is selling coffee in offline stores. Now it has two sub-brands: Luckin coffee EXPRESS and Luckin Deer Tea. The former is for unmanned retail coffee machines and the latter is for milk tea. It went public on NASDAQ in May 2019 [6]. The Luckin coffee fraud was revealed in April 2020, which indicated that its reports about third and fourth quarters of 2019 were fake.

3.2 LongTop Finance

LongTop Financial Technologies (NYSE: LFT) is a software developer and technology services provider based in Xiamen. It provides technology services and creates both standardized and custom-designed software for banks in China, including three of the four largest state-controlled banks: China Construction Bank, Agricultural Bank of China, and Bank of China. The company went public on the New York Stock Exchange on October 23, 2007 and it was exposed to financial fraud in April 2011 and announced its dissolution on August 31, 2011 [7].

3.3 General Electrics

General Electrics Company is an American multinational conglomerate which was formed through the 1892 merger of Edison General Electric Company and Thomson-Houston Electric Company. In 2011, GE ranked as the 14th most profitable company among the Fortune 500 but later severely underperformed the market as its profitability collapsed [8]. In 2019, GE was accused bring a “bigger fraud than Enron” by Harry Markopolos, and in 2020, the Securities and Exchange Commission started its probe into GE’s accounting practices.

For F-Score and M-Score analysis, this work selected three groups of companies as shown in Table 1 and Table 2. Each group contains one company who did frauds and other five companies who did not do frauds. All of the six companies are in the same industry with little difference in market value, so it is clearer to compare the results since they are in the same industry and have the same size.

Table 1. The M-score for fraud companies and non-fraud counterparts [9–26]

Fraud companies	M-score	Non-fraud companies	M-score
Industry: Fast Food Restaurant Chain			
<i>Year of data used: 2019 & 2018</i>			
Luckin	−3.86	Shake Shack	−4.00
		Haidilao	−4.31
		Starbucks	−3.95
		Wendys’	−4.15
		Taco Bell	−5.03
Industry: Power/Renewable Energy/Digital Industry			
<i>Year of data used: 2017 & 2016</i>			
General Electrics	−3.49	3M	−4.12
		Emerson	v3.92
		Honeywell	−3.92
		Intel	−3.44
		Boeing	−4.62
Industry: Software Developer/Technology Industry			
<i>Year of data used: 2011 & 2010</i>			
LongTop Financial	−3.21	Isoftstone	−3.93
		VanceInfo	−3.87
		HiSoft	−4.04
		Yucheng Technologies	−3.91
		Trunkbow	−4.11

Table 2. The F-score for fraud companies and non-fraud counterparts [9–26]

Fraud companies	F-score	Non-fraud companies	F-score
Industry: Fast Food Restaurant Chain			
<i>Year of data used: 2019 & 2018</i>			
Luckin	1.35	Shake Shack	1.07
		Haidilao	0.96
		Starbucks	0.79
		Wendy's	1.25
		Taco Bell	0.95
Industry: Power/Renewable Energy/Digital Industry			
<i>Year of data used: 2017 & 2016</i>			
General Electrics	1.21	3M	1.19
		Emerson	1.21
		Honeywell	1.35
		Intel	1.07
		Boeing	1.36
Industry: Software Developer/Technology Industry			
<i>Year of data used: 2011 & 2010</i>			
LongTop Financial	1.73	Isoftstone	0.87
		VanceInfo	0.99
		HiSoft	0.82
		Yucheng Technologies	1.07
		Trunkbow	1.12

4 Empirical Analysis and Results

4.1 Luckin Coffee

The Luckin coffee fraud was reported by Muddy Waters Research in January, 2020 and finally proved in April [27]. This work focus on its expansion rate and profit pattern, comparing with Starbucks, which serves as a successful model within the same industry as Luckin Coffee. Several unusual facts that could be considered as red flags have been discovered.

Expansion Rate. Since the establishment of its first store in early 2018, Luckin had own more than 4500 stores in China by the end of 2019. The expansion rate is incredible comparing that it takes Starbucks around 20 years to open more than 5000 stores in China since 1999. Such huge growth rate does not consist with the pattern of the industry, which leads to the further exploration to its business strategy.

Profit Pattern. Luckin's strategy is to seize market share by extremely low price, which even could not cover its cost, and at the same time, it also offers lots of coupons. However, lowering the price of goods without improving their quality could not build customer loyalty for Luckin. This is not practicable in foodservice industry due to the high customer mobility. By contrast, Starbucks' strategy of enhancing brand image by elegant environment and high product quality is better for its long-term development. Thus, there is a great probability for Luckin to manipulate its financial statements to cover the fact of declining revenue resulted from the loss of customers.

Change of Auditors Without Convincible Explanations. Luckin changed its auditors to Centurion ZD CPA&CO. in 2018 without a convincible explanation. This behavior could be seemed as a warning sign of its future frauds, and the exposure of Luckin's frauds in 2019 has proved this hypothesis.

Growth in Revenues Without Matching Rise in Cash Flows. Generally speaking, while depreciation & amortization remains stable due to unchanged depreciation rules, the growth of income may contribute to the rise in cash flow from operating activities (CFO) since it increases Accounts Receivables; However, the phenomenon that a growth in revenues along with a decrease in CFO is also acceptable because other items affecting CFO, such as the gain or loss on investment, can have great fluctuation. Comparing to Starbucks, Luckin's CFO acts very differently, as shown in Table 3. While revenues rose up slightly, Starbucks's CFO experienced a mediate decline. However, Luckin's CFO witnessed a big drop while its revenues were tripled.

Table 3. Luckin and starbucks revenue vs. CFO from 2018 to 2019 [9, 12]

Firm name	Revenues		CFO	
	2018	2019	2018	2019
Luckin	120.76	434.51	(188.27)	(311.27)
Starbucks	24,719.5	26,508.6	11,937.8	5,047.0

(Unit: million in UKD)

4.2 LongTop Financial

On April 6, 2011, Longtop's stock began to plummet after Citron Research questioned the company's alleged fraud because its profit margins were far higher than those of its competitors. On May 9, Citron again raised questions about Longtop's human resource management, and OLP Global also joined in. On May 22, Deloitte announced that it would no longer serve as the company's auditor. On May 23, the SEC opened an investigation into LongTop, and LongTop announced its dissolution on August 31. In four months and five days, LongTop went from a highly profitable concept stock with a market cap of \$1.4 billion to a worthless and notorious accounting fraud company.

The reason why it is involved in the financial fraud investigation and the evidence of its financial fraud are shown below [27].

Very High Profit Margins. Figure 1 shows that in 2010, the highest gross margin of other companies in the same industry was only 40%, while LongTop was as high as 60%, far exceeding other competitors [28].

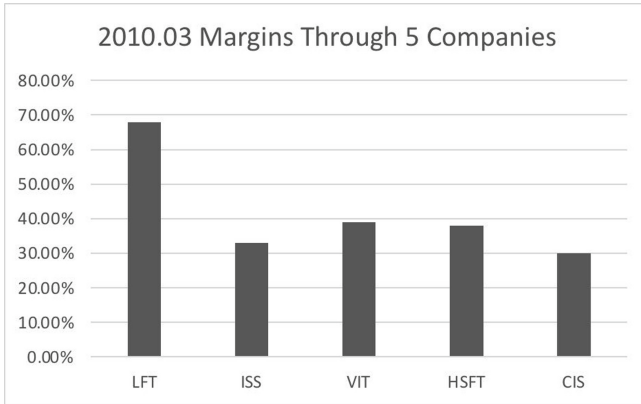


Fig. 1. Gross margin of five companies in the same industry [27]

Unconventional Staffing Model. More than 80% of LongTop’s employees are employed by LongTop Human Resources Co., Ltd. (XLHRS). LongTop claims that it has no connection with this company, but first of all their names are almost the same. In addition, this company does not have a website and does not have any other customers besides LongTop. Based on the complicated relationship between LongTop and this company, it is hard for us not to doubt that LongTop uses this company as a shelter for its financial fraud. The company allows LongTop to manipulate the wage expense and to shirk part of the responsibilities for debt and related financial expenses. Outsourcing companies have greatly obliterated the transparency of financial statements and provided good conditions for financial fraud.

The Auditor’s Sudden Resignation. Deloitte announced its resignation as Longtop’s auditor on May 22, 2011, one day before the release of its fourth quarter report for fiscal 2010. In its resignation letter, Deloitte stated three reasons: 1. Longtop’s financial information relating to bank deposits and loan balances was inaccurate and may also including sales revenue; 2. Certain members of Longtop’s management intentionally interfered with Deloitte’s audit work; 3. Illegal seizure of audit documents of Deloitte’s. Auditors’ sudden resignation and reasons for it are obvious red flags indicating that the company may do frauds.

4.3 General Electrics

In 2019, General Electric’s Company (GE), one of the largest firms in the United States, was accused by Harry Markopolos, who is known for his discovery of the Ponzi Scheme,

that it was having \$38 billion in accounting fraud by hiding its financial problems in its gas-turbine power and insurance business from investors. After a multiyear probe into GE's accounting practices, the Securities and Exchange Commission believed that GE had intentionally misled its investors, and as a result, GE agreed to pay a \$200 million penalty to settle federal claims [28]. Some evidence had shown GE's potential accounting frauds prior in 2017, and finally brought SEC into the probe.

Significant Increase in Liabilities. One red flag indicating GE's accounting frauds is the significant increase in its liabilities related to its insurance contracts in 2017, as shown in Table 4:

Table 4. GE's total insurance contract liabilities from 2016–2019 [15, 29]

Date	Insurance contract liabilities
December 31, 2016	\$26.1 billion
December 31, 2017	\$38.6 billion
December 31, 2018	\$35.6 billion
December 31, 2019	\$39.6 billion

In 2017, GE disclosed it would book a \$6.2 billion charge for its insurance operations in the fourth quarter, and a \$15 billion was also needed to set aside to bolster its insurance reserves. This sudden increase reveals that GE had lowered its costs for insurance claims, and failed to inform its investors about the uncertainties due to the lower estimates of future insurance liabilities while costs from long-term insurance claims should be rising [30]. GE's low estimates of the insurance liabilities enabled it to have a better debt-to-assets ratio which could mislead investors about its financial status. Despite that, the increase of liabilities is a warning sign for investors about GE's disclosure failure.

A Series of Changes Following the Departure of GE's Former CFO. The departure of GE's Chief Executive Officer Jeff Immelt in 2017 brought a series of changes to GE. Its stock price experienced a sharp decrease in 2017 and 2018, and GE also had to cut jobs and sell some of its business units to maintain an ideal condition. In addition, after having KPMG as its auditors for more than a century, GE decided to change to hire Deloitte starting in 2021 [30]. All these changes and moves revealed GE's poor performance, declining profits and cash flows. SEC also proved this fact by finding out that GE had to sell its receivables between GE Power and GE Capital to make its cash collections seem to be increasing [31]. Therefore, GE's unstable financial status in 2017 and 2018 could be told by the several changes it underwent. Overall, we found that the Red Flag analysis could be very effective and useful in detecting and predicting financial frauds as a company's frauds are very likely to be revealed by its changes and activities.

5 Conclusion

In this research, the approach for detecting and predicting financial frauds was discussed by using three models on the three selected companies who did financial frauds. Luckin Coffee, General Electrics, and LongTop Finance are three fraudulent companies in past 10 years selecting in this research as a sample, and they were compared to their competitors which are in the same industry and have similar size with them. After calculating and comparing their M-Scores and F-Scores, the result suggests that M-Score Model and F-Score Model could calculate the probability of financial frauds, and they are reliable regarding to the comparison between companies who manipulate their statements with companies who does not; the behavior of three fraudulent companies were also reviewed and analyzed, which indicates that Red Flag Analysis is a useful method to detect companies who did not make up their accounts but conduct frauds in other ways. However, the conclusion suggests that each method still has its limitation, and inaccuracy also exists in these two computational models. In other words, there is a lot of room for improvement in detecting frauds as some methods were designed decades ago while companies today are developing more and more techniques to avoid the detection of these methods. Therefore, the strategies of detecting frauds should be developed and adjusted with changes of times and economic environment.

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A Study on the Influence of COVID-19 Epidemic on American Stock Market Based on the Fama-French Five-Factor Model

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Abstract. After the COVID-19 epidemic swept the world, this paper confirmed and explained the impacts of the epidemic on the US stock market, which not only helped to comprehensively outline the impact of the epidemic on global economy, but also laid a solid foundation for researches of profit strategies by designing investment portfolios to cope with future global epidemics. According to the Fama-French 5-Factor Model, the following three conclusions can be obtained based on the analyses of data from all 49 industries of the American stock market. As for the increasing number of industries that can be explained by known factors during the pandemic, it can be concluded that the explanation capacity of the Fama-French 5-Factor Model was enhanced due to the pandemic. Since the significance of a series of industries factors ' β ' relative to zero has hardly changed during the survey period, it can be concluded that even after the outbreak of the epidemic, some common and influential influences, such as small-scale preferences and the characteristics of some industries, are still widespread. For the increasing number of industries whose intercepts became significantly different from zero after the outbreak of the pandemic, it can be concluded that some newly emerged factors impacted some industries during the pandemic, which ought to be included in the Fama-French 5-Factor Model in order to enhance the explanation capacity of the asset pricing theory during the pandemic.

Keywords: COVID-19 · Fama-French model · Stock market

1 Introduction

The great uncertainty of the stock market has haunted investor since the dawn of the modern capital market. To make it worse, the black swan phenomena, primarily proposed by Taleb (2019), induce even more uncertainty in the stock market, causing huge oscillation of the market value of stocks as well as tremendous anxiety among stock owners. In order to fight against the risks of loss and seize the winning chance in the black swan incidents, people have been striving for centuries to search for certain methodologies to assist them to earn profits from the uncertainty, which aroused the asset pricing theory. As a hot topic of modern financial economics, the asset pricing theory is often based on past research, aiming at determining and explaining the future price of a given asset

under uncertainty, and guiding people to better allocate assets to gain a profit. In fact, as Winston Churchill said, “the longer you look back, the further you look forward.” Out of the consistent respect towards history, economists have made countless brilliant achievements in the field of asset pricing. Based on the monthly data of Shanghai and Shengzhen A-shares, Gao (2017) profoundly investigated the impacts of the sentiments of investors as well as the risk factors induced by the sentiments on the asset pricing under the influence of multiple outside financial factors. Focusing on the Fama-French 5-Factor Model, Gao (2017) explored the effectiveness of the model in the Chinese stock market, and then, based on the Fama-French five factor model as the major asset pricing model, further investigated issues of liquidity pricing, IPOs long-term performance as well as mutual fund performance in the Chinese stock market. Based on the foreign research on the impacts of human capital on stock pricing, Wang (2018) investigated the influence of Chinese human capital on asset pricing. Meanwhile, as a typical black swan phenomenon, the pandemic of COVID-19 swept across the earth, harshly striking stock markets worldwide. An array of scholars in economics have devoted themselves to clearly figuring out the influence of the pandemic of COVID-19 on the stock markets. Adopting the index of the pure profits, Shuping et al. (2021) Investigated and analyzed from the perspective of finance the authentic impacts of the pandemic of COVID-19 on the financial listed companies. By analyzing the total atmosphere of the economic developments and the quality of credit assets of the commercial banks, Peiqin et al. (2021) explained in detail influence of the pandemic of COVID-19 on the quality of the commercial banks’ assets, and then offered the relative suggestions. Employing the interference model combined with the traditional ARIMA model, Yang (2021), by establishing the VAR model, systematically analyzed the dynamic impact of the pandemic of COVID-19 on Chinese stock markets as well as the public debt markets. However, there are some noticeable limitations in the current research. On the one hand, as an effective and plausible approach to predict future price of assets based on the past data, the theory of asset pricing was, however, primarily employed to analyze the data of the past, instead of paying more attention to the progressive influential events, such as the pandemic of the COVID-19. On the other hand, at present, the analysis of the impact of COVID-19 epidemic is mainly carried out in a rather small population, which is likely to lead to prejudice based on qualitative research methods. Hence, by employing the tested and plausible model of asset pricing, namely the Fama-French 5-Factor model, this paper is written to explore and illustrate the impact of the pandemic of COVID-19 on the American stock market based on the data from the 49 industries of American stock market during the pandemic. These conclusions would provide valuable reference for making profit strategy in future global health activities. Moreover, in order to process the raw data precisely and efficiently, the MATLAB is applied in the data analyses.

2 Reflection on the Asset Pricing Theories

Generally speaking, asset pricing theory tries to determine the formation mechanism of stock prices by analyzing the stock prices and return rates. Specific to the research process, there are majorly two approaches. The first approach is to select different assumed conditions to establish the complete theoretical framework with those assumed influential factors before finding out the factors which genuinely determine the prices of

assets based on the investigation of the data of the balanced prices of assets, while the second approach is to investigate acquired data and evidence to explore and determine what factors are related and decisive. Obviously, not only is the process of completing the theoretical framework needed to perfect a theory of asset pricing, but the examinations with the given facts are also indispensable. The interactions of these two methods has promoted the development of asset pricing theory. In fact, since the mathematical statistics method was applied to portfolio research in 1950s, many asset pricing models have appeared in the process of modern economists' exploration and research. However, based on the selected topic of this paper, only several vital models related to the models of pricing assets with factors are included in the section of reflection, namely the Capital Asset Pricing Model (short for CAPM), the Arbitrage Pricing Theory (short for APT), the Fama-French 3-Factor Model and Fama-French 5-Factor Model.

2.1 The Capital Asset Pricing Model (CAPM)

Primarily proposed by Sharpe (1964) and Lintner (1965), the CAMP is developed on the basis of the modern portfolio theory, aiming to determine the pricing relationship between the return rate of a single security and the return rate of the market portfolios. Generally, the theory of the CAMP is based on the following hypotheses.

1. The investors are the rational people pursuing the biggest interests. They can decide their securities based on their expected profit rates and the standard deviation.
2. The investors' expectations, expected rate of return and standard deviation of future profits of securities are consistent.
3. The security market provides a fully competitive but frictionless market atmosphere.

With the hypotheses stated above, the major formula of the CAMP can be concluded below as Eq. 1.

$$ER_i = R_F + \alpha_i + \beta_i(ER_M - R_F) \quad (1)$$

In Eq. 1, $\beta_i = \sigma_{iM} / \sigma_M^2$. In that equation, R_i represents the return rate of the security or the portfolio named i . R_F represents the return rate without risks, which is often indicated by the return rate of American public debts. σ_{iM} is the covariance of the return rates of the security i and the market portfolio, and σ_M^2 is the variance of the return rates of the market portfolio. Based on what has been stated above, the formula of CAMP reveals under a balanced market, the correlation between the expected return rate of a single security and the return rate of the market portfolio. Moreover, by further expanding the expression of β_i , it can be concluded that $\beta_i = (\sigma_{iM} / \sigma_i \sigma_M) \times \sigma_i / \sigma_M$. Based on the fact that $\sigma_{iM} / \sigma_i \sigma_M$ indicates the correlation coefficient between the return rate of the security i and the return rate of market portfolio, β_i does not only represent the correlation between the return rate of the security i and the return rate of market portfolio, but also indicates the risk correspondence between the two. In short, according to the theory of CAMP, the higher risk a security shoulders, the higher interest rate the security will have.

2.2 The Arbitrage Pricing Theory (APT)

Proposed by Ross (1976), the APT can be applied in a wider range of finance compared with the theory of CAMP. Overall, the universality of the APT is embodied from two perspectives: the APT has fewer precondition hypotheses than the theory of CAMP. Compared with the CAMP, which only uses a single market factor as an index of a certain security yield, the APT adopts a multi-factor model, which is in line with the actual situation of the security market. Generally speaking, the APT has the following precondition hypotheses.

1. There are enough securities in the capital market to be infinitely divided, and the capital market itself is fully competitive, but there is no friction.
2. The investors have certain expectations for the rate of return and standard deviation, and they all prefer the security with high expected rate of return and low variance risk.
3. The return rates of all securities are commonly controlled by several linear factors.
4. Once the arbitrage opportunity of capital market appears, it will soon be eliminated.

Based on the premise hypothesis, APT's formula can be summarized into the following two models.

$$R_{it} = \alpha_i + \sum_{j=1}^k \beta_{ij} F_{jt} + e_{it} \quad (2)$$

$$ER_{it} = \lambda_0 + \sum_{j=1}^k \beta_{ij} \lambda_j \quad (3)$$

In Eq. 2, R_{it} represents the return rate of the security or the portfolio in the period t . F_{jt} represents the corresponded value of the factor j in period t . α_i represents the corresponded expected return rate of the security or portfolio i when $F_{jt} = 0$. β_{ij} Represents the factor loading, indicating the sensibility of the security i to the j^{th} factor. e_{it} Represents the disturbing term. And in Eq. 3, ER_{it} indicates the expectation of the return rate of the security or the portfolio in period t . λ_0 represents the return rate without risk. λ_j Indicates the risk premium of the factor j . To obtain the final model of APT, time series regression analysis should be carried out by using the multi-factor model represented by Eq. 2 to determine the common influential factors on the return rates and the corresponding sensitivities β_{ij} before carrying out the cross section regression by using Eq. 3 to obtain λ_j .

As one of the most important milestones, the Arbitrage Pricing Theory initiates a brand-new methodology to analyze the issue of finance from a perspective different from the conventional way of even analysis and establishes the bridge connecting the academic theories with the reality. However, as the first theory to study multiple and non-uniform factors, arbitrage pricing theory has some serious limitations, among which the most questionable one is that it has not stated the exact factors affecting the rate of return.

2.3 Fama-French Factor Model

Factor model is a research method in the field of asset pricing research. It is to arrange companies in a certain order, get the factors to be tested that reflect the characteristics of

the companies, and then establish the investment portfolios. Two typical factor models, namely Fama-French 3-Factor Model and the Fama-French 5-Factor Model, are reviewed below.

Fama-French 3-Factor Model. Initially proposed by Fama and French (1993), the Fama-French 3-Factor Model is a typical type of asset pricing model discussed above. The equation of Fama-French 3-Factor Model is usually stated in the form below as Eq. 4.

$$R_{it} - R_{Ft} = \alpha + \beta(R_{Mt} - R_{Ft}) + sSMB_t + hHML_t + e_{it} \tag{4}$$

In Eq. 4, R_{it} represents the return rate of the security of portfolio i in the period t. R_{Ft} represents the return rate without risks, which is often indicated by the return rate of American public debts. R_{Mt} Represents the market return rate. SMB_t Represents the size factor. HML_t Represents the book-to-market factor; α is the intersection term. β , s , and h are the factor loading. e_{it} Represents the disturbing term.

In Fama-French 3-Factor Model, $\beta(R_{Mt} - R_{Ft})$ is in accord with that in CAMP model, indicating the correlation between the return rate of a stock and the risk. And SMB_t and HML_t derive from the size effect and the book-to-market effect respectively.

Because of the outstanding performance in the reality examination, the Fama-French 3-Factor Model is now widely applied in the research of asset pricing, investigation of incidents and performance of funds.

Fama-French 5-Factor Model. By analyzing the valuation model proposed by Miller and Modigliani (1961), Fama and French (2015) realized that the expected return rate of a certain stock is related to the book-to-market ratio, profits and investments of a company, which laid a solid foundation for the 5-factor asset pricing model.

Miller and Modigliani’s valuation model indicates that the market value of a listed company in a period t can be calculated by Eq. 5.

$$M_t = \sum_{\tau=1}^{\infty} E[Y_{t+\tau} - dB_{t+\tau}]/(1+r)^\tau \tag{5}$$

In Eq. 5, M_t represents the market value of the company in period t. $Y_{t+\tau}$ represents the return rate of equity of the listed company in period t. $dB_{t+\tau} = B_{t+\tau} - B_{t+\tau-1}$, which indicates the change in book value. r indicates the long-term expected return rate of the listed company’s stock. The following equation can be obtained by dividing Eq. 5 on both sides by B_t .

$$M_t/B_t = \sum_{\tau=1}^{\infty} E[Y_{t+\tau}/B_t - dB_{t+\tau}/B_t]/(1+r)^\tau \tag{6}$$

As is revealed by Eq. 6, the expected return rate can be explained from three perspectives: with all variables fixed except the market value of the company M_t as well as the expected return rate of the stock, the companies with higher value of book-to-market ratio, namely B_t/M_t , are quite likely to obtain a high expected return rate. With all variables fixed except the return rate of equity of the listed company, namely $Y_{t+\tau}$, and the expected return rate, namely r , the listed companies with higher profits, namely higher value of $Y_{t+\tau}/B_t$ should obtain higher expected return rate. With all variables

fixed expect the change in book value in period $t + \tau$, namely $dB_{t+\tau}$, and the expected return rate of the company, namely r , the companies with higher increase of the book value, namely the value of $dB_{t+\tau}/B_t$ which indicates the investment level of the company, should have lower expected return rate of their stock. In this way, after dividing companies into two groups, namely the value companies and the growth companies, Fama and French (2006) pointed out the criteria of the classification: the companies with characteristics of high profits, big ratio of book-to-market low investment are classified as the value companies while the companies with characteristics of low profits, big ratio of book-to-market and high investments are classified as the growth companies.

In order to examine the relationship unveiled by Eq. 6, Fama and French (2015) carried out factor regression by properly selecting the agent variables indicating the profit factor and investment factor, and then added the two factors into the Fama-French 3-Factor Model. In this way, the Fama-French 5-Factor Model has been established. The specific expression of the Fama-French 5-Factor Model can be written as Eq. 7.

$$R_{it} - R_{Ft} = \beta_1 + \beta_2(R_{Mt} - R_{Ft}) + \beta_3SMB_t + \beta_4HML_t + \beta_5RMW_t + \beta_6CMA_t + e_{it} \quad (7)$$

In Eq. 7, R_{it} represents the return rate of the security or the portfolio in the period t . R_{Ft} represents the return rate without risks in the period t , which is usually indicated by the return rate of American public debts. SMB_t Represents risk premium factor caused by the size difference of companies in the period t . HML_t represents the risk premium factor caused by the difference of companies on the book-to-market ratios in the period t . RMW_t represents the risk premium factor caused by the difference of companies' ability to earn profits in the period t . CMA_t represents the risk premium factor caused by difference of companies' investment level in the period t . β_1 represents the intersection term. β_2 , β_3 , β_4 , β_5 and β_6 are the factor loadings of the corresponded factors. e_{it} Represents the disturbing term.

3 Research Methodology

3.1 Data Selection

The raw data are from Kenneth R. French's data library (2021). March 10, 2020 is considered as the time when the COVID-19 epidemic broke out, and November 9th, 2020 is considered as the turning point of the epidemic. On this day, Pfizer announced that the vaccine jointly developed by it and German biotechnology company had more than 90% effectiveness in novel coronavirus. Therefore, from March 10th, 2020 to November 9th, 2020, a total of 170 days is considered as "epidemic period". In addition, in order to comprehensively summarize and analyze the impact of the epidemic in COVID-19, "the period before the epidemic" is 170 days before March 10th, and the period after the epidemic "is 170 days after November 9th, 2020. In this way, the data of 510 days divided into 3 groups are majorly explored.

3.2 Data Process

In the set of raw data, the values of the five factors, namely $(R_{Mt} - R_{Ft})$, SMB_t , HML_t , RMW_t , CMA_t , the return rates of the 49 industries and the return rates without risk are primarily provided. The difference between the return rates of the industries and the return rate without risk, namely $R_{it} - R_{Ft}$, is calculated and then set as the value of the dependent variable y before conducting the linear multivariate regression with the five factors as the independent variables. The coefficients, t-values, p-values are collected as the foundation of the research. All the processes of data are done by employing the METLAB as the tool of data processing as well as analysis.

3.3 Data Analysis

In order to find out the impact of epidemic situation on the stock market, industries with beta coefficient from the five angles will be studied. The possible reasons behind the impacts on the special factors will then be further discussed and explored.

- A. The industries (noted as “0–0” industries) whose beta values can be seen as zero in both “before” and “after” periods but are negatively different from zero in “during” period and the industries (noted as “0+0” industries) whose beta values can be seen as zero in both “before” and “after” but are positively different from zero in the “during” period.
- B. The industries with “before”, “during” and “after” betas all positively or negatively different from zero (noted as “+++” industries or “---” industries respectively).
- C. The industries (noted as “+-+” industries) whose beta values are positively different from zero in both “before” and “after” periods but negatively different from zero in “during” period and the industries (noted as “-+-” industries) whose beta values are negatively different from zero in both “before” and “after” periods but positively different from zero in the “during” period.
- D. The industries with intercept significantly different from zero.

Generally, category A of industries is included in the investigation to determine whether the outbreak of the pandemic increased or decreased the explanation capacity of the Fama-French 5-Factor Model, which is indicated by the number of industries with given factors significantly different from zero. The categories B and C of industries are included in the investigation to determine whether the preference of investors under normal situation works or not during the pandemic. The category D is included in the investigation to explore whether new factors outside Fama-French 5-Factor Model emerged in certain industries or not during the pandemic.

4 Results

By performing the above process, the following results are shown in the following tables. Note that the first two tables are provided mainly to provide the general outline of the 49 industries that are experiencing the epidemic situation. Because of the rather big quantity of industries with “+++” SMB factor, those industries are displayed in four arrays for the clarity of the Table 5.

Table 1. The number of industries with different influential factors

Period	3-factor	4-factor	5-factor
Before	17	12	0
During	20	16	4
After	17	16	3

Table 2. The ratios of industries with different influential factors

Period	3-factor	4-factor	5-factor
Before	34.69%	24.49%	0
During	40.82%	32.65%	8.16%
After	34.69%	32.65%	6.12%

Primarily, the pandemic seemingly enhanced the explanation capacity of Fama-French 5-Factor Model. As is illustrated by Table 1 and Table 2, with a few industries able to be explained by five factors, most industries can be explained by 3 or 4 factors. The number of industries that can be explained by known factors increased with the outbreak of the epidemic, but slightly decreased with the emergence of effective vaccine. Specifically, during the whole investigation period of the epidemic situation, the number of industries with 4 or 5 factors increased continuously. However, the number of industries with 3 factors increased with the beginning of the epidemic, but decreased as the emergence of vaccine. Hence, although the pandemic seemingly impacted the stock market violently, overall, more industries could be explained by known factors after the pandemic, indicating that the pandemic somewhat enhanced the predictability of the securities based on the established model.

Table 3. “0+0” Industries violently affected by the pandemic

Factors	Industry 1	Industry 2	Industry 3	Industry 4	Industry 5	Industry 6	Industry 7
SMB	Beer & liquor	Precious metals	Utilities	N/A	N/A	N/A	N/A
HML	Tobacco products	Entertainment	Rubber and plastic products	Construction	Personal services	Real estate	Other
RMW	Textiles	Construction materials	N/A	N/A	N/A	N/A	N/A
CMA	Tobacco products	Coal	N/A	N/A	N/A	N/A	N/A

Table 4. “0–0” Industries violently affected by the pandemic

Factors	Industry 1	Industry 2	Industry 3
SMB	N/A	N/A	N/A
HML	Defense	Precious metals	N/A
RMW	Food products	Rubber and plastic products	Trading
CMA	Construction	Business services	Real estate

The conclusion obtained by observing Table 1 and Table 2 is also proved by data displayed in Table 3 and Table 4. As is revealed by Table 3 and Table 4, an array of industries can be explained by new factors included in Fama-French 5-Factor Model that may fail to explain the industry under normal circumstances.

However, there are also industries that received little impact from the pandemic, which may be related to results of the application of some common and influential effects. As shown in Tables 5, 6, and 7, a rather large number of industries are included in the first two tables while no industries are included in the third table. Therefore, according to mathematical theories in statistics, the importance of beta coefficient in no industry was completely overturned by the outbreak of the epidemic, and the importance of betas coefficient relative to zero changed little in most industries during the epidemic in COVID-19, which proved that although the epidemic seriously affected the stock market, some common and influential preference among the investors continued to dominate some industries. Table 4 and Table 5 reveal two interesting points supporting the above conclusions. One is about an incredible number of industries with “+++” SMB factor: during the whole investigation period of the epidemic situation, 38 industries out of a total of 49 industries had positive SMB β , which was hardly influenced by the black swan phenomenon. The other one is the fact that medical industries, namely Medical Equipment and Pharmaceutical Products, have “---” RMW factor over the whole investigated period of the pandemic, undergoing little impact from the pandemic. The analyses of the reasons behind the phenomena will be discussed in the discussion section.

At the same time, different from the above industries, some industries are still severely affected by the epidemic. According to the mathematical theories in statistics that in the multivariate linear regression, if the intersection term is significantly different from zero, the independent variables cannot fully explain the change of the dependent variables, industries with intercept term significantly different from zero, as is shown in Table 8, are somehow affected by other unknown factors. Obviously, the number of industries affected by unknown factors increased sharply at the beginning of the epidemic; even after the emergence of effective vaccines, the number remained considerable. Hence, based on Table 8, it can be concluded that although more industries can be explained by the given five factors, some industries became the industries that can not be fully explained by those given factors because of the outbreak of the pandemic. In order to enhance and perfect the explanation capacity of the factor model of asset pricing theory, more new factors may be added into the model to explain the newly emerged industries that the given factors failed to explain during the pandemic.

Table 6. “---” Industries that were faced with rather little impacts.

Factors	Industry 1	Industry 2
SMB	N/A	N/A
HML	Pharmaceutical products	Computer software
RMW	Medical equipment	Pharmaceutical products
CMA	N/A	N/A

Table 7. Industries violently affected by the pandemic

Factors	“+—+” industries	“—+—” industries
SMB	N/A	N/A
HML	N/A	N/A
RMW	N/A	N/A
CMA	N/A	N/A

5 Discussion

5.1 The Increased Explanation Capacity of Fama-French 5-Factor Model

The Fama-French 5-factor model is based on a large number of empirical investigations, and these 5 factors represent the preference of most people for stocks to some extent. At the same time, the outbreak of COVID-19 epidemic, as a special black swan event, caused great anxiety among investors. In the shadow of anxiety, more investors who used to be brave in taking risks were then turning to stocks that made them feel safe—they are worried about losing everything in the key events that bring great turmoil to the global economy. In this way, because of the nature of human being as a social animals, people gained great comforts and security in the collectivity. Those investors would sell their stocks, which are rarely bought by their peers, and buy stocks that most people often bought. Thus, these five factors, due to people’s herd mentality, played a more decisive role in people’s stock selection. Hence, the explanation capacity of the Fama-French 5-Factor Model increased because of the pandemic of COVID-19, as is proved by Tables 1, 2, 3, and 4.

5.2 The Endurable and Influential Effects on the Stock Markets

As is universally acknowledged, the price rising of a stock is deeply rooted in the confidence as well as expectation on the stock. There are some influential effects on the stock market, contributing to consistent preference among investors—so influential that even the pandemic of the COVID-19 could not eliminate their influence, as is proved by

Table 8. Industries in the three periods whose intercept values are significantly different from zero

Period	Industry 1	Industry 2	Industry 3	Industry 4	Industry 5	Industry 6	Industry 7	Industry 8	Industry 9	Industry 10
Before	Coal	Business services	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
During	Recreation	Consumer goods	Chemicals	Rubber and plastic products	Electrical equipment	Automobiles and trucks	Computer software	Electronic equipment	Measuring and control equipment	Retail
After	Recreation	Entertainment	Printing and publishing	Medical equipment	Communication	Business services	Computer software	Retail	Trading	Other

Table 5, Table 6, and Table 7. In this survey, Table 5 and Table 6 highlight two kinds of influences, namely, small-scale preference and industry characteristics. The small-scale preference is embodied by the large number of industries with “+++” SMB factor in Table 5, which is deeply related to the risk premium. Generally, the risk premium is the higher return rate demanded by investors to set of the greater risks the investors shoulder, which is the difference between the return rate of a certain security and the risk-free return rate. In this way, the small companies, especially when great changes have taken place, are taking considerable risks. Therefore, stocks of the small companies would provide higher rate of return to offset the greater risks borne by the owners of stocks. Therefore, the market favors those industries with higher return, which leads to a small-scale preference phenomenon. The other effect, namely the characteristics of industries, is majorly embodied by the two medical industries with “---” RMW factor in Table 6. Generally, the negative RMW factor indicates that the market prefers the industries with lower profitability. It is irrefutable that scientific research is not only expensive, but also time-consuming. Under this case, some companies focusing on medical equipment and drugs would devote themselves to researching more advanced equipment or drugs to cope with the severe diseases. Therefore, large amount of money would be invested in research, which will inevitably lead to temporary low rate of return—the outbreak of violent COVID-19 epidemic may only further worsen these figures. However, investors, especially during the epidemic, saw hope in their actions to solve the epidemic—they believed that these companies would eventually find the cure and treatment method for COVID-19. Therefore, they flock into these industries, which leads to investors’ general preference for these companies. Based on the discussion on the two representative examples, it can be concluded that some influential effects still prevailed even though the pandemic broke out.

5.3 The Industries Becoming Unexplainable After the Outbreak of the Pandemic

The price rising of a certain stock is rooted in the confidence as well as the expectation of the stock owners toward it. People have a strong tendency to build confidence and expectation for what they are currently using and like. In this case, with the implementation of the lockdown policy to cope with the pandemic, people’s daily life was tremendously altered, which may lead to the change of their preference for stocks. In this way, some new factors which indicate people’s newly developed preference on the stocks of some industries during the pandemic may be introduced into the 5-factor model in order to better explain the return rates of those industries during the pandemic. An obvious example that needs to be analyzed is the entertainment industry: As shown in Table 8, after the outbreak of the epidemic, the intercept term of this industry became obviously non-zero. Owing to the lockdown policy, people were forced to stay home, which caused two consequences. On the one hand, they gained massive amount of leisure time. On the other hand, they could not go out and have fun, making their entertaining activities rather limited. Therefore, indoor entertainment has become the first choice of many people to spend their spare time. Under this case, those companies having the products that could entertain people the most and occupy people’s leisure time the most are likely to gain people’s favor, thus making their stocks rise. Based on what has been

stated above, for the Recreation Industry, the ability of a company to entertain people may be added as a new factor to measure their future return rates during the pandemic.

6 Conclusion

With the help of MATLAB, a statistical survey of 49 industries in the US stock market was made, and the following conclusions were drawn, which showed the influence of COVID-19 epidemic on the stock market from three aspects. (1) The epidemic situation enhanced the explanatory power of the Fama-French five-factor model. (2) Even after the outbreak of the COVID-19 epidemic, some universal and influential effects on the stock market still exist. (3) Some newly emerged factors impacted some industries during the pandemic, which ought to be included in the Fama-French 5-Factor Model in order to enhance the explanation capacity of the asset pricing theory during the pandemic.

This conclusion is helpful to study the impact of COVID-19 epidemic on the global economy. It also provides a good reference and solid foundation for researchers, who aim to make profit strategy by designing the right investment portfolios to cope with the global epidemic in the future.

In the future research, we will analyze the changes of industrial β value in epidemic areas will be analyzed. In addition, in order to better explore the reasons behind the above conclusions, more information and data of the investigated industries will be collected.

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Multilevel View of Literature on Healthcare Quality in Hospitals Differing in Ownership

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Abstract. This study makes a review on literature of the healthcare quality of public and private hospital to figure out the trend of the study on impact from public and private ownership on service quality and conduct the direction for future study. From individual level, organization level, industry level, national service system level, a review on the studies is made from different perspective to figure out the study on the service quality from a multilevel view. Study on the relationship between service quality and ownership mostly focused on organization, industry, and system level. Studies from the behaviour of physician and patient are fewer. Ownership effect studies were carried out mostly in universal coverage of healthcare service. More studies on the human behaviour related to the service quality and hospital ownership to make complementation to the literature, in order to make better policy-making decision support and individual behavior intervention.

Keywords: Ownership · Service quality · Multilevel · Hospital · Service system

1 Introduction

From the original study by Arrow (1963), in many countries, researchers argue about how hospital ownership status influences hospital performance, and apply implications from ownership theories in several countries. However, the evidence of empirical analysis for the influence ownership has on hospital performance in developing countries such as China is rare. Complexity of health care market, a great literature paid attention to the relationship between ownership and quality of a hospital from different perspective [1].

Since the health reform in 2009, China has invested a lot in health infrastructure, achieving universal coverage of medical insurance, which has enhanced the equity of basic public health services, and established a basic system of drugs, which have improved the quality of medical and health services.

Accessibility and equity sharply reduce the child mortality, maternal mortality and morbidity of infectious diseases, improving the health level and life expectancy of the Chinese. In 2015, China's per capita life expectancy got to 76.34 years. In recent years, diagnosis-related disease groups, and case combination indexes are used to evaluate medical service capacity, targeting service quality and hospital development in parts of China.

2 Service Quality of Public and Private Hospital

2.1 Individual Level

At the individual level, physician ownership and patient preference and choice has been paid attention to by scholars.

Stjin (2015) conducted a discrete choice experiment to indicate that difference in ownership is related to nursing home motivation and output quality and quantity [2]. Brian (2016) made an investigation of Taiwan's Stark Law-like and found that policy-makers ought to pay attention to physicians who refer patients to a financial interest, and the purpose of the original prohibition does not work out [3].

Esra (2012) made an investigation of how hospital ownership affects treatment choices reveal that not-for-profit hospitals have treatment choices of less profitable patients [4]. Niles (2016) carried out a multinomial logit model estimation of hospital choice to test whether hospital demand responding to quality traditional measured, is less important in choice determination [5]. Francesca (2016) analysed a non-monetary benefit model to conclude that the interaction between non-profit hospitals and health professionals with motivation increases the total surplus [6]. Tang (2016) made evaluation of preference over health care attributes of individual choice based on a discrete choice experiment, indicating that urban resident's value private health care less than rural migrants [7].

Virginie (2013) made an investigation of non-clinical quality funded by National Health Service by a switching regression model accounting for patient characteristics, selection into private hospitals and unmeasured characteristics by fixed effects, indicated that difference in reported experience are entirely attributable to factors other than hospital ownership [8].

2.2 Organization Level

Ownership Impact on Service Quality. Sloan (2001) measured service quality by survival, functional and cognitive changes, and living arrangements, indicated no differences in outcomes by hospital ownership [9].

Yu (2002) found government and for-profit hospitals to have higher adverse outcome incidence than non-profit hospitals by 3–4%. Additionally, ownership conversion from non-profit to for-profit increased adverse outcome incidence by 7–9% far more than that in other ownership conversion [10]. Chou (2002) found for-profit and non-profit homes to have manifest differences when asymmetric information exists [11]. Before 2009, the research of the ownership impact on quality mostly reveal that for-profit and government-controlled hospitals have higher mortality rates or adverse event rate than non-profit ones. Jensen (2009) found that hospital performance determinants include factors such as asset ownership, the degree of competition, resource allocation decisions and the nature of the incentives provided to management [12]. Eggleston (2010) discovered that merely changes in ownership could hardly dramatically improve or harm overall service quality. Both of desired hospital performance rewards and vulnerable patient's protection could be carried out by system incentives regardless of hospital ownership [13]. Gobillon (2016) pointed out that healthcare quality in for-profit hospitals relies on

innovative procedure performance capacity to be specific [14]. Jones (2017) argued that information shock led to reduction in the share of non-profit homes, which is driven by a combination of home closure and sector switching with low quality ones most likely to exit, implicating that reforms are carried out to increase consumer provision in public services [15]. Moscelli (2018) demonstrated that importance of controlling unobserved patient heterogeneity is essential in comparison of public and private hospitals' quality in England [16]. Tynkkynen (2018) claimed that investigation of the relationship between contextual circumstances and performance is worth more attention in the future in Europe. Significant weakness in studies on economic effects is the failure to control quality and other operational dimensions [17]. Bjorvatn (2018) found that private non-profit hospitals which specialized in certain procedures are more likely to admit less severe patients in Norway. The association between healthcare quality and ownership is mixed since private non-profit hospitals both offer shorter waiting time and length of stay [18]. Dalton (2019) pointed out that combination of both ownerships could lead to greater diversity in consumer types served, leading to a wider range of patients being served than in the absence of this coexistence [19].

Hospital Efficiency and Cost. As a non-profit institution, the study of hospital begins with examining how the non-profit status may cause misallocation of resources.

Newhouse (1970) proved that bias against produce lower quality products, rare response to a profitable opportunity, and reimbursement from third party would weaken the incentives for least cost production [20]. Silverman (1999) explored the association between for-profit ownership and American Medicare spending, revealed that for-profit area has greater per capita Medicare spending and increase rates than non-profit area [21]. Despite no significant difference in the timing of admission by ownership in USA, Lindrooth (2007) found that for-profit hospices do not tend to admit patients with less expected profitability. Medicare pricing system is probably incentives for efficiency [22]. Barbetta (2007) estimated the technical efficiency of a sample of Italian hospitals in 1995–2000 to suggest that economic performance differences come from institutional settings. Policies aim at reducing hospitalization rates, leading to a decline in technical efficiency [23]. Horwitz (2007) examined non-profit, for-profit, and government, indicating that non-profit hospitals' service varies by market mix, with no significant effect of for-profit market share on their operation margins [24]. HERR (2008) investigated the efficiency of 1500 German general hospitals from 2001 to 2003 indicated that publicly owned hospitals have higher technical and cost efficiency than non-profit hospitals with efficiency scores negatively correlated with length of stay, which is lower than that in private hospitals [25]. Miyata (2010) made a generic prediction model application with discharge data provided by 469 hospitals in 2006, which fits well to hospitals with wider range of acute care events [26]. Tiemann (2011) provided the evidence from German studies to suggest that private ownership does not necessarily have higher efficiency than public ownership [27]. Mcintosh (2015) compared government-managed hospital network and the new PPP-managed hospital network in Africa, Lesotho, indicated that mix ownership network delivered more services with higher quality [28]. Christina (2016) explored a model tested in California hospitals, and proved private non-profits to be interested in physician-intensive services while public hospitals are interested in labour-intensive services [29]. Roberto (2017) applied a stochastic frontier model to a

dataset composed by 133 Italian hospitals during 2008–2013, revealing that transient efficiency is more important than persistent efficiency and ownership, specialization and size mostly determine both types of inefficiency with no significance of and teaching hospitals and multihospital systems [30]. Karmann (2017) examined stimulation from hospital policy to hospital TFP growth and exploitation of German federal states variation 1993–2013, indicating that reducing the length of stay, scope-related policies under activity-based hospital funding, and deepening capital with scarce capital may enhance TFP growth, reflecting quality improvements rather than output volume increase [31].

Hospital Human Resource. Allocation of authority depends on the degree of impurity of goods produced.

Marco (2006) claimed that more important investment from a party requires greater authority, especially when the degree of impurity of goods produces is large [32]. Karl (2009) found that India has applied human resource strategies in different context in achieving the goal of reducing maternal mortality by thoughtful use of ownership transfer, position enhancement, and task shifting to improve health outcomes of women and children in resource-constrained settings [33]. Tang (2013) found that unbiased market policy environment might be main reason for expansion of private hospitals. Specific hospital-physician relationship in China could be an explanation of unbalanced age distribution and healthcare workforce mobility in private hospitals [34].

2.3 Industry Level

At the industry or market level, scholars did great work on the industry evolution, performance assessment, and incentive-related empirical study.

Market Performance Effect. Daniel (2000) made an examination of the influence that exogenous determinants of hospital choice has on hospital market competitiveness, and the effects on social welfare from the interactions between competition and managed-care organizations influence, indicates that increasing HMO enrolment partially explains the change in hospital competition [35].

Henry (2002) investigated relationship between preponderance of the non-profit form, the rapid decline in acute care hospital services demand by testing exit rate of hospital industry and estimating the population change effects to demonstrate the difference in responding to demand reductions [36]. Sujoyn (2006) examined that how ownership form could influence entry and exit behaviour in US hospital industry since 1970 by theoretical predictions, indicating that for-profits react faster in entering and exiting a changing market than non-profits [37].

Hsien (2008) compared stroke and cardiac patients' program expenditure and treatment quality, indicating that no difference in index admission expenditures with 10% higher patients' long-term expenditure in non-profits than for-profits (Hsien 2008) [38].

Jill (2009) claimed that for-profit market share estimation with medical service provision and operating margins indicate for-profits to have higher operating margin than non-profits in markets [39]. Hugh (2010) made investigation of how information changes affects hospital quality by modelling patient information as an imperfect signal, representing that hospital quality with initial relatively imprecise information would be

improved by better information. Better information improves patient welfare if welfare depends on actual quality rather than perceived quality [40]. Carol (2010) carried out a natural policy experiment with the targets' global effectiveness establishment, representing that targets meet goals of reducing waiting times, without diverting activity from less-monitored health aspects or decreasing patient health [41].

Boris (2012) measured financial sustainability by probability of default to mirror hospital survival ability in the market to indicate that public hospitals with highest path dependence in poor financial standing [42]. Natalie (2015) made a review of qualitative literature to identify high performance hospitals, their factors for success and practical strategies for improvement [43]. Julia (2016) made qualitative comparative analysis to indicate that employer provide a nuanced account of contract performance in mixed sector markets [44].

Hospitals Competition Effect on Service Quality. Other scholars made the research on the impact that hospital competition has on service quality.

Cutler (1996) made an estimation of the extent public insurance' s crowding out private insurance to prove approximate 50 percent of the increase in Medicaid coverage to be associated with reduction in private insurance coverage, as employer-based insurance less frequently taken [45]. Brekke (2010) analysed the competition effect on quality in health care markets with regulated prices, by taking a differential game approach [46]. Chen (2010) found that usage of patient-reported data could make quality of care from the patients' perspective to be sensitive to the degree of competition [47]. Cooper (2011) claimed that NHS patient choice reform, which raises hospital competition, is proved to lead to improvements in hospital quality [48]. Brekke (2012) declared that profit constraints could increase welfare and make a complementation or substitution to a higher regulated price, referring to on the degree of altruism [49]. Katz (2013) found that if the prices are held fixed, increase in competitions with more care providers or greater precision of quality related signals available to consumers, would result in lower equilibrium quality [50]. Cookson (2013) found that a negative association exists between market competition and elective admissions, which was slightly reduced by pro-competition reform effect, indicated that competition did not undermine equity [51]. Pan (2015) demonstrated that hospital competition could give rise to fewer outpatient costs, lower observation room mortality, and shorter outpatient waiting time [52]. Zhao (2016) affirmed that competition effects on nursing home quality becomes stronger with information transparency increase, indicating that quality reporting and market structure regulations should be improved [53]. Cooper (2018) verified that policymakers face a potential trade-off that facilitated surgical centre entries led to shorter pre-surgery stay at public hospitals nearby in England [54]. Timothy (2018) explored for-profit provider entries' implications with unobserved quality to suggest that retaining a not-for-profit incumbent brings benefit when allowing competition by for-profit providers in public service sector in spite of shortcomings in quality assessment [55].

2.4 Service System Level

At the service system level, and the reform perspective, scholars carry out the work in the following aspects:

Impact of Health Reform. April (2000) made a review of the literature examines the problems addressed by these reforms, reforms' core elements, reforms' structured way, the implementation and evaluation for venturing down this reform path, to yield some insights about reform modalities [56] (April 2000).

Elaine (2004) confirmed that Medicare upcoding reflected risk-taking and alignment between administration goals and staff behaviour [57]. Guang (2012) made an political feasibility evaluation of healthcare reform in Taiwan to reveal the failure of reform proposal and the use of social network analysis in mapping political conflict between stakeholders [58]. Jonathan (2012) made an examination of the impact of expansion to near-universal coverage state-wide to show that reform decreased uninsurance rate and preventable admissions with hospital cost growth [59]. Neeraj (2017) found that exploitation of payment reform could explain that competitive markets with higher costs are to experience larger reductions mostly driven by exit of "high-cost" providers [60].

Private Sector and Health Coverage. Rosemary (2016) demonstrated that the performance of the private sector, which acts important role in universal health coverage, focuses on quality, equity of access, and efficiency being enhanced by interventions to target it as a whole, rather than individual providers alone [61].

Barbara (2016) discovered that universal health coverage focuses on taking a perspective that requires policies chosen to contribute the whole system rather than any sector alone, in private sector management policy design. Heterogeneity of private providers gives rise to study on policies that might respond appropriately to four types of private provider [62]. Dominic (2016) claimed that evidence for intervention in effectiveness and limitations of private sector ought to include not only prohibiting, but also encouragement to improve quality. Furthermore, interventions concern scalability and scope are proved to be basis for universal health coverage [63]. Maureen (2016) declared that private sector is only understood within context of mixed health systems as reality. Partial country typology development with metrics and other country information, illustrated how public sector could model the private sector's structure and behaviour [64].

Health Care System Improvement. Timothy (2001) analysed the role of ownership in public good provision to indicate that public good with incomplete contract ought to be with party that value the benefit from it more [65].

Mark (2002) applied a hospital financing exogenous change to test organizational behaviour theories, revealing that soft budget constraint causes the critical difference between three types of hospitals [66]. Karen (2008) made a review of health delivery in China and suggest that simply shifting ownership or encouraging providers could hardly solve problems on quality, responsiveness, efficiency, cost escalation and equity. Change in the way providers are paid, could make substantial improvement [67]. Bjorn (2010) demonstrated that Sweden and China have similar tendency towards market-orientated solutions such as striving to make combination of managerial-organisational efficiency with the humanitarian-egalitarian goals to provide better care, in spite of dissimilarities in legislation, organization, and finance between health care systems [68]. Ping (2012) constructed a structural equation model to demonstrate that quality and satisfaction to be distinct concept, while model (satisfaction mediates quality and loyalty) is most appropriate in Chinese healthcare context, implying the importance of patients'

satisfaction in measurement of patient experience [69]. David (2015) worked out a review of China's health care experience to reveal that health insurance might be easier to reform than delivery systems, with primary care seeming to be essential in service delivery effectiveness [70]. Xi (2017) claimed that China's primary health-care system has made remarkable progress, facing challenges on workforce, village doctor turnover, information systems, a paucity of clinical practice data, lack of financial incentives to encourage cost-effective service, effective insurance policies, poor performance in quality measurement and control of risk factors [71].

3 Conclusion

This study makes a review the studies on the quality of hospitals that differ in ownership from multilevel view. Such evidence could be valuable in understanding private sector's function in health service delivery system, and policy implications in mixed-ownership market regulations in developing countries. It is indicated that physician and patient's related study could explain the relationship from individual level, while hospital's ownership, productivity and human resource could influence the service quality. In addition, market level performance factors and competition effect of medical industry could also explain ownership effects on hospital service quality. From a broad view, the reform in health service system such as payment reform, health coverage with private sector promotion, health care system reform, are demonstrated to have significant effect on the service quality.

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Quantitative Analysis for Company Panel Data in Chinese A-Stock Market—Based on Multiple Linear Regression Model

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Abstract. According to the Efficient Markets Hypothesis (EMH), which claims that market prices already represent the relevant information, the active trading strategy of a small number of informed analysts can lead to accurate market price, higher or lower than the real prices, leading to the arbitrage opportunities. Assume that the Chinese A stock market is not semi-strong, which means that by getting price and other public data, excess performance can be produced through the trading strategy, quantitative analysis. Quantitative analysis refers to a trading strategy that takes advantage of stocks' panel data to find the formula price, using multiple linear regression model. In this paper, data from Chinese A-stock market, CIS 300, CIS 500, CIS 1000 were used to find out whether the strategy is valid during 2006–2020. The result is not good. The reason may be that there are maybe other factors that have influence on the real price.

Keywords: EMH · Chinese A-stock market · Panel data · Multiple linear regression · Quantitative analysis · Fundamentals

1 Introduction

This study uses the method of quantitative analysis on company panel data in Chinese A-stock Market, using a multi-factor linear regression model. The quantitative strategy is based on the normal stock trading but using quantitative analysis on fundamentals to make a model to predict the return of different stocks in the future. The return of a specific company is decided by many internal and external factors of the company. 1. Regrading quantitative analysis, this work will have the calculations of the return, volatility, sharpe ratio and maximum drawdown of the portfolio in order to evaluate portfolio quantitatively and versatily. And the return of this strategy based on the data from 2010–2020 was came up.

2 Idea

Quantitative investment helps analyze large number of fundamental factors that are effective to indicate the profitability of companies. The alpha comes from the return of securities that this work long and short.

3 Highlight

The quantamental strategy is based on the normal stock trading but using quantitative analysis on fundamentals to make a model to predict the return of different stocks in the future. The return of a specific company is decided by many internal and external factors of the company. Some of the factors are significant and some of them are not. If the insignificant factors can be kicked out and the significant ones can be kept, then run a regression between the historic return and each of the significant factors, a relative reliable relation between the return and the factors can be got². Having the regression results, the “predicted return” can be estimated. Then, by comparing the predicted return and the real return, whether the company has the highest profitability can be known. Finally, having that in mind, the portfolio by longing the companies that have high profitability and shorting the companies that have low profitability can be made. In such, if this model is good enough, a good alpha can be expected.

The signals of this model are just the residuals, the differences between the predicted return and actual return. For example, if for company XYZ, the current actual return is 1% and the estimation of the current return from the model is 2% the market is not giving the correct return of the company and the market can be considered as inefficient. From there, a 1% difference (2% expected return – 1% real return) can be seen and profits can be earned by longing the company. This is where this paper’s signals come from. By calculating the differences between the expected return and the actual return, this portfolio long top 5%, in this case 90 securities, companies that have largest positive differences and short bottom 5% companies that have largest negative differences.

Before the calculation of return and risk from the portfolio, the return is expected to be 10% and risk is also 10%.

4 Specification

4.1 Analysis

The Efficient Market Hypothesis (EMH) mainly says that all known information is already factored into the price of securities such as stocks³. There are three forms of EMH, the weak form EMH, the semi-strong form EMH, the strong form EMH. Among the three forms, the semi-strong EMH refers that the price already contains information about some company panel data that show the value, profitability, solvency, operation and growth of companies. If the assumption is made that the price data couldn’t incorporate the panel data timely, then the market doesn’t reach the level of semi-strong market, then investors can take advantages of the panel data to predict stocks return and make profits. In the model, it assumes that the market is semi-efficient. The stock price reflects

to changes of five factors above, so return also reflects to these changes⁴. This work then uses these five factors to estimate the return of companies and compare the expected return to the real return. Long/short decisions by analyzing the results from comparison and finding the most profitable company and the least profitable company were made.

Regrading quantitative analysis, the return, volatility, sharpe ratio and maximum drawdown of the portfolio were made in order to evaluate portfolio quantitatively and versatily.

4.2 Data

The universe of the portfolio is CSI 300, CSI 500 and CSI 1000. The reason this work chooses these as universe is that CSI 300, CSI 500 and CSI 1000 contains stocks with good liquidity and performance in Chinese stock market. Among the three index, CSI 300 contains companies with high market value, while CSI 5000 and CSI 1000 contains companies with relatively low market value. These three indexes are added to cover both big companies and small companies in Chinese A-stock market. With data from these companies, a comprehensive trading strategy containing all types of companies can be made, therefore having a better understanding of the whole market.

Data types are shown in Table 1 below:

Table 1. Factor category

	Candidate factors
Value factor	Price Earnings Ratio (PE); Price/book value ratio (PB); Logarithmic Cap (LCAP); Logarithmic floating Cap (LFLO); Price Cash Flow Ratio (PCF); Price-to-sales Ratio (PS)
Profitability factor	Return on Assets (ROA); Return on Equity (ROE); Net Profit Ratio (NPR)
Operation factor	Fixed Assets T Rate; Current Asset Ratio
Solvency factor	Fixed Assets Ratio; Equity To Asset
Growth factor	Total Asset Grow Rate; Earnings Per Share (EPS); Operating Revenue Grow Rate

There are three main reasons why these factors are chosen. The first reason is that these are the most basic factors that a listed company have during each year, each month or even each day. Then, choosing these factors can make sure that the data used during the quantitative analyze are accurate and full. The second reason is that these factors will not have a very huge difference between companies in different industries. For example, a factor that represents the amount of real asset can have a huge difference between Alibaba and SAIC MOTOR since for an internet company, the amount of real asset is most likely to be lower than the amount of a company which produce motors. Then, using such a factor to make a model is not accurate. The third reason is that many financial institutions have shown that value factor, profitability factor, operation factor, solvency factor and growth factor which are five rough factors dominate the trend of the

stock price so that more precise factors should be chosen from these five factors to make a more accurate prediction.

Regression is shown below:

$$\text{Expected Return} = b_0 + b_1 * F_1 + b_2 * F_2 + \dots + b_{16} * F_{16}$$

This regression combines the five factors above and Y value is the expected return that this work shall predict. Here, the expected return should be the (expected price of the stock - price of the stock now)/price of the stock now. The larger this value is, the more this stock is going to appreciate.

All the price and panel data above are got from WIND database, which is reliable and comprehensive. The in-sample data are from 2006 to 2015 and out-of-sample data from 2016 to 2020. The reason for choosing these two time periods is that all kinds of market conditions have taken place during the period of 2006 to 2020.

4.3 Signal Generation

First of all, the regression model is used as the following to generate expected return for every individual stock listed in the universe:

$$\text{Expected Return} = b_0 + b_1 * F_1 + b_2 * F_2 + \dots + b_{16} * F_{16}$$

where b_0 - b_{16} are coefficients and F_1 - F_{16} are all the candidate factors listed in the above table. In terms of calculating the coefficients, this work manipulates the data in a rolling-style. Particularly, the historical values of return and candidate factors in 2006–2010 are used in deriving the coefficients that are used to generate expected returns for all the stocks in 2011. Additionally, the historical values in 2007–2011 calculate the coefficients used in 2012 expected return calculation, in which the pattern continues for the entire period. There is one example of the regression:

$$\begin{aligned} \text{Expected Return} = & -0.6599907 + 0.0104623 * \text{LFLO} + 0.0188431 * \text{LCAP} + 1.31\text{E} - 38 * \text{PE} \\ & + 0.0037194 * \text{PB} + 0.0005469 * \text{PS} - 0.0001318 * \text{PCF} + 0.806804 * \text{EPS} - 0.0009729 * \text{ROA} \\ & - 0.00000994 * \text{NPR} + 0.0000341 * \text{ROE} - 0.0001465 * \text{ORGR} + 0.0000289 * \text{TAGR} + 0.0064473 * \text{FATR} \\ & - 0.4071372 * \text{CATR} + 0.0114895 * \text{ETA} + 0.0599285 * \text{FAR} \end{aligned}$$

Thus, the signal is derived as the expected return, as the following:

$$\text{Signal} = \text{Expected Return}$$

After listing out all the signals, they are sorted and ranked from the highest positive on the top to the lowest negative on the bottom.

4.4 Portfolio Construction

Total ¥100,000,000 is to invest in securities from CSI 300, CSI 500, and CSI 1000. Data from 2006 to 2010 were used to build regression. The regression to create portfolio and hold it for 5 years were used. Data from 2016 to 2020 to be the out of sample data were used as well. Since the signal is the difference between expected return and real

return, in portfolio, 90 securities that have largest positive difference were longed and 90 securities that have largest negative difference were shorted. By long and short securities at the same time, risk of portfolio is reduced. This portfolio rebalances each month. In this work, ¥50,000,000 is used for long decisions and ¥50,000,000 for short decisions. Within both long and short section, signal weighting is used to decide the percentage of money should be invested in each security.

4.5 Trade Execution

There are five types of fees occurred during the portfolio holding period. They are bid ask spread, commission fee, stamp tax, transfer fee, and securities management fee. Commission fee is the fee that traders give to the securities companies. It is 0.03% of trade value. Stamp tax is the tax that governments place on legal documents, usually in the transfer of assets or properties. It is 0.1% of trade value. Transfer fee is the fee that traders give to the China Securities Depository and Clearing Corporation Limited. It is 0.002% of trade value. Securities management fee is the fee that traders give to the China Securities Regulatory Commission. It is 0.002% of trade value. The average total cost for both long and short part is around 220,000 yuan which is 0.22% of the total trading volume.

5 Implementation

5.1 PnL Analysis

Before reviewing the results of the strategy, it is of importance to state that six models have been run in order to get a cross-sectional evaluation of the quantamental strategy and more importantly, the variance and efficacy of the candidate factors⁶. The main model includes all sixteen factors listed in the candidate factors table and the rest of five models include factors that follow the classification in the candidate factors table. For example, the value model includes only the value factors, which are PE, PB, LCAP, LFLO, PCF, and PS that explain the intrinsic value of a stock.

To begin with, the following graph (Fig. 1) shows the PnL of the main model starting from the year of 2011 to 2015:

By comparing the PnL graphs from the main model to other five models, all six graphs have positive trends overall are shown. That means that all the six models make money. However, PnL for main model varies much greater than other five models and lower returns at the end of 2015 for main model are also shown. It means that a higher risk but lower return for the main model compared to other five models.

This paper tries to analyze more deeply about the model performance, so it uses statistics to analyze that⁷. It uses annualized return and Sharpe ratio to assess the profitability of the portfolio, and volatility, maximum drawdown is used to assess the risk of the portfolio. Table 2 shows the statistics:

The annualized return is slightly higher than the index. The sharpe ratio of the main model is low, possibly resulting from the fact that the portfolio shorts stocks in a generally growing market. However, at the same time, the maximum drawdown is the highest among all six model, indicating a high risk of the main strategy.



Fig. 1. Cumulative total return PnL for main model, 2011–2015

Table 2. Statistics of portfolio performance

In-sample data (2011–2015)				
Model	Return	Volatility	Sharpe ratio	Maximum drawdown
Main	8.07%	16.23%	0.28	−39.18%
Value factor	35.66%	23.87%	1.35	−12.59%
Profitability factor	36.51%	26.00%	1.27	−12.25%
Operation factor	34.91%	32.99%	0.95	−14.82%
Solvency factor	34.08%	25.08%	1.22	−13.68%
Growth factor	34.60%	25.11%	1.24	−13.84%

5.2 Differences from Expectation

The portfolio return has been calculated by putting in sample data, which is from 2011 to 2015, into the multiple linear regression model and compare it with the expected result. The result is a little different from expectation. By reanalyzing the panel data of chosen stocks and checking events in the stock market during this period, it concludes several reasons why the trading strategy didn't perform well.

1. Financial crisis in 2008 and stock market crisis in 2015. The big fluctuation in 2008 and 2015 may have a severe influence on the result of regression. At first these events are expected to help better the predictions result of the stocks return then making higher return and lower volatility of the portfolio. But the uncertainty of the economic routine is ignored, as a result, there isn't events causing large fluctuation of return in 11–15 so the predictions are not getting improved.
2. The panel data is somewhat rough to predict return precisely. Though daily price and return data of each stock can be found, factors data like data of profitability

factors, growth factors and so on, are recorded quarterly, which makes it impossible to get accurate change trend every day.

- Other factors influencing the return. In the research, it contains 16 factors that influence, and almost decide the price and return of stocks. The regression result is good, with many factors are significant and the R square is around 0.75. However, maybe there is other factors that the work didn't notice but it also affects the return of stocks¹⁰. It is likely that the model will become more precise after adding the factors into the regression.

5.3 Out of Sample

In order to test the portfolio performance in the future, 2016 to 2020 were taken as the out-of-sample data. By comparing PnL of main model with PnLs of other five models, it tells that all the six models perform bad. The six models have downward trends and vary a lot. The main model loses more money than other five models do is also shown. This means that these five factors are not good at predicting returns or not sufficient to predict returns.

There are statistics in Table 3 from the main model and other five separate model:

Table 3. Out-of-sample data

Out-of-sample data (2016–2020)				
Model	Return	Volatility	Sharpe ratio	Maximum drawdown
Main	−38.04%	37.25%	−1.12	−153.65%
Value factor	−20.52%	47.71%	−0.50	−98.67%
Profitability factor	−5.88%	20.15%	−0.47	−68.95%
Operation factor	−6.03%	20.15%	−0.47	−69.03%
Solvency factor	−5.81%	20.14%	−0.46	−68.96%
Growth factor	0.22%	69.88%	−0.05	−61.71%

From statistics table, it shows that five out of six models have negative return and sharp ratios are not good. Especially the main model is shown to have lowest return and highest max drawdown. This means that the main model does not work well to predict return and does not work well to earn money. Also, all bad returns show that neither these five separate factors nor these five factors combined can predict return well.

6 Conclusion

6.1 Trading Recommendation

There are three main recommendations based on the analysis of portfolio performance. The first one is that during the construction of the model, analysts can put more factors

in the model to make a more accurate prediction. The second one is that investors can focus on a particular industry during the stock trading since factors for companies in the same industry are more comparable and meaningful in the model so that it can have a more accurate prediction. The last one is that when long stocks, investors should be careful about those stocks with extremely low price. Although the model may show that these stocks will have a higher price, these companies may delist because of some other unpredicted factors for example political factors.

6.2 Looking into the Future

In addition to the classification and candidate factors listed in this article, there are also many valuable ones to consider. For example, Uhrskov, the author of *Combination strategies within asset management*, integrates the “sell-side analyst ratings” into the model to explain for the fundamental side of the overall strategy (Uhrskov 47). Besides that, a ranking system is also considered by a lot of researchers in the field. According to Uhrskov, the best way to amplify the effectiveness of the candidate factors is through long/short strategy and the typical way is to generate out a rank and pick by a quantile. For example, Uhrskov uses the “sell-side analyst ratings” to generate a “conviction ratio” for all the stocks in the universe and long the top 10% and short the bottom 10%, which epically gives a decent risk-adjusted return (Uhrskov 48).

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Since the order of the names above does not show each member’s distribution, each one’s work is listed below:

Yanyu He: Idea, Highlight, Part of calculation of portfolio return, PnL calculations and graphs for in-sample data and out-of-sample data.

Ran Qin: Abstract, Implementation, calculation of portfolio returns for in-sample data and out-of-sample data using R studio, part of PnL calculation.

Ruichen Zhao: running program to calculate the weight for portfolio construction, coming up the idea of the paper.

Zhijian Luo: Signal generation, collection and manipulation of data, calculation of statistics and PnL in implementation, and looking into the future.

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Exploration of Time Bank Elderly Care Service Restructuring—Based on the Profitable Mode

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Abstract. This paper analyses the current situation and existing problems of traditional time bank based on voluntary work. In order to solve these problems, this paper illustrates the idea of restructuring traditional time bank on the basis of blockchain technology and creating a new elderly care service platform consisting of both the non-profit part and the profit part, which is of vital significance to better deal with the aging society. The paper comes to the conclusion that the two parts will share income and potential customers to ensure daily operation of the system.

Keywords: Time Bank · Profitable · Blockchain

1 Introduction

Family pension has always been the mainstream in China. But as China enters an aging society, the increasing leverage ratio puts pressure on providing better services for the elderly. Banks, social security and commercial insurance provide financial support for the elderly. And pension institutions, community pension, volunteers, homemakers and so on to provide a certain degree of labor services for the elderly. However, there are still many problems to be solved in the aspect of pension services, such as the lack of adequate pension institutions and uniform service standards. At present, China's general view is to realize the self-sufficiency of pension funds, starting from young people to save pension funds. So if there is possible to build up Time Bank to save labor time for aged ourselves starting from young age, it is no more than an attempt to new pattern of old-age care.

2 Analysis of Current Time Bank

2.1 Brief Introduction of Time Bank

In the United States, he first proposed the concept of Time Bank, whose essence is to monetize time by establishing an exchange system of “labor for service” [1]. Volunteers exchange “time coins” by providing services to the elderly, which can be used to purchase

Y. Yang and J. Wang—These authors contributed equally to this work and should be co-first authors.

the services of other volunteers in the future. The elderly are one of the main beneficiaries of the rise of Time Bank, which provide a feasible way to solve the problem of aging. So far, more than 1,000 communities around the world have piloted the model. Some Chinese countries such as Beijing, Shanghai, Guangzhou and Nanjing have established Time Bank to provide services for the elderly, which has achieved positive social effects [2].

2.2 Difficulties and Troubles of Popularizing Time Bank

The Problems of Lacking of Policy Support at the National Level. At present, China's Time Bank is mainly based on communities, and the country has not promulgated special policies or regulations, lacking of national financial support, material and legal guarantee put a large rock in the sustainable development of Time Bank.

The Problems of Imperfect Information Management System. Current Time Bank completely rely on the centralized information management system of a mutual community support network nodes [3]. Under this operation pattern, it is difficult to achieve the uniform measure of service and general exchange over different communities. And due to the opaque trading process, we cannot accurately grasp the personal information, facing the risk of information leakage.

The Problems of Lacking of Professional and Diversified Services. It is generally accepted in sociology that the needs of the elderly mainly include three aspects: economic support, daily care and spiritual consolation [4]. However, the services provided by Time Bank are mainly daily life services, lacking spiritual and cultural construction and professional medical care services, which is difficult to meet the growing diversified needs of the elderly.

The Problems of Insufficient Financial Support. The foreign Time Bank model itself is a public welfare or non-profit organization, and it does not need to pay to be a member of the Time Bank [5]. In fact, the establishment and operation of the Time Bank requires a certain cost, including the salary of professional employees and the cost of operation. Therefore, to realize the sustainable development of Time Bank, it is necessary to solve the problem of the source of funds.

2.3 The Feasibility and Possibility of Restructuring Time Bank

Block-Chain Makes it Possible to Solve the Difficulties of Time Bank. The technological innovation of embedding Block-chain technology into Time Bank can help solve the difficulties such as imperfect information management, low operation efficiency and difficulties in universal deposit and withdrawal under the existing mode, which is conducive to the formation of socialized endowment service construction force, improving social recognition and participation of Time Bank.

Time Bank Meets the Requirement of Modern Pension Market. The extension of life expectancy of China's elderly population and the growth of consumption level promote the silver economy. For enterprises serving the elderly, China will be a large market. In combination with the block chain technology, Time Bank can use the algorithm to realize the demand and service match of supply and demand, the accurate time record transaction, the service content and the quality information, etc. Complete automatic settlement, not only improves the service quality, provides the effective supply, also can improve the applicability of the main body, stimulate the vitality of the aging market.

Huge pool of potential volunteers. Maslow's hierarchy of needs theory proposes that people need to participate in social activities to satisfy their physiological, security, social, respect and self-actualization needs. The reconstructed Time Bank does not set limits on the participants and advocates cooperation with various social subjects, such as students, re-employment groups and hospitals, which forms a virtuous circle because the participants are both service providers and beneficiaries. Various social members realize their self-value by participating in the Time Bank to provide services, and in return, they can get corresponding benefits through the incentive mechanism of the platform

3 Restructured Elderly Care Service Platform Based on Blockchain Technology

The elderly care service platform, relying on block chain technology, combines the non-profit part, which is based on voluntary mutual assistance services, with the profit part, which involves financial products, commercial banks, insurance companies and pension funds, through the "peseta coin" which can be universally deposited and withdrawn in the platform system.

The profit part contains two sections of "community integrating medical care" and "pension finance". The profit part plays an important role of providing financial support for the non-profit part and enhance the long-term operation power of the elderly care service platform. In return, the non-profit part provides traffic activation for the profit part. The two parts benefit each other and make it possible of the long-term benign cycle of the platform. Figure 1 shows general idea of the restructured elderly care service platform based on the blockchain technology.

3.1 Non-profit Part

Steps of Restructuring Time Bank on the Basis of Blockchain. The reconstruction idea of the non-profit part of this paper is as follows: based on the generalized time bank and relying on blockchain technology, a network is formed in which volunteers provide services, elderly people receive services, social organizations participate in assistance, and the government supervises. To be specific, an online platform will be established based on blockchain technology [6]. Information like the service duration and service type provided by volunteers, consumption records of senior citizens and participation of various subjects will be recorded in the blockchain in the form of peseta coins, forming an interconnected information and transaction network.

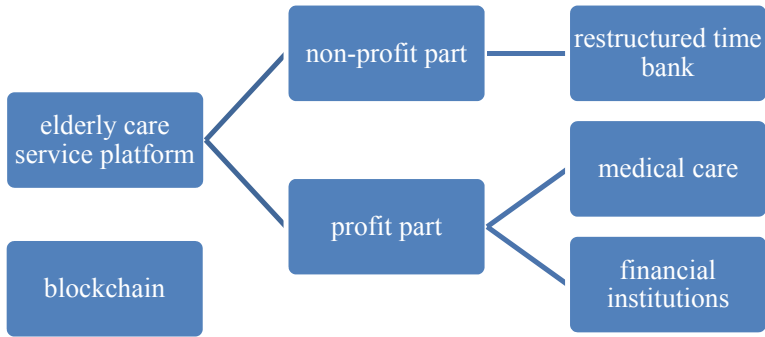


Fig. 1. General idea of the restructured mode

Step 1: Online registration. Participants can take part in the system by registering on the mobile phone, no longer limited by time or space. Volunteers' registration includes not only personal information such as name, age and residence, but available service time, service type and other information closely related to their volunteer services as well. Volunteers can choose from various kinds of services like daily companionship, medical care, housekeeping service according to their own expertise and interests in order to provide better service. The elderly, as the recipient of the service, can also apply in the system by filling in information about their health status, service type, duration and location, and special needs if any. Considering the elderly may have low acceptance and adaptability to the online information platform, their application can be assisted by their caregivers, or they can turn to community workers for help, which involves institutional involvement. In the restructured time bank, participants include not only service providers (young elderly people, students and other volunteers) and demanders (elderly people), but also multi-party cooperation institutions, such as schools, communities and pension institutions, which can all be registered in the same way.

Step 2: Supply and demand matching. By collecting large amount of information, the online platform quickly realizes supply and demand matching within the system by using the internal algorithm of blockchain. For instance, participants who have well-completed information and who have participated in the time bank with good credit record can directly enter the automatic matching link, otherwise, the system may indirectly confirm new participants' identity information and credit records through schools, communities, nursing homes and other institutions, and screen eligible participants to enter the supply and demand matching system. Considering that the time bank platform provides humanized services, background staff are also equipped to adjust automatic matches. However, compared with the existing time bank, time and labor costs are sharply reduced. In a word, the time bank with blockchain technology mainly relies on automatic matching and is supplemented by manual matching.

Step 3: Settlement of transactions. After the service, the system will automatically settle the peseta coins. First, the volunteers who provide the service and the elderly who receive the service fill in the service participation information in the system respectively, and both parties can conduct self-evaluation or mutual evaluation in the system, as the guarantee of service quality and credit record. Then, with the support of blockchain

technology, the order is checked with the previous service application to improve the accuracy and integrity of records. After verification, service time, service content, service quality and other factors are taken as input parameters. According to the standards set before hand, the system automatically calculates the peseta coins payable. Finally, the peseta coins flow from the account of service receiver to that of service provider.

Blockchain Technology Solves Existing Problems of Time Bank. Blockchain technology provides technical support for the information system of time bank. Firstly, the decentralized blockchain ensures each node automatically maintain and update data, eliminating manual work and reducing labor costs. Secondly, the time bank no longer rely on a single settlement center, contrarily, information is recorded and monitored by each block, which improves veracity and reliability of data, and protects interests of participants. Thirdly, the online system can complete records of volunteer service, including service time, service type and service quality. Supported by blockchain, the system will calculate the peseta coins payable. During the process, the blockchain technology serves as a guarantee of fairness.

The introduction of blockchain technology helps reduce the storage and circulation risks of peseta coins. The blockchain technology helps to disperse the storage risk from the central node to each block, improving the security of peseta coins. The restructured time bank involves not only service providers and demanders, but also a large number of social institutions as cooperative partners, which effectively enhances the liquidity of peseta coins. Specifically, the restructured time bank, based on blockchain, builds a transaction network including service providers, service recipients and social organizations. The peseta coins can be used to trade for any product and service, tangible or intangible. With the support of blockchain technology, time bank participants can realize credits replacement, online donation and service trade within the platform [3]. In fact, in our restructured model, peseta coin circulation is much more than that. There is no need for participants to wait until they get elder and transfer their peseta coins into services. For instance, students can exchange peseta coins to the school for voluntary hours, which significantly shortens the turnover cycle of peseta coins.

The fission effect of the Internet helps to improve social recognition and participation of time bank. Individuals can share their participation of the time bank through online platform to obtain additional bonus points, which is likely to attract their friends to learn about and participant in the time bank. These new participants may gather more friends, which makes the “fission effect”. In a word, online publicity helps to discover potential participants. Online publicity has the characteristics of low cost and large flow, which is able to easily achieve the social media fission effect of “ $1 + 1 > 2$ ”.

3.2 Profit Part

Community Integration Medical Care. In terms of pension data information, blockchain technology features tamper-resistant and transparency, allowing an intelligent platform to be established, which will gather highly continuous, traceability, irreversible, extensible, anonymity medical data, and realize remote monitoring of the aged and get plenty of information data, including living condition, physical function and psychological state of the elderly as well as medical supplies used in the process of medical

[3]. These data are encrypted by blockchain and combined with the Internet of Things technology to realize automatic, which is a good way to improve service efficiency and avoid data fraud. Compared with the traditional pension system, the open, transparent and non-modifiable system based on blockchain technology enables consumers, producers and the government to establish a trusted pension supply chain.

In terms of intelligent pension platform, the Distributed Ledger Technology of blockchain has advantage over traditional pension service, mainly reflected in the active response to daily needs of the elderly, in-depth mining and processing of data and real-time monitoring.

In terms of medical staff authentication, thanks to the transparency of blockchain, medical staff authentication services become available. As for the risk of data leakage, the identity and governance rules of blockchain can pre-define user access and control rights to guarantee the privacy level and transparency of medical records, by ensuring that only qualified participants can see the necessary data.

In terms of the refinement of pension regulation data, the government, through the application of blockchain technology, realizes full record of the refinement of pension regulation data, establishing a transparent information collection and management system, accelerating the in-depth development of the pension industry, and improving the scientific regulation level of pension policy.

In terms of precise subsidies, blockchain technology can implement orientation tracking and offer financial support properly in place.

In terms of application and promotion of pension policies, blockchain technology helps to improve the allocation efficiency of resources via technical innovation. Taking housing problem as an example, example, the property of old people is regarded as important assets of pension, blockchain records residents' house ownership situation, which benefits the government in housing management, designing suitable pension scheme and avoiding certain housing endowment legal disputes.

Pension Finance. In each node set under the blockchain technology, the platform will set up the pension financial sector, attracting commercial banks, insurance companies, pension fund companies to enter. Each co-dependent platform forms a financial sector of the reconstructed platform, which is committed to enhancing the profitability of the platform and providing all-round, multi-variety and highly matched pension financial services. The market effect brought by the introduction of various financial platforms can provide continuous economic incentives for participants, constantly improve the quality of services provided, and shift from providing general services for service objects to providing services with high technical content and relatively professional services.

As a new platform combining profit model and non-profit model, our platform has three main profit sources from the perspective of overall profit (see Fig. 2). First, time arbitrage. The platform serves as an intermediary third party, and the funds invested by investors in pension products and other value-added pension services will stay on the platform and be transferred as credit collateral after other platforms complete corresponding services. During the cycle, the fund flow is managed by the platform, and a large pool of working capital is formed by small accumulation. Platforms can use this money to hand over to fund companies or make investments to profit from it. Second,

traffic profit. The settlement of all parties of the non-profit part, such as volunteers, community workers, the elderly and their family members who have become registered users, provides a good flow base for the profit platform. This huge traffic for the product not only opens up the market, but also make reconstruct platform to earn a lot of advertising and cooperation fees. Third, distribution of insurance and related pension products. The reconstruction platform enhances people’s risk awareness of self-pension. The platform put people in frequent exposure to endowment insurance, strengthen the elderly pension awareness and financial literacy, people entered the non-profit use platform will pop up related insurance and pension products, which promote users to buy related products and make profit.

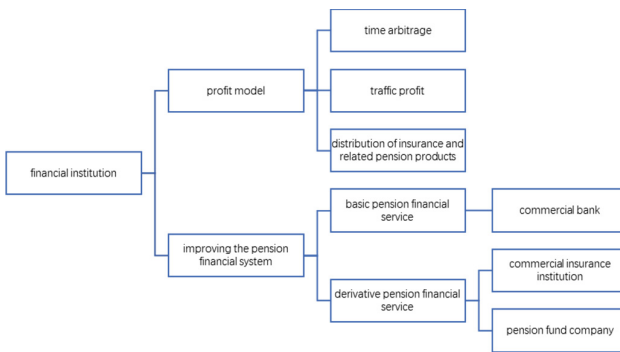


Fig. 2. General idea of pension finance

Introduction of Commercial Bank Platform. As the financial institutions that residents rely on most, commercial banks account for a large proportion of pension savings and pension financial products in the whole pension financial products [7]. Introduction of commercial banks will bring advantages to reconstructing the platform:

Channel function. Commercial banks have the advantage of channels. They can make full use of their nationwide branches, ATMs, telephone banking, online banking, mobile banking and other channels to connect with customers in all aspects. The vast customer base of commercial banks can serve as the initial customer flow of the platform. The concept of “self-pension” and “saving for retirement” advocated by the platform and the introduction of new customers from the non-profit part can increase customer demand for commercial banks, which can be described as “mutual benefit and win-win”.

Account management function. At present, China’s basic endowment insurance and enterprise annuity are designed and managed for individuals, so the management of basic endowment insurance and enterprise annuity accounts will involve the management of primary accounts. China’s commercial banks have rich experience in personal account management and are indispensable third-party partners for all kinds of pension funds and enterprise annuity.

Introduction of Insurance Company Platform. Theoretically speaking, the pension insurance with the characteristics of installment after retirement is the best choice to

deal with longevity risk, and also the main composition of pension financial products system.

The commercial endowment insurance can make use of the principle of risk transfer and disperse survive provide security for the elderly, to avoid running out of longevity risk assets, and can meet the demand of the elderly big sick disease insurance.

The reconstruction of the time bank platform itself, as a supplementary pension mode in addition to social and family pension, advocates the "self-pension" mode for the elderly. Therefore, the introduction of commercial insurance also fits the nature of the platform. On the basis of traditional commercial insurance products, more new old-age insurance products should be introduced into the platform, such as individual tax [8] and reverse mortgage[9].

The introduction of new insurance is conducive to more elderly people choosing to buy commercial insurance products. Meanwhile, the reconstruction platform provides insurance companies with a large amount of information about the life expectancy of the elderly, the structure of serious diseases, medical needs and other aspects, which can help pension companies better optimize the pricing and category development of their own pension insurance products. Block chain technology, on the other hand, the real continuity can help solve the problem of adverse selection, in the process of underwriting, insurance company can apply for access to data on block chain platform through access to a hospital to provide the access rights to the individual health and the medical data, reduces the underwriting fees, adverse selection in pricing additional cost will be reduced, and then improve the product value.

Introduction of Pension Fund Company Platform. As a supplement to the basic pension function of commercial banks, pension target fund and commercial pension insurance will constitute an important part of the third pillar of China's pension. At the same time, as an advanced step of basic financial products of banks, pension target fund can further derive fund products that better match the risks of the elderly on the basis of satisfying investors' basic rate of return [10].

Current pension target funds include target investment funds that aim at the investor's retirement date and robust or balanced pension funds that aim at the investor's risk tolerance. Unlike other general funds, pension target funds have minimum holding periods of one, three and five years. Guided medium-and long-term investment to a certain extent. At the same time, low investment threshold, clear pension goals and longer duration can achieve higher fund returns, better meet investors' requirements for asset appreciation. Different from commercial pension insurance, the income target of pension target fund is no longer limited to the elderly population, and both families and children can benefit from pension target fund. The pension target fund can meet the demand of asset appreciation brought by the capital market and also meet part of the liquidity demand.

Necessity and Significance of Blockchain Technology for the Profit Part.

Blockchain pension service financial system has obvious edges. It covers a wide range of resources, involving the integration of individuals, families and financial institutions. It traces back for a long time and runs through the whole life cycle of an individual, providing individualized service for each person. The program is dynamic, capturing intergenerational trends in "income-consumption-investment" activities and gradually

adjusting the asset matching program. The establishment of the blockchain pension service financial system is a long-term process, constantly strengthening the adaptability between the financial system and the irreversible aging society. It is necessary for the system to seek for in-depth development and ecological optimization.

Peseta coin autonomy mechanism. Similar to Bitcoin, the blockchain pension service financial system sets up an incentive mechanism to issue “pension coins” to individuals through the time bank system. The purpose of the incentive mechanism is to ensure the operation of the system and to foster the national awareness of pension finance. The peseta coin plays an important role in encouraging individuals to carry out pension planning in advance, raising pension awareness in the society, and gradually increasing the accumulation of national pension funds. Peseta coins can be used to purchase pension financial products and services in the system, which are able to be transferred, inherited and traded. The virtuous cycle within the system provides long-term power for financial institutions to continuously optimize products and services, which is the fundamental reason for the stable value of peseta coin. The stability of peseta coin value ensures the effectiveness of incentive mechanism, attracts more individuals to enter the system, integrates more resources, forms a wider virtuous cycle, and gradually forms an open and autonomous system.

Development in depth. From the perspective of life cycle, pension finance can gradually raise pension awareness of residents. The pension financial service can be extended to the whole life cycle of all asset management and financial services, including student loans, house mortgage, insurance configuration, children education plan, and so on. The continuous in-depth development of blockchain pension financial system not only ensures the accumulation of national pension funds, but also provides comprehensive financial services. Meanwhile, the mature development of the financial system is promoted and the financial literacy of the whole society is improved.

Ecological expansion. Blockchain can be scalable by adding nodes. In the elderly care service platform, each individual node actively contribute to the information, while other nodes, like social security departments, financial institutions, enterprises and real estate registration will verify and ensure the authenticity of the data. As a result, the financial institutions can take advantage of the information to provide personalized financial services. A well-developed system is able to expand its business scope to the whole pension finance. On the one hand, the system can add pension management companies, medical supplies, health care services, pension real estate and other enterprises as new nodes to provide for the elderly. On the other hand, the new will contribute new information to the system, and financial institutions can provide corresponding financial support for them to promote the development of the pension industry. This process is called ecological expansion, which is bound to expand the scope of virtuous cycle and continuously improve the whole system. Furthermore, it can be expanded to cultural tourism, e-commerce, targeted poverty alleviation and other fields to drive the development of the national economy and promote social welfare.

4 Conclusion

To sum up, the elderly care service platform conceived in this paper connects the non-profit and profit part with the “peseta coin” on the basis of the blockchain technology. The non-profit part can be perceived as the restructured time bank, which solves the problems of the current time bank by cooperating with social organizations to expand the participant group to a large extent. The profit part mainly contains two parts: medical care and pension, which brings income to ensure daily operation of the whole platform. The whole system is intended to solved the current aging problem and improve social welfare.

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Secular Stagnation, Affluence of Countries, Economic Growth Factors—Observations and Empirical Evidence Across Global Countries

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Abstract. This paper aims to examine the effect of secular stagnation on rich countries by using the data comes from the Penn World Table (PWT) and the World Development Indicators (WDI) of large-scale transnational data from 1970 to 2019 in 173 countries (regions) around the world. The results show that the global economy experienced economic stagnation in 1990, and the economic recession in rich countries has become more serious. Based on the baseline results, utilizing all explanatory variables before 1990 makes efforts to solve the endogenous problems about omitted variables, then obtain consistent results by weighted least squares regression and robustness test. Two possible mechanisms by which national wealth affects secular stagnation under different circumstances are identified: (1) Rich countries influence economic growth through intermediary effect mechanisms such as trade openness, the growth rate of employment population, industrial structure, national savings rate. (2) Middle-income countries mainly slow down economic stagnation by the growth rate of employment population. These findings contribute to promoting the activities of countries form different levels of wealth under the macroscopic perspective of economic growth and secular stagnation.

Keywords: Secular stagnation · Affluence of countries · Economic growth

1 Introduction

The last three decades have been a period of greatest change in the world economic landscape. Mainly, the economies of several Asian countries with several large populations, such as China and India, have grown rapidly, with their total economies continuing to expand and accounting for an increasing share of the global economy. In contrast, the

economic development of 7 developed countries such as Japan and the United States has gradually slowed down or even stagnated.

To be more specific, there have been several world economic crises since the 1970s, and the world economic crisis in the western economic world from 1990 to 1992, which began in July 1990 in the United States. Since the United States was the world's top economic power and the dollar was the world currency, the crisis soon spread to Western countries such as Canada, Japan, Europe and Australia. It was not until the end of 1992 that the United States came out of the doldrums, while Western Europe, Japan and other countries still suffered a serious shadow. Germany got the hardest hit in the crisis, suffering from the German "unified economy", which paid the price of higher indirect taxes, tighter monetary policies and high interest rates after German reunification. The United States suffered from a "debt economy" and Japan from a "bubble economy" [1].

Some studies show that there are mainly two factors leading to that situation. One is the decline in consumer confidence in the economy: with Iraq's invasion of Kuwait and the rise in oil prices in 1990, people became less willing to spend. With the invasion of Kuwait and the rise in oil prices in 1990, people became reluctant to spend [2]. The second is the credit crisis caused by the banking system. U.S. banks suffered severe losses when home prices jumped after issuing large home loans, leaving many banks with no new money to lend. As a result, small and medium-sized enterprises had difficulty obtaining loans so the social capital became less liquid [1, 3, 4]. On the contrary, during this period, the newly industrialized countries, with their cheap labor and large markets, increased this indicator at a rate of 4.6%, compared with the richest countries, which had been growing at an average annual rate of no more than 1% for several years. After this, prolonged stagnation became a hot issue after the financial crisis in 2008. In 2013, former US treasury secretary Larry Summers suggested "secular stagnation" may be seen in that the average growth rate of GDP for richer countries has slowed down. This comment has been widely discussed worldwide [2].

To confirm whether this view is correct, this work surveyed economic developments in countries around the world from 1970–2019 in an attempt to answer these three questions.

1. How to measure the slowdown?
2. Is the slowdown larger for richer countries?
3. What other factors might affect the slowdown except countries' economy level?

This article establishes two econometric models to measure economic stagnation, examines whether a country has economic stagnation around 1990, and analyzes the relationship between the country's wealth and economic stagnation on this basis, and tries to answer whether rich countries are more prone to economic stagnation.

The rest of the paper is organized as follows. The Sect. 2 below is a literature review; the Sect. 3 is about observation facts and assumptions; the Sect. 4 comes to the measurement of economic stagnation. Section 5 describes sample selection, variable measurement, model design and reports summary statistics. Section 6 presents empirical results to discuss whether rich countries are more prone to economic stagnation and other factors that affect economic stagnation. Section 7 provides further analysis about WLS and robustness test and the last part is the conclusion.

2 Literature Review

2.1 Economic Growth Models

In the classical economic era, scholars such as Adam Smith, David Ricardo, and Thomas Malthus laid the foundation for the theory of economic growth [5]. During this period, Adam Smith proposed the theory of “division of labor for economic growth” in *The Wealth of Nations*, and Malthus proposed the population theory in *The Principle of Population*, which suggested that a faster increase in population than in the means of subsistence would limit economic development.

In the neoclassical era, economists began to study the variables in economic models. Depending on the complexity of the model, the Solow growth model and the Ramsay model are presented separately. The Solow model makes two predictions, one being the so-called conditional convergence. The lower the starting level of real GDP per capita relative to the long-run or steady-state position, the faster the growth rate. The second is that in the absence of continuous technological progress, per capita growth will eventually stop. Yet per capita growth rates have been observed that can continue to grow for more than 100 years. That is the flaw in this model, which does not explain long-term growth.

Also, this model does not introduce consumption as a variable. This deficiency is remedied in the Ramsey model. Ramsey’s classic paper in the *Journal of Economics* entitled “A Mathematical Theory of Saving” established the Ramsey model, which analyzes optimal economic growth under deterministic conditions and derives the intertemporal conditions for satisfying the optimal path. The model combines macro and microeconomics, allowing economists to analyze economic problems dynamically. During this period, Allyn Younger, Frank Knight and Joseph Schumpeter also laid down many of the basic ingredients presented in modern theories of economic growth.

Later, constants in economic growth models were also studied. Beginning with the works of Romer and Lucas, research on economic growth has experienced a new boom. Romer, Ahon & Hoyt and Grossman & Helpmann incorporated R&D theory and imperfect competition into the growth framework, arguing that technological progress leads to economic growth. Growth theory in this period was more concerned with endogeneity. Incremental rewards, human capital, population growth rate, and technology diffusion were also included in the neoclassical model to study economic growth.

In conclusion, the factor spillover and constant terms in the linear relational function of economic growth models have been studied by encomiasts.

2.2 Secular Stagnation

In the modern period, “secular stagnation” was first introduced by the American Keynesian economist Hansen, who argued that the Great Depression (recession) could lead to persistent unemployment and economic stagnation in the United States, preventing full employment from being achieved. Higgins later added to it. The concept of prolonged stagnation has been used mainly to distinguish regular cyclical recessions, but Hansen, Higgins and others also acknowledge that the meaning of prolonged stagnation has been less clear [6, 7].

Until 2013, economists led by Summers started to pick up the concept of long-term stagnation again. The reason is that after the outbreak of the global financial crisis in 2008, the world's major economies, including the United States, Japan, and the euro-zone, continued to lower nominal interest rates up to zero or negative interest rates and adopted various bailout and stimulus measures such as quantitative easing, but the economy still remained in the doldrums and fell into a quagmire of low growth and deflation. In this context, former US treasury secretary Larry Summers proposed in a seminal speech at the International Monetary Fund headquarters in New York that the global economy had entered a long-term economic slump. Larry Summers has used the term to refer to a situation where demand and supply for savings Larry Summers has used the term to refer to a situation where demand and supply for savings deliver very low equilibrium real interest rates.

Teulings and Baldwin's definition of long-term stagnation, its causes, and effective solutions are still highly controversial. Barry Eichengreen and Gabriel Sterne describe long-term stagnation as a period in which central bank interest rates will - either frequently or perhaps continuously - be pushed down against their natural floor of zero [8].

Although the idea of economic stagnation was raised early, the idea ceased to be of interest to scholars due to the post-war boom and other factors. It was only after the financial crisis that swept the world in 2008 that scholars paid renewed attention to this issue [9–11].

3 Observation Facts and Assumptions

In 2013, Larry Summers proposed that the average GDP growth rate of rich countries is slowing down, and the “long-term stagnation” will be observed. However, there is no unanimous approval regarding Summers' views. To answer this question, some typical countries are selected to observe whether the economic secular stagnation has appeared.

3.1 Observation Facts

In this work, the decline in GDP growth is used to measure whether the economy is declining, the GDP used in this article is the actual GDP calculated at constant prices in 2017. If the GDP growth rate continues to decline, it is considered that the economy has begun to decline; if the GDP growth rate fluctuates within a certain range, the economy is considered to be developing steadily; if the GDP growth rate continues to rise, the economy is considered to continue to develop; of course, with the national conditions and development of each country at different stages, the growth rate of GDP will show different trends. 6 typical countries were selected, the United States (USA) and Japan (JPN) represent developed countries; Hungary (HUN) and Brazil (BRA) represent middle-income countries and, and China (CHN) and Vietnam (VNM) represent poor countries.

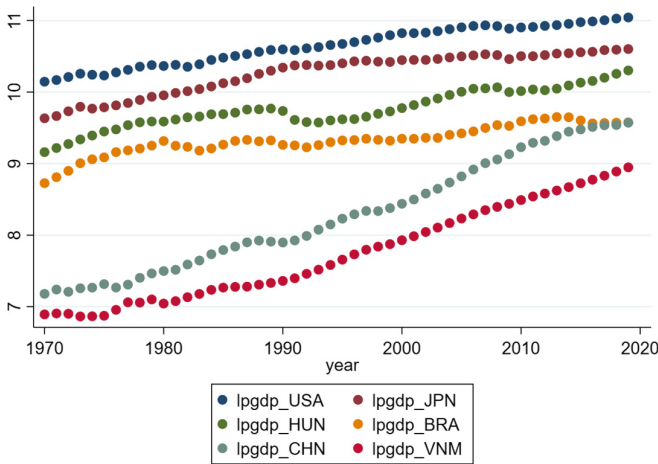


Fig. 1. Trends in GDP per capita in typical countries

It can be seen from Fig. 1 that developed countries (USA and JPN) have grown slowly in the past 50 years, and their GDP growth has slowed around 1990; Middle-income countries (HUN and BRA) have a bit of economic stagnation, but not obvious in the past 50 years. There is no economic stagnation in low-income countries (CHN and VNM), and even a slight increase in economic growth around 1990. Taking 1990 as the demarcation point, the average GDP growth rates of the United States and Japan before 1990 were 3.10% and 4.65%. After 1990, the average GDP growth rates of the U.S. per capita were 2.43% and 1.09%, a decrease of 0.67 and 3.56 percentage points; The average GDP growth rates of China and Vietnam before 1990 were 5.98% and 6.25%, and the average GDP growth rates after 1990 were 6.25% and 6.62%, an increase of 0.27 and 2.06 percentage points respectively; the GDP of HUN and BRA before 1990 the average growth rate was 3.14% and 3.2%. After 1990, the average GDP growth rate was 0.84% and 1.78%, a decrease of 2.3 and 1.4 percentage points.

In order to further observe the economic development of countries at different stages of development in the past 50 years, while trying to avoid the influence of fluctuations in per capita GDP in adjacent years on the observation results, this paper uses 5 years as a unit to calculate the growth rate of per capita GDP of the representative country, the trend chart of the average GDP growth rate of each country is made, as shown in Fig. 2:

It can be seen from Fig. 2 that for developed countries (USA and JPN), the 5-year average economic growth rate has gradually declined, and the decline in the average GDP growth rate of Japan is significantly faster than that of the United States; for middle-income countries (HUN and BRA), The 5-year average economic growth rate has a downward trend, but it is not very obvious; for low-income countries (CHN and VNM), the 5-year average economic growth rate shows a clear trend of gradual increase, and there is no economic stagnation.

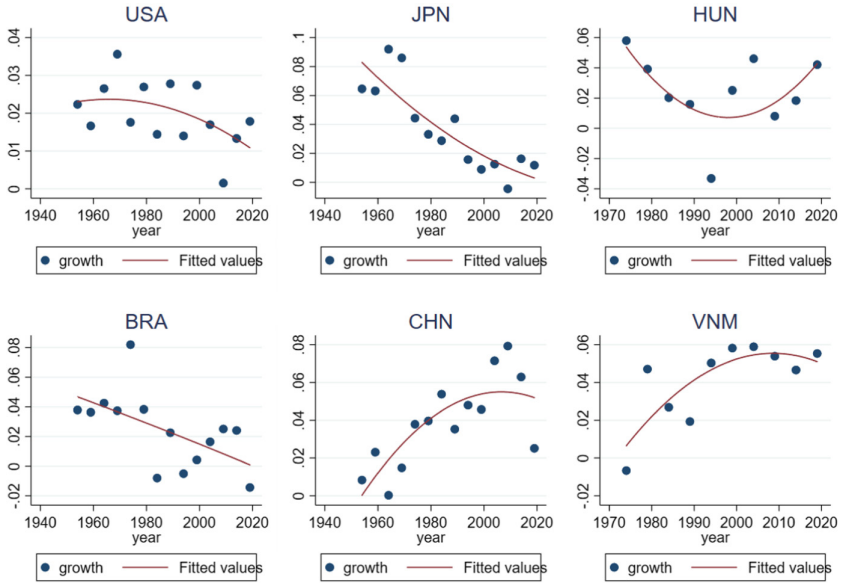


Fig. 2. Five-year average per capita GDP growth rate of typical 6 countries

3.2 Assumptions

According to the qualitative results, three hypotheses are proposed.

1. Hypothesis 1: The developed countries experienced economic stagnation around 1990.
2. Hypothesis 2: The economic stagnation of middle-income countries in 1990 was not obvious.
3. Hypothesis 3: There is no economic stagnation in poor countries.

4 Measure the Slowdown

In order to test whether the above three hypotheses are true, it is necessary to first judge whether the countries experienced economic stagnation or rapid economic development in 1990, or the economic growth rate did not change significantly, and calculate the corresponding development index. When the development index is negative and significant, it indicates that the country has experienced economic stagnation; when the development index is positive and significant, it indicates that the country’s economy is still developing rapidly; when the development index is small or statistically insignificant, it indicates the country’s economic growth rate has not developed significant changes.

4.1 Econometric Model

In order to get more accurate results, this paper uses econometric models to calculate the economic development index. On the one hand, the results of the economic development

index depend on the selected economic growth calculation cycle, such as one-year or five-year economic growth rate; on the other hand, it also depends on the different econometric models. Due to the limited sample size, using the 1-year economic growth rate can make better use of the sample information. At the same time, it is found that the economic development index calculated using the 1-year economic growth rate is significantly better than the 5-year economic growth rate. Therefore, the 1-year economic growth rate is use. When choosing an econometric model, it can be assumed that the economic growth rates of countries around 1990 are consistent. Therefore, this paper chooses two econometric models. Model 1 assumes that the economic growth rates of various countries around 1990 are the same, which is realized by dummy variables, which is called Base model; model 2 assumes that the economic growth trend of various countries around 1990 differently, the model is set according to the idea of Chow test, which is called the Chow model.

In order to express consistency, the two models use β_{1i} to represent the economic development index. When the economic development $\beta_{1i} < 0$, it indicates that the economy has declined, β_{1i} represents the degree of economic decline; when $\beta_{1i} > 0$, it indicates that the economy is still developing rapidly, and β_{1i} represents the degree of economic development; when $\beta_{1i} = 0$, it indicates that the economic growth rate has not changed, and it can also be considered that no economic decline has occurred.

First, the base model settings are as follows:

$$\ln(gdp_i) = \beta_{0i} + \beta_{1i}d_{1990} + \epsilon_i \tag{1}$$

where i represents each country, $\ln(gdp_i)$ is the annual GDP growth rate from 1970 to 2019. The explanatory variable d_{1990} is a dummy variable, when $year \geq 1990$, $d_{1990} = 1$. When $year < 1990$, $d_{1990} = 0$; β_{1i} is the coefficient of interest in this paper, In the base model, it is called beta_Base.

Then, according to the thinking of Chow’s test, the article calculated the difference in economic growth around 1990 while retaining the original trend of economic growth around 1990. Dummy variables were used to construct the following model:

$$\ln(gdp_i) = \beta_{0i} + \beta_{1i}I_{[year-1990]} + \beta_{2i}year + \beta_{3i}I_{[year-1990]} + \epsilon_i \tag{2}$$

When $year < 1990$:

$$\ln(gdp_i) = \beta_{0i} + \beta_{2i}year + \epsilon_{1i}$$

When $year \geq 1990$:

$$\ln(gdp_i) = (\beta_{0i} + \beta_{3i}) + (\beta_{1i} + \beta_{2i})year + \epsilon_{2i}$$

i represents each country. Regress each country separately and observe the coefficients of β_{1i} and β_{3i} and the significance of their joint test. When the coefficients of β_{1i} and β_{3i} are When the joint test is significant, it means that the country’s economic structure has changed around 1990. When the coefficient of β_{3i} is significant, it means that the country’s GDP has changed significantly around 1990. When the coefficient of β_{1i} is significant, it means that the country’s economic growth rate has changed significantly

around 1990. This means that β_{1i} is the economic development index, In the Chow model, it is called beta_Chow.

This article uses the two models to measure the economic development index of each country, and then judges whether the country has economic stagnation according to the positive, negative and significant of the core explanatory variable β_{1i} . . The difference between the base model and the Chow model is that the base model assumes the same economic growth rate before 1990 (or after 1990) while the that there are respective economic growth development trends. Therefore, the base model assumes a stronger assumption. Although the assumptions of the Chow model are relaxed, the applicability beyond the sample size cannot be guaranteed, the base model and the Chow model have their own advantages and disadvantages. This paper reports the results of the base model and the Chow model.

4.2 Results of Economic Stagnation Measurement

This article uses the Penn World Table, version 10.0 data set, a total of 183 countries or regions, and deletes countries or regions with a population of less than 100,000 people and missing GDP data before 1990. A total of 173 countries' sample data is retained.

Table 1. Model comparison

Model	$\beta_{1i} < 0$	$\beta_{1i} > 0$	$\beta_{1i} = 0$	Significance
Base model	102	49	22	95
Chow model	76	76	21	153

It can be clearly seen from Table 1, in base model, there are 102 countries with economic stagnation, and 49 countries with rapid economic growth, 22 countries have no significant economic stagnation or sustained economic growth, 95 countries have significant results; In Chow model, 76 countries have economic stagnation, and 76 countries have rapid economic growth, 21 countries with no significant economic stagnation or, 153 countries have significant results; It can be seen that both base model and Chow model are very significant.

Comparing the two models, there are 91 countries whose β_{1i} signs are exactly the same; there are 23 countries whose β_{1i} signs are inconsistent, but the coefficient estimated by the model is not significant; there are 4 countries whose β_{1i} signs are inconsistent the signs of is inconsistent, and the p-values of the coefficient t-tests of the two models are both significant, but their estimated values are very small. The β_{1i} value is in the range of (0.003154, -0.01913), which shows its economic significance very low. In summary, the estimated economic development index of the two models is relatively consistent.

Take the base model as an example, countries with incomplete data and populations of less than 100,000 are deleted, leaving 146 countries. According to the World Bank's classification of poverty in various countries in 1989, 36 are rich countries, 65 are middle-income countries, and 45 are poor countries. Among the 36 rich countries, 32 countries

have experienced economic stagnation, accounting for nearly 90%; in 65 middle-income countries, 50 countries have experienced economic stagnation, accounting for 77%; in 45 poor countries among the countries, 16 countries have experienced economic stagnation, accounting for only 36%. It can be seen that most of the rich countries have experienced economic stagnation, while some middle-income countries have experienced economic stagnation, and most of the poor countries have not experienced economic stagnation.

5 Empirical Design

5.1 Sample Selection

The sample examined in this article includes economies data of the explained and controlled variables comes from the Penn World Table (PWT), version 10.0 and the World Development Indicators (WDI) database provided by the World Bank during the period of 1970–2019.

Further, the data is filtered as following steps: First, excluding countries with missing data of GDP before 1990. Second, eliminating the economies whose populations less than 100,000.

5.2 Variable Measurement

Before running the empirical regression, the variables of secular stagnation, affluence of countries and control variables about economic growth factors are defined and measured as follows in Table 2. Two proxies have been developed to capture secular stagnation: *beta_Base* and *beta_Chow*. Between the two measures, *beta_Base* reflects the economic slowdown of country *i* in 1990. *Beta_Chow* is considered a suitable proxy, as it measures significant changes in economics and captures effectively a country has broken its growth structure.

The World Bank divides the world's economies into four income groups, namely, high-income, upper-middle-income, lower-middle-income, and low-income groups. These groups are used to show the performance of different countries or regions in reducing poverty, growth, and increasing per capita income. For example, statistics show that 60% of the world's population lived in low-income countries in the 1990s. In order to alleviate the endogenous problem of mutual cause and effect, this work use the 1989 World Bank classification of country income.

The per capita gross national income is the main indicator to measure the wealth of a country and its position in the four groups. This paper divides the wealth of countries into three groups: low-income countries, middle-income countries, and high-income countries, and set their dummy variables to 0 and 1. In the robustness test, the continuous variable of the natural logarithm of the actual per capita GDP will be used to replace the grouping variable.

Draw on the experience of the economic growth literature, this paper also includes a number of variables to control various factors that may affect a country's productivity to explore underlying mechanisms [12]. For details, see Table 2:

Table 2. Variable definition

Variable	Units of measurement	Definitions
Measures of slowdown/secular stagnation		
beta_Base	Number of coefficients	The growth rate of country <i>i</i> in the full sample period is regressed to the dummy variable of year 1990
beta_Chow	Number of coefficients	The growth rate around 1990 of country <i>i</i> in the full sample period by chow's test to represent economic break
Measures of rich/middle/poor countries		
Rich/middle	Dummy variable	The World Bank's classification of national income by economies in 1989
lngniper	US dollar	Natural logarithm of Real GDP at constant national prices (in mil. 2017US\$) divided by Population (in millions)
Measures of control variables used in baseline specifications		
Openness	Percent	Economic openness-the average percentage of merchandise imports and exports of CGDPo (PPP/XR) at current PPPs from 1980 to 1989, price level of USA GDPo in 2017 = 1
Employrate	Ratio	Average growth rate of Number of persons engaged (in millions) from 1980 to 1989
Industry	Percent	Industrial structure-the average percentage of industrial added value in GDP from 1980 to 1989
Saving	Percent	Savings ratio-the average share of total savings in GDP at current PPPs from 1980 to 1989
Military	Percent	Military expenditures-the average proportion of public sector military expenditures in GDP from 1980 to 1989

5.3 Baseline Model

The model used in the literature to investigate whether rich countries suffer more is:

$$\beta_{1i} = \alpha_0 + \gamma_1 Dummy_i + \gamma Control_i + \epsilon_i \quad (3)$$

where β_{1i} is estimated comes from the base model and Chow model in the previous step, *i* denote the country. $Dummy_i$ is a dummy indicating the affluence of countries, i.e., $Dummy_i=1$ if the country *i* was divided into high-income (middle-income) countries by World Bank in 1989, and $Dummy_i$ 0 if *i* was divided into the poor countries. Besides, some control variables are put in to the model. ϵ_i is the residual item.

5.4 Descriptive Statistic

Table 3 provides summary statistics and a correlation matrix for our main and control variables in this study. It can be seen from Panel A that the mean of beta_Base is -0.00437

while the minimum of it is -0.0750 . It shows that the economic stagnation in 1990 was a universal economic phenomenon in the world. Low-income countries account for more than half, respectively. For control variables, an average country has a share of imports and exports of GDP at current PPPs of 47%, growth rate of hired labor of 2.58%, industrial added value in GDP of 30.53%, savings ratio of 20.01%, military expenditures in GDP of 3.90% from 1980 to 1989.

In Panel B, the positive correlation between secular stagnation (beta_Base, beta_Chow) and rich or middle-income countries lends initial support to the hypothesis that wealthy economies have stagnated in economic growth since 1990. Since the correlation coefficients between the key variables of interest are low, multicollinearity is not likely to be driving our regression results.

This table reports the summary statistics and correlation matrix for variables constructed based on the sample of PWT and WDI database from 1970 to 2019. Panel A presents descriptive statistics including variables used in main regression; Panel B provides correlation matrix of main and control variables. ***, **, and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 3. Summary statistics and correlation matrix.

Panel A. Summary statistics								
Variable	Min	25%	Median	Mean	75%	Max	SD	N
beta_Base	-0.0750	-0.0186	-0.00499	-0.00437	0.00569	0.0860	0.0253	173
beta_Chow	-0.0774	-0.0133	0	0.00296	0.0151	0.100	0.0285	173
Rich	0	0	0	0.247	0	1	0.433	146
Middle	0	0	0	0.445	1	1	0.499	146
Openness	0.00661	0.150	0.299	0.470	0.642	3.341	0.501	173
Employrate	-0.00739	0.0178	0.0265	0.0258	0.0338	0.101	0.0159	142
Industry	9.023	20.68	29.66	30.53	37.93	69.17	12.56	149
Saving	-64.14	12.89	20.45	20.01	26.75	113.0	14.69	151
Military	0.0445	1.793	2.774	3.895	4.743	21.24	3.550	125
Panel B. Correlation matrix								
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
beta_Base	1							
beta_Chow	0.867***	1						
Rich	-0.243***	-0.198**	1					
Middle	-0.257***	-0.233***	-0.512***	1				
Openness	-0.274***	-0.304***	0.493***	-0.0690	1			
Employrate	0.140*	0.0770	-0.176**	0.0980	-0.00800	1		
Industry	-0.310***	-0.274***	0.281***	0.227***	0.0500	0.0330	1	
Saving	-0.246***	-0.218***	0.260***	-0.0130	0.142*	0.179**	0.386***	1
Military	0.0170	0.0400	0.112	0.103	0.0650	0.432***	0.293***	0.0520

6 Empirical Results

6.1 Baseline Results

The estimation results are reported in Table 4. Column 1–4 of Table 4 use β_{1i} in the base model and Column 5–8 use β_{1i} in the Chow model. Columns 1 and 2 compare economic growth rates in high and middle-income countries for poor countries respectively, it is found that economic growth in both rich and middle-income countries is significantly slower than in low-income countries, and the absolute coefficient of rich countries is slightly higher than that of middle-income countries. In the 3 and 4 columns, adding a series of control variables mentioned before depicts the results more realistic, and it can be seen that although the significance decreases, the coefficient direction of the dummy variable is still negative. From columns 5 to 8, it is found that using beta_Chow makes the difference between rich and middle-income countries’ coefficients a little wider.

Table 4. Baseline regression of secular stagnation outcomes on a country’s wealth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	beta_Base	beta_Base	beta_Base	beta_Base	beta_Chow	beta_Chow	beta_Chow	beta_Chow
Rich	-0.0286***		-0.0278**		-0.0270***		-0.0220*	
	-0.00539		-0.0107		(0.00624)		(0.0115)	
Middle		-0.0236***		-0.0105*		-0.0268***		-0.0111*
		-0.00481		-0.00564		(0.00603)		(0.00647)
Employrate			-0.0017	-0.3			-0.0361	-0.642**
			-0.288	-0.215			(0.310)	(0.247)
Openness			0.000747	-0.0196*			0.00270	-0.00633
			-0.00659	-0.0107			(0.00710)	(0.0123)
Industry			2.62E-05	-0.000388			4.02E-05	-0.000278
			-0.000355	-0.000257			(0.000383)	(0.000295)
Saving			-0.000215	-0.00064**			-0.00071**	-0.0013***
			-0.00033	-0.000251			(0.000356)	(0.000288)
Military			0.00183	-8.45E-05			0.00331**	0.000371
			-0.0013	-0.000888			(0.00140)	(0.00102)
Constant	0.0157***	0.0157***	0.0125	0.0437***	0.0245***	0.0245***	0.0236**	0.0639***
	-0.00348	-0.00338	-0.00821	-0.00927	(0.00403)	(0.00423)	(0.00885)	(0.0106)
Observations	60	69	60	69	60	69	60	69
R-squared	0.327	0.264	0.365	0.424	0.244	0.227	0.381	0.494

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.

6.2 Influencing Factors Analysis

Table 5 and Table 6 show the results of interacting dummy with control variables, respectively. Table 5 shows the interactions for high-income countries, and Table 6 shows the interactions for middle-income countries. This work selects the aforementioned economic openness, average growth rate of number of persons engaged, industrial

added value as a percentage of GDP, savings rate as a percentage of GDP, and military expenditure as a percentage of GDP.

Table 5. Influencing factors analysis for high-income country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A. beta_Base										
Openness_rich	0.0291	0.0407*								
	(0.0221)	(0.0243)								
Employrate_rich			1.392***	1.508***						
			(0.435)	(0.524)						
Industry_rich					0.00133**	0.00132*				
					(0.000620)	(0.000707)				
Saving_rich							0.00131**	0.00159**		
							(0.000606)	(0.000756)		
Military_rich									0.00220	0.00314
									(0.00229)	(0.00267)
Panel B. beta_Chow										
Openness_rich	-0.0250	-0.0144								
	(0.0258)	(0.0268)								
Employrate_rich			1.923***	1.912***						
			(0.486)	(0.548)						
Industry_rich					0.00141*	0.00132*				
					(0.000724)	(0.000766)				
Saving_rich							0.00238***	0.00290***		
							(0.000634)	(0.000749)		
Military_rich									0.00118	0.00276
									(0.00259)	(0.00289)
Control variables	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	60	60	60	60	60	60	60	60	60	60

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.

First, an analysis of high-income countries shows that these interaction terms are all positive. Among them, the interaction terms of the average growth rate of persons engaged, the average proportion of industrial added value in GDP and the average proportion of savings rate in GDP are all significantly positive. High-income countries with faster average employment growth rate are less vulnerable to economic stagnation, as labor abundance boosts production and makes them less prone to stagnation. High-income countries with more industrial added value in GDP have healthier industrial development and are less affected by economic stagnation. High-income countries with high savings as a percentage of GDP have more domestic savings and a greater capacity to grow steadily when growth suffers. By comparing Table 5 with Table 6, it is found that these factors have a greater impact on economic stagnation in high-income countries than in middle-income countries.

Table 6. Influencing factors analysis for middle-income country

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A. beta_Base										
Openness _middle	0.00714 (0.0243)	0.0281 (0.0249)								
Employrate _middle			0.944** (0.465)	1.004** (0.489)						
Industry _middle					-0.000115 (0.000525)	-0.000372 (0.000517)				
Saving _middle							-0.000560 (0.000509)	-0.000528 (0.000535)		
Military _middle									-0.000628 (0.00220)	-0.000107 (0.00202)
Panel B. beta_Chow										
Openness _middle	-0.0479 (0.0307)	-0.0102 (0.0288)								
Employrate _middle			1.097* (0.573)	0.583 (0.575)						
Industry _middle					1.04e-05 (0.000665)	-0.000296 (0.000594)				
Saving _middle							-0.000147 (0.000589)	-0.000453 (0.000616)		
Military _middle									-0.00219 (0.00274)	-0.00139 (0.00231)
Control variables	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES
Observations	69	69	69	69	69	69	69	69	69	69

Standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

7 Further Analysis

7.1 Weighted Least Squares

The White test is performed and analyzed on the total 8 regressions of the main test reported in Table 4. It is found that all except the regression (7) rejected the hypothesis that our model has heteroscedasticity.

In order to obtain more stable results with smaller standard errors in our models, the result of Weighted Least Squares Regression is shown in the Table 7.

Table 7. Weighted least squares regression results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables	beta_Base	beta_Base	beta_Base	beta_Base	beta_Chow	beta_Chow	beta_Chow	beta_Chow
Rich	-0.0286*** (0.00628)		-0.0255** (0.0111)		-0.0270*** (0.00841)		-0.0217* (0.0117)	
Middle		-0.0236*** (0.00513)		-0.0105* (0.00556)		-0.0268*** (0.00627)		-0.0117* (0.00663)
Openness			-0.00218 (0.00832)	-0.0185* (0.0103)			0.00431 (0.00866)	-0.00568 (0.0128)
Employrate			-0.162 (0.291)	-0.261 (0.210)			-0.211 (0.309)	-0.691*** (0.253)
Industry			-6.84E-05 (0.000348)	-0.000390 (0.000254)			-1.00E-05 (0.000372)	-0.000266 (0.000295)
Saving			-0.000268 (0.000308)	-0.000667** (0.000253)			-0.000883*** (0.000330)	-0.00127*** (0.000278)
Military			0.00170 (0.00135)	-0.000120 (0.000849)			0.00331** (0.00143)	0.000514 (0.00108)
Constant	0.0157*** (0.00314)	0.0157*** (0.00308)	0.0204** (0.00898)	0.0429*** (0.00920)	0.0245*** (0.00359)	0.0245*** (0.00387)	0.0311*** (0.00947)	0.0639*** (0.0106)
Observations	60	69	60	69	60	69	60	69
R-squared	0.264	0.239	0.299	0.430	0.151	0.214	0.370	0.493

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.

From Table 7, the results using the β_{1i} in the first step of the base model did not change from the main test results. The coefficients between rich countries and poor countries are significant negative, which convey a sharp slowdown of economic growth in rich countries compare to the poor countries. The coefficients of middle countries work in the same way. It is found that the absolute value of coefficients of rich countries were larger than those of middle countries, indicating that the slowdown in rich countries was more pronounced.

When it comes to β_{1i} in the first step of Chow model, it is found that the differences between rich countries and middle countries compare to poor countries are not that big, which means the degree of slowdown in GDP growth are more reflected between poor countries and other countries, with rich and middle wealthy countries facing secular stagnation problem in economic growth nearly in the same degree.

After introducing the control variables to the baselined model, it is found that although the significance decreases slightly, the result still supported our findings, and the difference between the absolute values of the coefficients widens. That means both rich countries and middle countries are facing the secular stagnation compares to low-income countries, what's more, the degree of slowdown is greater in rich countries.

7.2 Robustness Test

In the main test and the WLS test, the dummy variable is used as a classification for judging the country's wealthiness standard. To measure the robustness of the results, the logarithm of the average GDP per capita for 10 years from 1980 to 1989 is chosen as a

replacement variable for measuring the country’s wealth standard. The results obtained by the robustness test are shown in the Table 8.

Table 8. Robustness test results

	(1)	(2)	(3)	(4)
Variables	beta_Base	beta_Base	beta_Base	beta_Base
Ingniper	-0.00684***	-0.00469**	-0.00594***	-0.00245
	(0.00128)	(0.00202)	(0.00156)	(0.00239)
Openness		0.00118		-0.00178
		(0.00581)		(0.00688)
Employrate		0.0307		-0.0264
		(0.187)		(0.222)
Industry		-8.48E-05		-0.000188
		(0.000252)		(0.000298)
Saving		-0.000552**		-0.000777**
		(0.000276)		(0.000327)
Military		0.000271		0.00128
		(0.000818)		(0.000969)
Constant	0.0499***	0.0450***	0.0505***	0.0421**
	(0.00972)	(0.0139)	(0.0118)	(0.0165)
Observations	91	91	91	91
R-squared	0.242	0.288	0.140	0.233

Standard errors in parentheses, *** p < 0.01, ** p < 0.05, * p < 0.1.

From the result of Table 8, in line (1) and (3), it is found that the GDP per capita and the β_{ii} which got from the first step regression models showed a significant negative correlation, that is, with the increase of the country’s GDP per capita, the growth of GDP growth rate before and after 1990 had a downward trend. It confirms the conclusion that the GDP growth in richer countries has slowed more sharply than in other countries, then the conclusion can be drawn that rich countries are facing secular stagnation more severely.

When focusing on the result in line (2) and (4), it turns out that the results even not significant after the control variables are added in regression (4), similarly, the significance decreases even though the coefficients remain significant in regression (2). A possible reason may be that the control variables have different effects on countries with different levels of wealth but them have the same coefficients in our model. For instance, the increase of military fees may reduce GDP growth rate in rich countries because of taken up the funds for economic development, but for low-income countries, this may

help to keep the state in a peace and stable environment and promote economic development. So not only the coefficient itself not significant but affect the model's significance as well.

However, on the whole, the conclusions of our robustness test and the main test are consistent for the three hypotheses. To a certain extent, the conclusions are robust.

8 Conclusion

This paper constructs a unified analysis framework that includes secular stagnation, a country's wealth, and economic growth factors. An empirical analysis of large-scale transnational data from 1970 to 2019 in 173 countries (regions) around the world found that the global economy experienced economic stagnation in 1990, and the economic recession in rich countries has become more serious. Due to the heterogeneity of national economic development stages and types of growth factors, cross-terms are introduced into the model to test the mechanism through which national income affects economic stagnation.

Further, rich countries influence economic growth through intermediary effect mechanisms such as trade openness, the growth rate of employment population, industrial structure, national savings rate while Middle-income countries mainly slow down economic stagnation by the growth rate of employment population. Then weighted least squares regression and robustness test prove the consistency of the results. These findings contribute to promoting the activities of countries form different levels of wealth under the macroscopic perspective of economic growth and secular stagnation.

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The Impact of Covid 19 on Chinese Stock Market—Taking Internet, Pharmaceutical and Several Sectors as Example

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Abstract. This paper investigates the impact of COVID-19 on Chinese stock market among different selected industries: pharmaceutical, internet, media, tourism and aviation industries by event study and market adjust model. This epidemic had a general negative on whole stock market except pharmaceutical industries. That phenomenon is contributed by the scarcity of masks and medicines at the beginning of the pandemic. In addition, the comparison between medium industry and tourism industry shows that real economy experienced a huger shock by pandemic.

Keywords: Covid19 · Pandemic · Chinese stock market

1 Introduction

Since January 2020, Covid-19 inflicted heavy losses on human societies and economies. The pandemic has been going on for nearly two years. Wuhan, a Chinese city, was the first city the pandemic occurred in China. Chinese stocks witnessed the effects of this pandemic on China to some extent, furthermore, changes in various stocks illustrate the ability of facing epidemic for different industries.

In China, this epidemic started 30th of January in 2020. In March 2020, WHO ranked it as an international concerned public safety and health event. Network industry stood out in past two years. Besides these firms, pharmaceutical stocks benefited from pandemic, for instance, mask producers or medicines producers. For catering, transportation or travel industries, the stock market declined following the outbreak of epidemic. In addition, the effective-nesses differed in the scale of firms.

As the popularization of health QR code and vaccine in China, the epidemic has been controlled nowadays, thus, the entire economy and stock markets were gradually improving. For current China and other countries or regions, the stock has been generally stable.

This paper probes how did the entire Chinese stock market changed a line with the change pandemic, and also comparing the impact of pandemic for stocks according to different scales of firms besides different industries. As collecting data and absorb experience through this event, we can intervene in the economy better to facing catastrophes.

2 Literature Review

Throughout the history, there was many pandemics which had impacts on global economies. SARS, which occurred in 2002 China, has similarities to covid 19 both they stimulated the development of internet, (Eysenbach, 2003). Moreover the stock price of tourism in Taiwan declined 29% during SARS, (Chen, 2007). Aids pandemic, during 2002 to 2012 in Nigeria has a general decline on real GDP growth rate from 20 to 8, (Dauda, 2012). Ebola, affected investor sentiment seriously, the geographic proximity was the most crucial factor that affected stock price during Ebola. (Marinc, 2017).

In terms of covid 19, it has longer duration and various effects on different countries. SARS MERS Ebola, none of these pandemics had such a serious negative effect on stock market by the analysis of MSCI index, (Feyyaz, 2020). The covid 19 stimulates mask economy and also the rate of anxiety. It worsens the supply of labour market in Canada, (Lemieux et al. 2020). Through paired t test analysis, Dow Jones industrial index average showed a huge decline during pandemic, Chinese stock index showed experienced a increase during pandemic, S&P and Euronext 100 indexes showed a non-significant difference during pandemic, (Ngwakwe, 2020). Up to 2021, Chinese pandemic has been generally controlled, overseas pandemic may more serious. For instance, the consumption of drinks in America increased 14% in 2020. Covid had a short term negative effect on countries, for example in February 2020 Shanghai securities composite index declined by 8%, besides it has a bidirectional spill over effect on Asian, American and European stock markets, (Qing et al. 2020).

A part from the impact on global stocks, that on market performance is also tremendous. The decline of stock returns for freer countries was less, (Erdem, 2020). The demand of electricity decreased due to this pandemic, and also renewables, (Graf, 2021). Furthermore, this pandemic has a cross effect between nations. With the worsening of Indian pandemic, Chinese took up the largest export of APIs in the world. Chinese pharmaceutical companies got benefits directly from Indian pandemic, which means international situations may also influence stocks.

3 Methodology and Data

3.1 Research Methods

Event studies were originated by Ball & Brown (1968) and Fama et al. (1969). Event Study is mainly focus on the impact of emergencies on the stock market. This method requires that emergencies are not expected, moreover, no interference from other events during the event. This pandemic is an unexpected event, obviously these market investors did not predict it in advance. Meanwhile, the outbreak of COVID-19 is in the Chinese Spring Festival period, and interferences of other events is relatively low, which meets the basic research requirements.

3.2 Sample Selection

This paper takes data from China centre for diseases control and prevention official website, corresponding the separation of pandemic and also several significant events,

for example, the lockdown of Wuhan. We also collected CSI300 and SISZ series indexes through CSMAR database, NTES finance, Shanghai stock exchange website. In addition, we also example typical firms' performance during pandemic.

3.3 Research Method

In this paper, it studies the change of sample stock return rate 3 days before and after the event, by using market adjust model. In the market adjusted model, the observed return of the reference market on day t R_{mt} is subtracted from the return R_{it} of the observation i on day t . The formula is $AR_{it} = R_{it} - R_{mt}$. Thus explaining the influence of a specific event on the price change and return rate of sample stocks, furthermore analysing the impact for various industries from epidemic. It involves 5 firms out of A shares from 5 various industries.

4 Analysis

We selected three major events in China. Firstly, January 23th is the date of lockdown of Wuhan, which indicates a serious beginning of the pandemic. Secondly, April 8th is the date of the introduction of healthy Qr code, which helps government to control the track of citizens. Thirdly, December 31th is the date of the invention of vaccinations. The Shanghai Securities Composite Index (SCI) is used as the market return. We listed the abnormal returns in turns and also calculated the CAR value. At the beginning of 2020, the general stock and Chinese economy were shocked by pandemic, people lost their jobs, we also experienced a hard time, it many people died of it.

These firms from left to right are typical firms for tech: ghyx (BGCTV: Beijing Gehua CATV Network), hotel: sljd (BTG:Homeinns Hotels Group), media: sdcb (Apptime), pharmacy: hbzy (HuaBei medince),and aviation: nfhk (China southern airlines).

All firms selected are representative. BGCTV is a state owned company which is famous and huge, it established in September 1999, in addition, it is the only firm in Beijing that is responsible for broadcasting and operating internet. Medium sdcb is one of the most potential firm of media stock market, is also permitted by state. BTG hotel owns many brunch hotels, which mainly represent the effect on Beijing hotels, same as BGCTV, it also established in 1999, current assets valued 2 billion. HuaBei zhiyao produces half of Chinese pharmacies, is one of the biggest pharmaceutical firms. China southern airlines has the biggest passenger capacity in China and the scale is ranked as top 1 in Asia too, fourth in the world (Table 1, 2).

Obviously, the CAR of sljd (600258) negative 16.12 and nfhk (600026) negative 11.12 were the lowest among this five firms. Three days before lockdown, the value was the worst, after lockdown, the negative returns was better than before, which means the lockdown helped up to control pandemic effectively. Since to the lockdown of Wuhan and outbreak of pandemic, people had less tendency to travel, which means firms that related to tourism are easily affected more than others by pandemic. Nfhk didn't affected by this event seriously, that means at that time, covid was not nationwide.

In contrast hbzy (600812) got benefits from this pandemic, owing to the shortage of medicine and masks. The market returns of this panel surged incrementally compared

Table 1. Performance around 23th January (dates not included were not trading days)

Industries	Technology ghyx600037	Tourism sljd600258	Media sdcb600551	Pharmaceutical hbzy600812	Aviation nfhk600026
1/20/20	-0.15	-9.77	0.42	0.81	-3.22
1/21/20	-1.03	-3.82	-0.25	9.07	-1.36
1/22/20	-0.18	3.06	-0.28	-10.09	0.02
1/23/20	-2.05	-1.53	-1.84	1.04	-0.99
2/3/20	-2.25	-2.28	-2.28	12.93	-2.23
2/4/20	-0.25	0.86	7.66	-4.43	-5.14
2/5/20	0.8	-2.64	-0.09	5.24	1.8
CAR	-5.11	-16.12	3,34	14.57	-11.12

Table 2. Performance around 8th April (dates not included were not trading days)

Industries	Technology ghyx600037	Tourism sljd600258	Media sdcb600551	Pharmaceutical hbzy600812	Aviation nfhk600026
4/2/20	0.05	-0.03	0.36	no data	no data
4/3/20	-0.65	0.53	-0.47	no data	no data
4/7/20	0.14	2.57	-0.43	no data	no data
4/8/20	0.87	2.04	0.06	no data	no data
4/9/20	0.53	0.05	2.03	no data	no data
4/10/20	-1.29	0.97	-1.3	no data	no data
4/13/20	-0.87	-2.37	-1.24	no data	no data
CAR	-1.22	3.76	-0.99	no data	no data

to the SZZS index (the stock market index). The pandemic had a contrarian effect on pharmaceutical industries.

When it comes to April, it is clear that the CAR value of these firms were eased than that of January. Unfortunately, there was no trading days during this event for the last two firms. For sljd, the CAR value changed a lot from negative 16.12 to positive 3.76, which means the following the control of pandemic, people's confidence about travel panel increased, in addition, the Qr code has transparent effect.

In terms of December 2020, the covid 19 was generally controlled, we can see the CAR of all firms in this chart were positive, especially for the ghyx, it had a huge abnormal returns and increased gradually. The CAR value of nfhk became from negative to positive, up to December, the flying company operated normally and.

gradually, it is also a good sign and people started to began original life. Furthermore, the abnormal returns of hbzy was not as huge as before masks was not emergency (Table 3).

Table 3. Performance around 23th December(dates not included were not trading days)

Industries	Technology ghyx600037	Tourism sljd600258	Media sdcb600551	Pharmaceutical hbzy600812	Aviation nfhk600026
12/28/20	3.99	-5.34	-2.69	-0.1	-3.56
12/29/20	4.55	3.01	2.1	-3.93	2.46
12/30/30	2.96	-0.72	-0.42	1.12	-0.28
12/31/20	2.29	7.96	3.71	-0.67	6.22
1/4/21	3.15	9.61	7.31	7.72	6.71
1/5/21	3.28	-4.62	-2.02	3.23	-2.19
1/6/21	3.38	-3.69	-2.62	2.84	-2.96
CAR	23.6	6.21	5.37	10.21	6.4

5 Discussion

Generally, the bearing capacity of Chinese stock market is much better and stable, our economy and stock market adjusted fast before 2020, however, several industries still lost during the deteriorated period.

In 2021, owing to Covid 19, the China southern airlines ranked as the fourth loss firm in all firms in China which shows the transportation affected by it seriously. Due to the scarcity of masks and medicines at the beginning, the pharmaceutical company stood out among several panels in A share, even the price of one mask could be hundred during a period of time. The transparent abnormal returns of HuaBei ZhiYao illustrates it.

Real economy generally affected by covid especially for careening and tourism industries as the characteristics of epidemic, the decline of hotel stock price proves it. Since lockdown, people spent more time on internet, working at home will be a prevalent trend in the future. Online teaching and working also shows an ability against emergency disasters.

6 Limitations

This research only used market adjust model, which cannot fully represent the real expectation of A share. In addition, we only selected one typical firm out of each industry which has limitations. There was a major event that lack a part of data for two companies, that contributed to the close of trading days, so we cannot draw a conclusion about pharmaceutical and airline companies.

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Asset-Price History of Bilibili and the Analysis of the Stock Price of Bilibili and Overall Market

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Abstract. “The U.S. stock market is the engine of the U.S. economy”. Unlike China, in the U.S. (the “top bastion of capitalism”), stocks and real estate are the main forms of American wealth, and they are also an important part of the U.S. market economy and financial markets. The price of stocks is affected by many factors, and macroeconomic factors are one of the essential influencing factors. Five aspects, including economic growth, inflation, monetary policy, interest rates, and exchange rates, are the main factors affecting stock prices. As valuable securities, stocks have the characteristics of a market economy, and the price of stocks fluctuates and changes constantly. There is an important point in Marxist economics: The relationship between supply and demand determines the price of a product, and it’s true for stocks. No matter the stock market at which level or the stock market in which country, the rise, and fall of a company’s stock price is affected by the supply and demand of the stock. Stocks are the product of market economic development, and the price of stocks is affected by macroeconomic factors, including but not limited to national policies, economic development, and currency policies.

Keywords: Stock analysis · Macroeconomy · BiliBili · Regression Analysis

1 Introduction

With the development of China’s economy, more and more funds enter the domestic and foreign stock markets, and investors and retail shareholders always pay attention to the development of the stock market to get more profits. As a cultural community and video platform where China’s young generation is highly concentrated, Bilibili has won the attention of many shareholders. On March 28, 2018, Bilibili was listed on the NASDAQ in the United States, and many investors poured into the US capital market. This report aims to provide a reference for investors and shareholders by analyzing the influencing factors of Bilibili stock prices [1].

To better analyze the impact of related factors on stock prices, this article selects regulation, Consumer Price Index, and S&P 500 Index to analyze the impact of macroeconomic factors on Bilibili’s stock and uses different statistical models like regression to do data analysis.

2 Analyze the Impact of Macroeconomic Factors on the Stock of Bilibili

Inflation is a phenomenon that will occur when economic development reaches a certain level, which is inevitable. Inflation is caused by the fact that the imbalance between supply and demand in economic development affects the price level, and the second is that the amount of money issued in the market exceeds the amount of money actually in circulation, and the currency depreciates, and prices rise. In general, it is also the fluctuation of the imbalance between supply and demand that affects the purchasing power of money. The purchasing power of money will affect the price of stocks, which as marketable securities are based on money, so choose inflation as the second factor in this economic model.

From January 2017 to the end of the third quarter of 2018, the rise in the S&P 500 was still relatively encouraging. This is largely related to the tax cuts that Mr. Trump introduced early in his presidency, fiscal policies to increase infrastructure investment, and “America First” trade policies. Although the Tax Cuts and Employment Act was passed by the U.S. House and Senate in December 2017. But that is certainly a good economic forecast for the U.S. stock market. As a result, the S&P 500 has risen significantly throughout 2017, especially since the bill was passed.

The Tax Cuts and Employment Act came into effect on 1 January 2018. On January 1, 2018, the Tax Cuts and Employment Act was formally implemented. A proactive fiscal policy will definitely promote consumer demand including import demand, and inflation will rise as a result. The core CPI of the United States has increased from 1.8% in January 2018 to 2.3% in July and maintained at 2.2% in December [2]. At the same time, the trade deficit has been exacerbated by the increase in imports. The S&P 500 Index fell sharply in February due to strong interest rate hike expectations at the beginning of 2018. Since March, the core consumer price index exceeded 2%, reaching 2.1%. The interest rate hike continued until the end of the year. But the recovery in U.S. economic growth in the first half of the year was more pronounced, and the faster gains were restored after the fall in the S&P 500 in February. By the fourth quarter of 2018, the negative consequences of a double fiscal trade deficit and a decline in economic growth are beginning to emerge as a result of continued proactive fiscal policy that has led to import growth and stagnant export growth. At this point, the United States slowed fiscal spending. But the core consumer price index remained high at 2.2%, causing the S&P 500 to fall sharply in the fourth quarter of 2018. At this point, the U.S. interest rate cut is expected to strengthen, the end of the rate hike cycle.

If there is a large increase in the CPI, that is, a larger increase in market prices, the value of money in the hands of residents will shrink. Leading to a reduction in market investment funds will make the stock market rise lack of upward momentum, the stock market is likely to fall or adjust the market. Back on Bilibili’s closing price icon, it is clear that there have been no significant ups and downs in closing prices since the listing and until the end of 2019 (See Fig. 1).

From January to the end of July 2019, the Fed, Congress, and the government may have been hesitant or divided over whether to curb inflation, boost growth and employment, or reduce the trade deficit as policy goals. There is no policy that can fix every problem. In the end, the U.S. authorities decided to abandon their inflation targets in

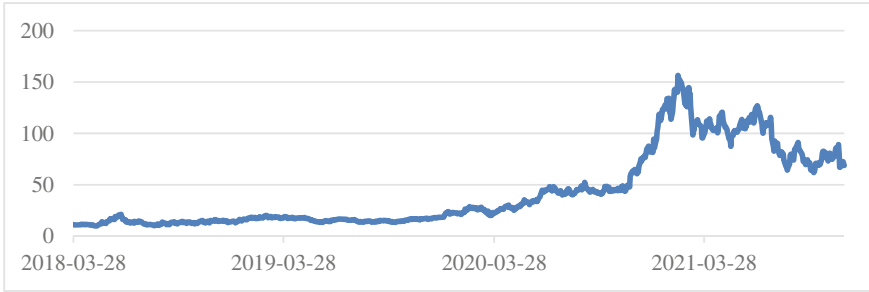


Fig. 1. Closing price (Unit: RMB)

order to protect economic growth, employment, and trade, which outweighed the losses. The U.S. authorities will adopt a policy mix of interest rate cuts and increased government spending. The Fed cut interest rates for the first time since the rate hike cycle on August 1, 2019. And cut rates twice in September and October of that year, starting in mid-October 2019, the Fed buy \$60 billion a month in short-term Treasury bonds, injecting huge amounts of liquidity into the economy by expanding its balance sheet.

While the Fed’s rate cut is good news for U.S. stocks, there would be growth for stock market. Because, on the one hand, under normal circumstances the willingness of depositors to deposit will decline, some people will choose to make other investments. On the other hand, interest on loans has decreased, lenders’ financial pressures have eased, and their willingness to lend has increased. Both of these factors usually lead to a more generous stock market, which drives the stock market higher. The truth, however, is that U.S. 10-year and one-year Treasury yields have fallen sharply since the August 1 rate cut, and inverted Treasury yields is even more pronounced. This can often be explained by investors’ lack of optimism about short-term economic growth in the future, with bond investors choosing to sell or avoid short-term bonds, resulting in lower short-term bond prices and higher yields at maturity. Based on graph 1, there is no such increment in Bilibili stock price. It reflects that the Fed’s first interest rate cut did not do much to boost confidence in economic growth.

2.1 Analyze the Factors Affecting Stock Price Volatility on Bilibili’s Stock

Stock Price Volatility. Volatility is a statistical measure of fluctuation in securities or commodity prices over a given period. Market volatility can use the standard deviation assessment methods to measure. High stock price returns will have an impact on increasing uncertainty, thus increasing volatility. According to Ghozali, the calculation of stock historical volatility rate can be measured by the formula of variance. [3] Namely:

$$\sigma^2 = \frac{\sum (r_i - E_r)^2}{N - 1}$$

σ^2 = volatility variance

r_i = stock return

E_r = expected return

n = number of observations

Factors that affect stock price volatility are as follows.

Equity Rate of Return. The equity rate of return is the ability of the equity to fund all the operating activities of the company and provide benefits for the capital owners [4]. While the return on equity is the level of making profits and assigning to the capital owner. Hence, the higher profits the company earns, the more interest in buying shares in the company itself. This indicates that the change of the interest of stock sales will influence the stock price itself according to the market mechanism, then it is assumed that.

H1: Return on Equity has a positive effect on the stock price volatility.

Debit to Equity Ratio. Hanaf defines the debt-to-equity ratio as the ratio of debt owed by the company to capital [5]. The debt-equity ratio is often used as a proxy for leverage. And the rising of corporate leverage will affect the change of the interest in stock buying [6]. But if a company has low profitability, it will decrease people's interest in stock buying.

Interest Rate. Interest is the vital way that government regulates the economy and also the important factors. Meanwhile, the level of interest determines the cost of capital of the enterprise, the change of the interest rate will affect people's savings, consumption, and other activities, including the amount of money in circulation. All of these will influence the level of stock price and the development of the stock market.

Cash Ratio. The debit-to-cash ratio reflects a company's cash ratio. Cash ratio is a measure of performance method, it compares the amount of cash the company's cash exists in the form of current assets. As Cheng and Schaefer considered that the cash ratio is the ability of all the cash and the securities have the ability to cover all the current debt owed by the company [6]. Owing to the basis of the calculation is that current assets are considered highly liquid, so using the ratio is better to measure a company's ability to pay all the short-term expenses it incurred. A company with a good financial ratio will have an impact on the company's ability to settle accounts. This ability will provide the company with a greater profit level. When the short-term debit is met, the company will operate better. Thus, investors tend to keep away with a company that has large financial risks because their expected revenue of return on stock will not be satisfied. It's clear that debit is one of the risk factors. While the cash ratio is the financial risk factor, influencing the investor's investment interest, leading to the stock rise and fall.

Stock Fundamentals. Not only referring to the current performance of individual stocks, but the future performance is also significant for the stock price. For instance, some companies are now mediocre but the stock prices are very high, which is considered that have high growth in the future. Then the fundamentals would have great improvement. In general, the market tends to choose future blue chips which are not as highly valued as future blue chips.

Market Liquidity. Market liquidity is considered the most direct factor of stock price. Even though a company is in a high boom industry; if there is no market liquidity, the

stock price will not go well. Generally speaking, an abundance of market liquidity allows the company to enjoy a liquidity premium. In other words, the influx of capital makes every investor think there is a better bidder, which in turn makes it easy for the share price to trend.

Exchange Rate. A fall in the dollar means less investment in the dollar, which needs to look for other investment channels, often bringing about rising US stock. The relationship of exchange rate and stock price is not simple, the most direct manifestation of the rise and fall of the exchange rate is the appreciation and depreciation of the RMB, when exchange rate changes lead to the RMB appreciation, hot money flowed into the stock market, the stock prices are revalued, resulting in a rise in the short term.

In sum, before the outbreak of COVID-19, Bilibili on Nasdaq in 2018, before the Covid-19 outbreak (about early 2020), the stock price has maintained a more positive growth trend. It has grown steadily from its offering price of \$9.80, reaching as high as \$29, it is fair to say that Bilibili stock has great potential.

3 Analysis of Bilibili’s Stock Price During the Covid-19

Bilibili went public in 2018 in NASDAQ, its stock price increased by 90% from 9.80 (issue price) to 16.62 at the end of 2019. At the beginning of 2020, Covid-19 began to wreak havoc all over the world, financial derivative market also has been influenced. However, according to < Modeling, and analysis of the effect of COVID-19 on the stock price: V and L-shape recovery >, the sectors like technology have enough ability to withstand the downturn and recovered relatively quickly from the falling.

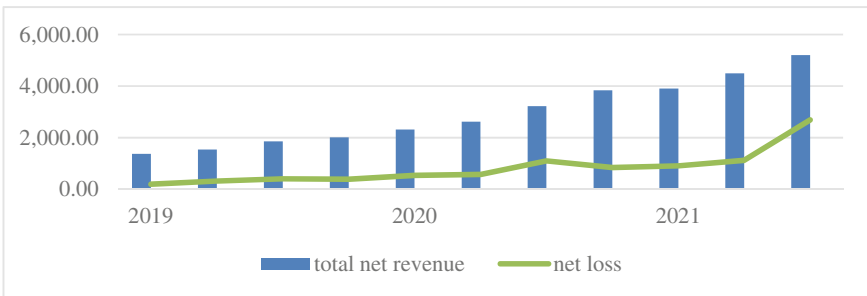


Fig. 2. Bilibili’s total net revenue and loss (Unit: RMB)

3.1 Influence of Total Revenue and Net Loss

The total net revenue of Bilibili was increasing continuously, however, the rate of its net loss increased quicker than that of total net revenue, especially in 2021 Q3 [7]. In this quarter, the stock price fell rapidly as shown in the diagram. At that time, because the

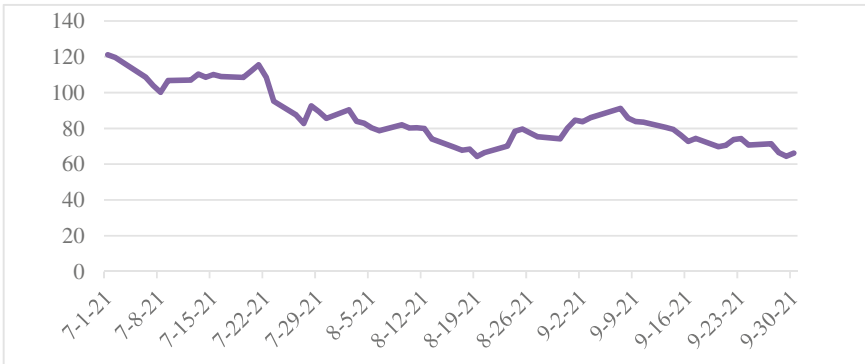


Fig. 3. Bilibili's stock price (Unit: USD)

event about Didi Dache (A well-known Chinese taxi-calling app) invading users' privacy was made public, the Chinese government formulated < Regulations on the Management of Network Product Security Loopholes >, which came in effect in September 2021. This strategy can put pressure on technical businesses for protecting users' privacy, which influenced the operation of Bilibili. As shown in Fig. 2 and 3, Its Operation Loss increased by 357.4 million RMB in Q3 compared with 2021 Q2 and the corresponding moves of stock price were in the opposite direction of total net loss. [7].

3.2 First Dramatic Increase at the Beginning of 2020

Online countdown party is popular and the outbreak in China began in December 2019, so such a way of celebrating the new year caught more people's attention. Bilibili held a countdown party for their young users and its audience rating is greater than some traditional TV stations. 27% of Internet users in China watched this online party on that day, which led the closing price of BILI NASDAQ to increase by approximately 25% in three days.

3.3 Second Dramatic Increase in April and May 2020

The number of Monthly/Daily Active Users (MAU/DAU) and monthly active content creators are two significant indexes for Bilibili. MR. Rui Chen, Chairman of the Board and Chief Executive Officer of Bilibili, said "Both MAUs and DAUs grew at phenomenal rates while our level of community engagement reached an all-time high. In the first quarter, our daily time spent per user soared to a record high level of 87 min, while Bilibili's monthly active content creators and their content submissions more than doubled compared with the same period last year." [8] In April, Sony of Japan bought 4.98% shares of Bilibili at a price of US\$ 400 million (about RMB 2.8 billion), which gave foreign institutional investors (FII) and domestic institutional investors (DII) confidence, and the stock price increased by 15% in a week [7].

3.4 Analysis of Michael Porter’s Five Forces Model

Bilibili has entered many related industries, such as ACG and the broadcast industry, which greatly improved its bargaining power. Most of the promotion of anima and the quadratic metagame is through Bilibili. In addition, the user of Bilibili have relatively high consumption ability, good willingness to pay and the core users have been stable and active. Brand loyalty of such users is much higher than Bilibili’s substitutes and there is no other similar application in China. Bilibili has its own game studio and E-sports teams and invested in several TV series and shows. Therefore, according to this model, the barrier of entering the market is very high, the strategy-making of Bilibili is relatively independent. MAUs and average monthly paying users were continuously increase in the past 3 years as shown in Fig. 4 [7].

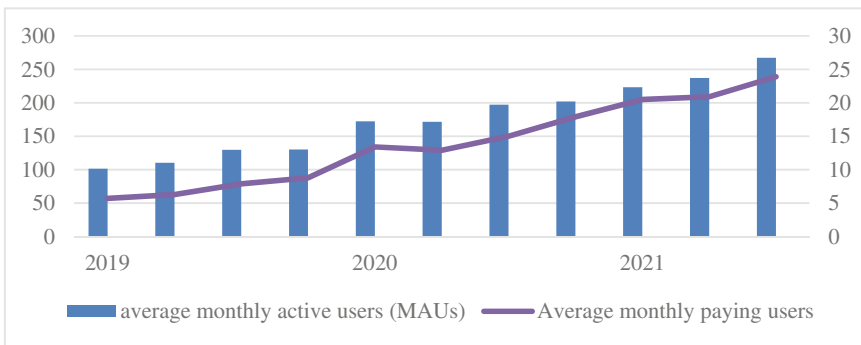


Fig. 4. MAUs and average monthly paying users of Bilibili (Unit: million)

In June 2021, MR. Rui Chen said that the retention rate of regular users of Bilibili has remained at 80% in the 12th month.

3.5 Dramatic Fall of Stock Price in March of 2021

The stock price of Bilibili peaked in March and then fell dramatically. At that time, the United States Securities and Exchange Commission passed the < Foreign Company Accountability Act >, the regulatory object is mainly listed in the United States of China concept stock enterprises. There was a downward trend in most of China’s Concept Stock. As shown in Fig. 5, the stock price of BABA, JD, and BILI, three different types of tech companies, all decreased dramatically in March 2021.

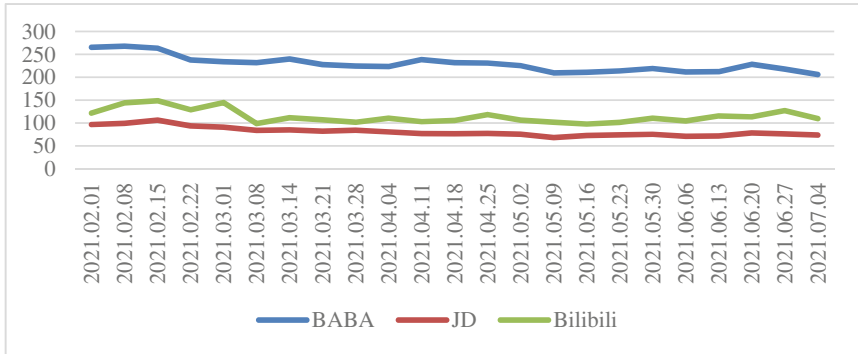


Fig. 5. Stock price of three China concept stock (Unit: USD)

4 Data Description

The information from Fig. 6 is acquired from Yahoo Finance, which contains the histogram of Bilibili’s daily adjusted closing price since its listing on the NASDAQ market in March 2018 [9]. Figure 7 is also obtained from Yahoo Finance and is a graph of the NASDAQ Index, which reflects the changes in the Nasdaq stock market [10]. The basic index is 100. NASDAQ’s listed companies cover all new technology industries, including software and computers, telecommunications, biotechnology, retail and wholesale trade, etc. The chart has the daily adjusted closing price from 3/29/2018 to 10/29/2021.

By comparing the line chart of the daily return rate of the two stocks from Fig. 8 and 9, the yields of both stocks have fluctuated to a certain extent, but the daily yields of Bilibili’s stocks fluctuate more obviously since the listing; the peak value has reached 20.03% and the lowest value is -18.68%. In contrast, the fluctuation range of the Nasdaq Index is roughly limited to between 8.93% and -13.15% (Fig. 8 and 9).

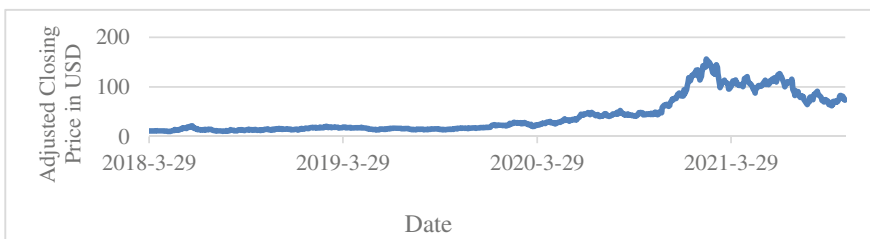


Fig. 6. Adj close (Bilibili)

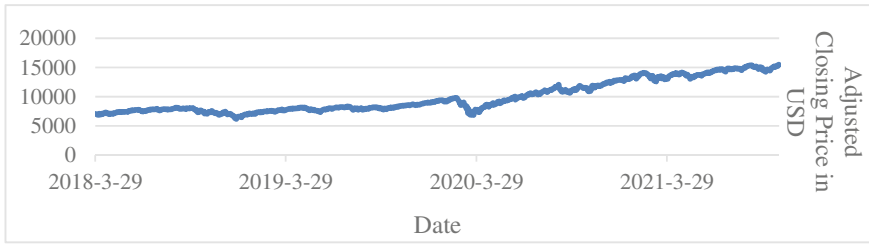


Fig. 7. Adj close (NASDAQ)

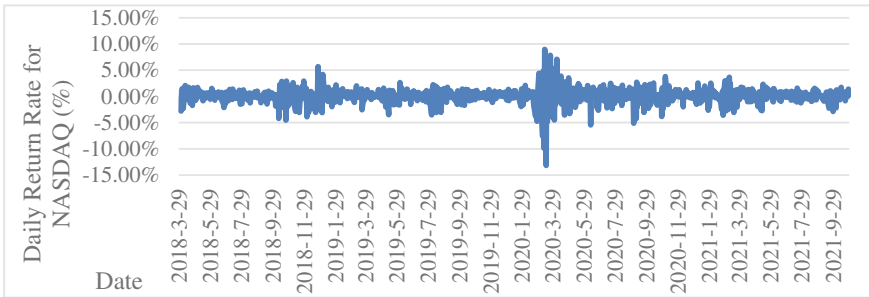


Fig. 8. Daily return rate (NASDAQ)

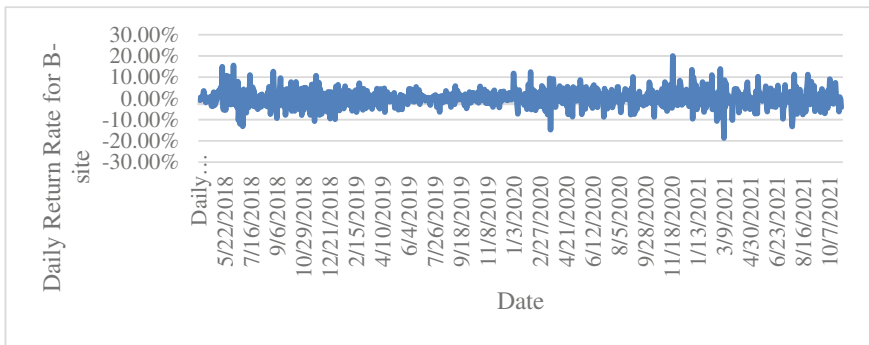


Fig. 9. Daily return rate (Bilibili)

4.1 Methodology

Multiple Regression Analysis. Multiple Regression Analysis refers to a statistical analysis method that regards one variable as the dependent variable (Y) and the other one or more variables as the independent variables (X) among the related variables, establishes the linear or non-linear mathematical model quantitative relationship between multiple variables and uses sample data for analysis. Multiple Regression can also be seen as an advancement to the Simple Linear Regression Analysis. While analyzing the performance of Bilibili’s stock in the American market, the work treats Bilibili’s stock

price as a dependent variable (Y). And the work considers the NASDAQ index, whether the pandemic is eliminated or not, and the personal saving rate in the United States as independent variables (Xs). The formula of the multiple regression is shown below:

$$Y_i = \beta_0 + \beta_1x_{i1} + \beta_2x_{i2} + \dots + \beta_px_{ip} + \epsilon$$

where β_0 stands for the y-intercept, β_p represents the slope coefficients of each independent variable, x_i manifests every independent variable, and ϵ is the residual. After running the regression analysis on Excel, data can be obtained below:

Table 1. Regression output

OUTPUT								
Regression statistics								
Multiple R	0.937620398							
R square	0.87913201							
Adjusted R square	0.878729564							
Standard error	12.87162449							
Observations	905							
ANOVA								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	3	1085761.171	361920.4	2184.471	0			
Residual	901	149276.5239	165.6787					
Total	904	1235037.695						
	<i>Coefficients</i>	<i>Standard error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-86.861562	1.684568723	-51.5631	4.7E-271	-90.16769724	-83.55542676	-90.16769724	-83.55542676
Adj close (NASDAQ)	0.011655111	0.00016599	70.21577	0	0.011329339	0.011980883	0.011329339	0.011980883
Whether during the pandemic	-20.5680001	1.190788964	-17.2726	5.82E-58	-22.90504299	-18.23095721	-22.90504299	-18.23095721
Personal saving rate in the United States (%)	1.657567718	0.09015813	18.38512	2.39E-64	1.480623337	1.834512099	1.480623337	1.834512099

From the Table 1, an equation can be retrieved:

$$Y_i = -86.8616 + 0.0117 \times Adj\ Close(NASDAQ) - 20.5680 \times pandemic\ factor + 1.6576 \times personal\ saving\ rate\ in\ the\ USA$$

While running the multiple regression, the coefficient of determination is 0.8791, which means around 87.91% of the variations can be explained by the regression model. The y-intercept of -86.8616 represents that when the adjusted closing prices of NASDAQ and personal saving rate in the U.S. are zero, and the financial market is not experiencing the pandemic, the starting stock price of Bilibili would be -86.8616. The

coefficient of the adjusted closing price of NASDAQ of 0.0117 means that holding American personal saving rate and the factor of the pandemic constant, when the stock price of NASDAQ increases by 1 dollar, the overall stock price of Bilibili increases by 0.0117 USD. Similarly, the coefficient of American personal saving rates of 1.6576 means that holding the stock price of NASDAQ and the factor of the pandemic constant, when the personal saving rate increases by 1, the overall stock price of Bilibili increases by 1.6576 USD [11]. Moreover, the adjusted R square of 0.8787 represents that 87.87% of variations can be explained by the regression model; it also shows the addition of some useless variables in the model as the adjusted R square is less than the R square of 0.8791. In terms of significance, the significance F of zero is less than the level of significance of 0.05, so there is evidence to suggest that the whole regression equation is significant. While looking at the p-value of the adjusted closing price of NASDAQ and American personal saving rate, both of them are less than the significance level of 0.05. Therefore, both β_1 and β_3 differ from zero so that both coefficients of slopes are significant.

In this part, a qualitative dummy variable, which is the factor of the pandemic is involved in the multiple regression. The reason why having the dummy variable of whether the pandemic still exists or not is that the dummy variable allows statisticians to use a single regression equation to manifest the relations between different subgroups. For the coefficient of dummy variable of -20.5680, it means that holding the stock price of NASDAQ and American saving rate constant, if pandemic still exists, then the stock price of Bilibili will decrease 20.5680 USD. However, if the pandemic is eliminated, then it shows no effect on the stock performance. Due to that, the significance F of 5.82E-58 is less than the significance level of 0.05, so the overall regression equation is significant in this case.

Thus, the β_1 , β_2 , and β_3 , in this case, all differ from zero and all coefficients of slopes are significant. All in all, the entire regression model is well-established (Fig. 9).

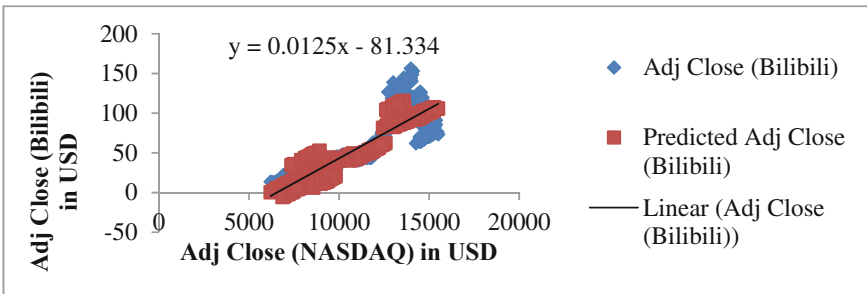


Fig. 10. Adj close (NASDAQ) line fit plot

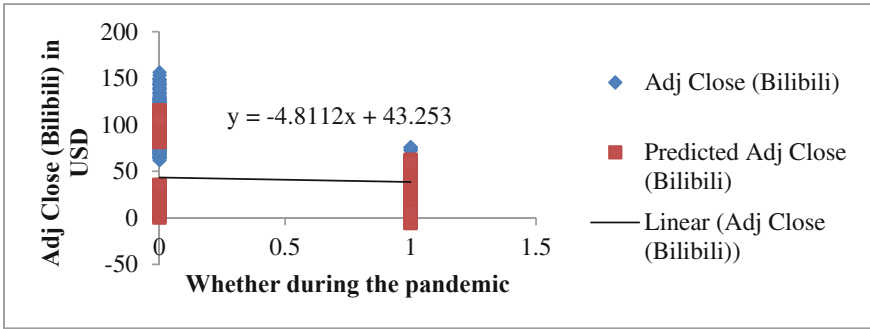


Fig. 11. Whether during the pandemic line fit plot

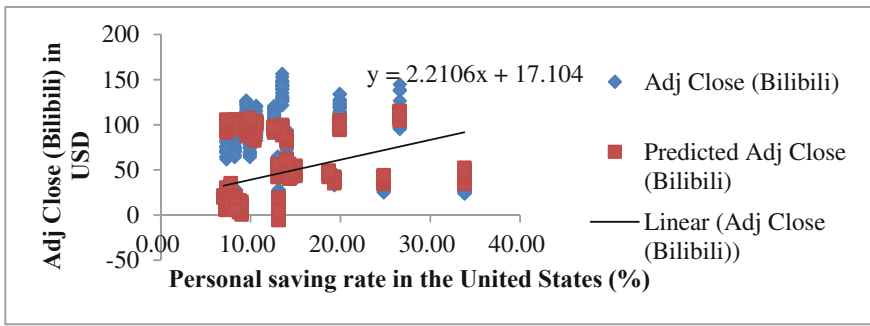


Fig. 12. Personal saving rate in the United States (%) line fit plot

From Fig. 10 and 12, the positive coefficient of 0.0125 and 2.2106 clearly indicates that there is a positive correlation between the stock price of Bilibili and the stock price of NASDAQ as well as the personal saving rate in America. However, in Fig. 11, the correlation between the stock price of Bilibili and whether the pandemic exists is negative. Such correlations are shown in the trend lines, which means pandemics will harm Bilibili's stock performance, while the improvements of the NASDAQ index and saving rate in the U.S. can help the stock price of Bilibili grow.

5 Conclusion

In this paper, the work has analyzed the history of Bilibili's stock price and discovered several factors which could influence the trend of stock price like inflation, stock price volatility, cash ratio, internal/external growth, exchange rate, etc. By comparing the performance of Bilibili in the US stock market with the NASDAQ Index, the results have described the link between the whole market and single stock. Several special factors are also be considered, for example, the outbreak of epidemic and government strategy. The objective of this paper is to let investors who are interested in Bilibili know more about its stock price. Through analyzing the historical data, this work plays the role of a consultant that tells the public that the stock of Bilibili is still worth buying despite

the global economic fallout from the pandemic due to the fact that the company's stock price is relatively stable under the broader market environment.

Acknowledgement. All the authors are the first authors.

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The Impact of Multiple Rounds of the COVID19 on China's Stock Market

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Abstract. The outbreak of COVID-19 in 2020 is unquestionably a “black swan” encountered by China’s economy, which brings severe challenges to China’s economy and makes China’s stock market more volatile and unpredictable. Therefore, this work will use collected data from WHO website including death and confirmed cases to build the mathematic model and visualize the graph trend. Then, these graphs will be used to determine the significant point-in-time. Subsequently, from January 13, 2020 to December 17, 2021, the China Securities 800 Index and the China Securities Investment Association Fund Valuation Industry Sub-index will be used as the basis for event analysis methods to discuss the rate of return of the epidemic on various industries in China in China with empirical research objects. Empirical results show that by studying the impact of the epidemic on different industries, it can provide theoretical basis and empirical suggestions for regulators and investors to make investment decisions during the epidemic.

Keywords: China · The COVID-19 · Stock market · Analysis method

1 Introduction

So far, COVID-19 has had a huge impact on the whole world, affecting people’s daily lives and social economic development. As the country first affected by the new pavilion epidemic, China’s economy has also been greatly affected, but the subsequent implementation of the Chinese government’s policies provided the most solid guarantee for economic activities that have been impacted. The stock market has always been regarded as a barometer of economic development, and the impact on economic development is often reflected in the stock market as soon as possible. Therefore, how the stock market has been hit by the epidemic deserves in-depth study.

The impact of the COVID-19 epidemic on the Chinese market began on January 20, during which the market was closed during the Spring Festival. According to relevant news reports, the epidemic will suppress the stock market from profit and risk appetite, and the stock market volatility will increase. On February 3, as the first trading day after the Spring Festival holiday, the three major stock indexes in the A-share market opened sharply lower, maintaining low fluctuations all day long. As of the close, the Shanghai Composite Index, Shenzhen Composite Index and Growth Enterprise Market Index had

fallen 7.72%, 8.45% and 6.85% respectively, and more than 3,000 stocks in the two markets fell by the daily limit.

However, during the epidemic, China's financial market as a whole remained relatively stable and showed amazing resilience. Deutsche Bank's China Financial Status Index (FCI) shows that after February 2020, China's financial situation has generally improved, and interest rates have also declined. During the outbreak, the Chinese stock market also stabilized relatively: the peak of the Shanghai-Shenzhen 300 Index fell by only about 10% from late January to early February, and so far it has performed better than overseas markets. This is due to the fact that the Chinese government has provided strong liquidity support to the financial market without directly intervening in the market and has adopted a dynamic zeroing policy to ensure good economic performance and better balance the relationship between epidemic prevention and control and economic and social development.

According to relevant media reports, China's COVID-19 epidemic has developed into a normalization of prevention and control. While preventing and controlling imported from abroad, it also responds to new local cases and asymptomatic infections.

Generally speaking, China's economic development under the background of the COVID-19 epidemic has gone through three stages, namely, the deep V-shaped fluctuation period, the shock recovery period and the stable recovery period. [1] Three to five days after the outbreak of the COVID-19 epidemic, the risk spillover in each market has increased to varying degrees, that is, the risk resonance has increased. [2] And the epidemic has a sharp impact on the economy in the short term, but it will not change the medium- and long-term growth trend. After the epidemic eases, the relevant economic activities will return to normal operation and the economy will gradually recover. [3, 4].

Since the economic impact of the epidemic is still uncertain, it is necessary to investigate how COVID-19 affects the Chinese stock market through research on the response to the stock market.

In this work, mathematical models and visual graphic trends will be established by data collected from the WHO website, including deaths and confirmed cases. Then, these graphs will be used to determine the significant point-in-time. Subsequently, from January 13, 2020 to December 17, 2021, the China Securities 800 Index and the China Securities Investment Association Fund Valuation Industry Sub-index will be used as the basis for event analysis methods to discuss the rate of return of the epidemic on various industries in China with empirical research objects. Empirical results show that by studying the impact of the epidemic on different industries, it can provide theoretical basis and empirical suggestions for regulators and investors to make investment decisions during the epidemic.

2 Data and Methods

2.1 Peak

Tracking on the COVID-19 timeline, China has been through a several outbreak incidents according to regional outbreaks. The pandemic has potential negative impact on country economy and market, the severity of pandemic varied frequently which may bring big impact on Chinese stock market. This event inspires to find PEAK as main idea through

the whole investigation. By applying those outbreak incidents called PEAK as dummy variables, then builds a regression model which led to investigate the direction of impact on specific industries.

The official data of confirmed cases and death cases has been captured from WHO website the 03 January 2020 to 15 December 2021, the labelled graphs are shown below:

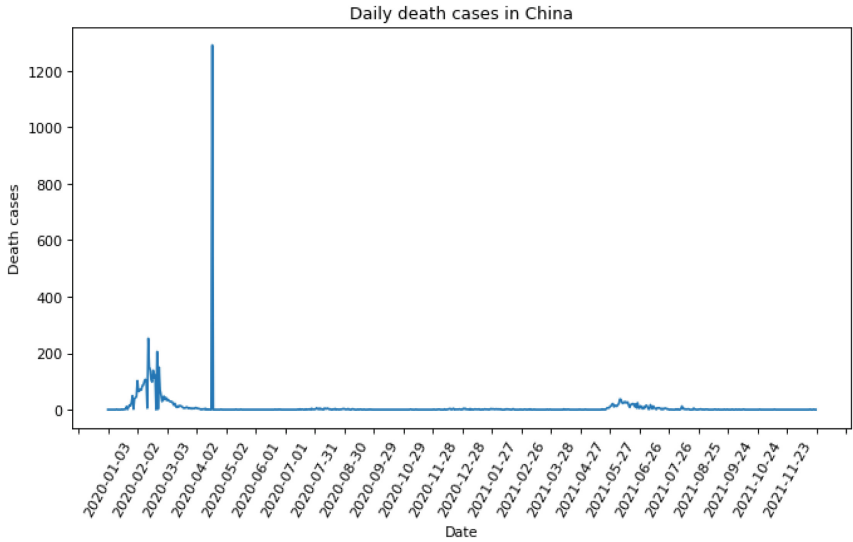


Fig. 1. Daily death cases in China

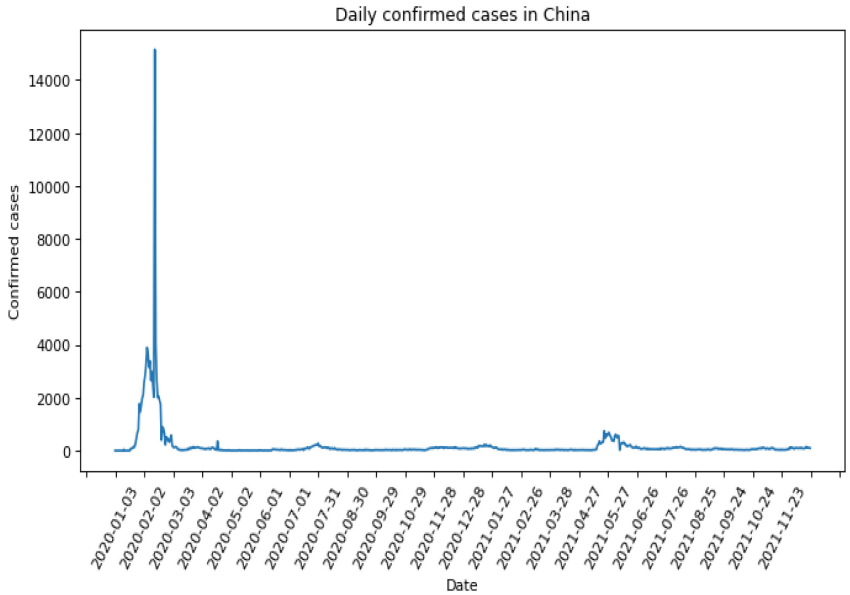


Fig. 2. Daily confirmed cases in China

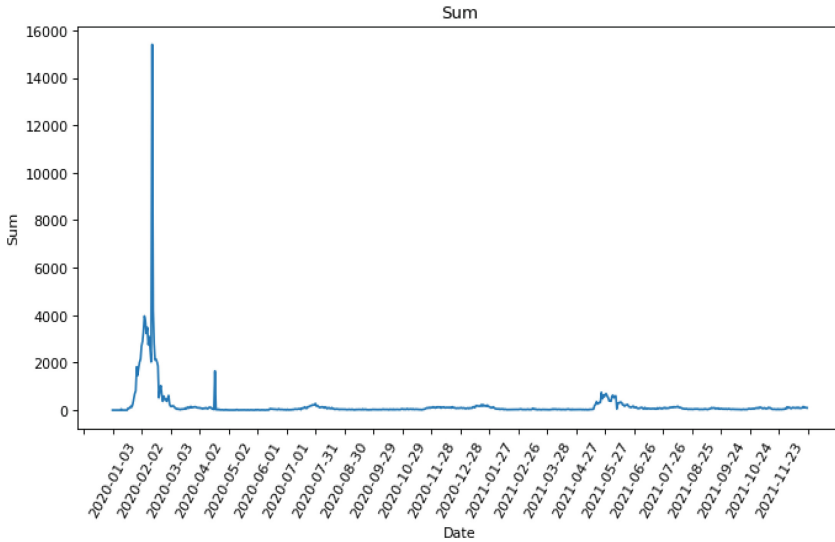


Fig. 3. Sum

Upon those Fig. 1 and 2, there are several local maximums occur as peaks for describing the severity of pandemic. Furthermore, by combining the number confirmed cases and dead cases, then obtain the sum as the representative data, the following graph can be scratched:

According to the trendline in Fig. 3, it increased rapidly from the start since the first COVID-19 outbreak, then it suddenly dropping down to a relatively under controlled level with the first Chinese vaccine announced. As new variants and several regional cluster outbreaks occurred, it rises back slightly. After 2020–4, the line does not have very strong fluctuation. Until 2021–5, there has been a slightly fluctuation with mid-level frequency.

Moreover, according to the statistic of national health commission of the people’s republic of China, there are four rounds of outbreak, resulting in March of 2020, June of 2020, November of 2020 and May of 2021.

Combining the data of national health commission and the overall trendline, we considered to divide pandemic into four period: from 2020–01-03 to 2020–02-29, from 2020–03-01 to 2020–06-30, from 2020–07-01 to 2020–12-31, from 2021–01-01 to 2021–12-15. Then the filter has been used to find the local maximum at that period, hence obtained those four top balances as four peaks in pandemic.

Referring to Table 1, 4 peaks with the sum of death and confirmed cases corresponding to time period are shown above. It is obvious that the overall situation turns better as the time passes.

Table 1. Top balance

Top balance	Time
15404	2020/2/13
1646	2020/4/18
277	2020/7/31
744	2021/5/23

According to the government report, there are four outbreaks are shown on Table 2:

Table 2. The outbreak stage

<i>The outbreak stage</i>	Timeline	Cases	Death	End time
<i>First round outbreak</i>	2019.12–2020.03	81,071	4,633	2020.04.03
<i>Peak</i>	2020.01.20–2020.03.23			
<i>Beijing outbreak in cluster</i>	2020.06–2020.07	363	0	2020.07.06
<i>Peak</i>	2020.06.06–2020.06.27			
<i>Second round outbreak</i>	2020.11–2021.03	2,262	0	2021.02.16
<i>Peak</i>	2020.11.23–2021.02.22			
<i>Guangzhou outbreak in cluster</i>	2021.05–2021.06	170	0	2021.06.20
<i>Yunnan Ruili outbreak in cluster</i>	2021.07–2021.08	108	0	
<i>Nanjing outbreak in cluster</i>	2021.07–2021.08	762	0	
<i>Peak</i>	2021.05.10–2021.09.13			
<i>Continue</i>				

As shown in Table 2, these four peaks stand for the most serious situation referring death and confirmed case in China, which means once the outbreak of disease start, the death and confirmed cases increase with time, then reach to the maximum amount, then drop down back to lower level.

2.2 The Recovery of Chinese Economy

Throughout the whole, the global epidemic has gradually entered a phase of mitigation. Zoom into China, the post-pandemic period can be determined by the recovery of economy as it becomes one prominent representation of post-pandemic period according to some professional papers. This inspires us to search some macroeconomic data that represent the overall Chinese economy during COVID-19. Among all, PPI, financial revenue and GDP have been chosen, which in the rate of monthly growth as main. The SERIES function has been used to transfer GDP seasonal growth into monthly growth, hence obtain the GDP monthly growth trend line on the graph. Combining these three

indexes tracking from December 2019 to November 2021, the result is shown in the following graph:

As Table 3 shown, from the end of 2019 and the beginning of 2020, three significant indexes stayed in negative growth, indicating a less optimistic impact to Chinese economy due to corona virus. However, Chinese market has recovered in 2021 with positive growth in these three indexes.

Table 3. Statistic of Chinese PPI, financial revenue and GDP growth

Month	PPI monthly growth	Financial revenue monthly growth	GDP
2019-12	-0.5%	3.59%	
2020-01	0.10%	0.00%	
2020-02	-0.40%	0.00%	
2020-03	-1.50%	-26.11%	-6.80%
2020-04	-3.10%	-14.98%	
2020-05	-3.70%	-10.01%	
2020-06	-3.00%	3.22%	-1.60%
2020-07	-2.40%	4.34%	
2020-08	-2.00%	5.29%	
2020-09	-2.10%	4.53%	0.07%
2020-10	-2.10%	2.97%	
2020-11	-1.50%	-2.73%	
2020-12	-0.40%	17.44%	2.30%
2021-01	0.30%	0.00%	
2021-02	1.70%	0.00%	
2021-03	4.40%	42.39%	18.30%
2021-04	6.80%	29.38%	
2021-05	9.00%	18.71%	
2021-06	8.80%	11.66%	12.70%
2021-07	9.00%	11.06%	
2021-08	9.50%	2.73%	
2021-09	10.70%	-2.12%	9.80%
2021-10	13.50%	-0.14%	
2021-11	12.90%	-11.23%	

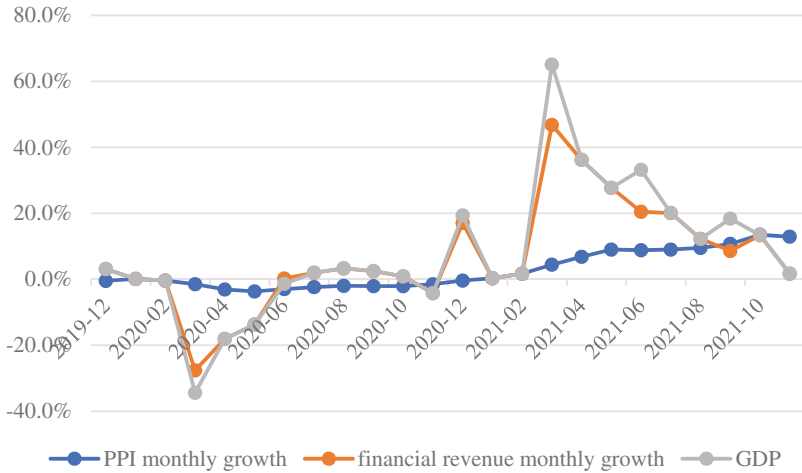


Fig. 4. Chinese PPI, fiscal revenue and GDP growth chart

Upon the outbreak matrix and Fig. 4, it can be observed that when the covid-19 was exposed, the overall trend showed a downward sloping, in March 2020, they dropped to the lowest, which correspond to the peak of the first-round outbreak. After that, the overall economy gradually turned back to positive monthly growth. In December 2020, it reaches the first peak, around March 2021, they reach the second peak, which is the highest peak so far. Moreover, it has been announced the first Chinese vaccine is allowed to be used in March 2021. These two facts bring a Chinese economic recovery at this point in time that represents the start of the post-pandemic period.

2.3 Indexes

The Industry Classification Index organized by the China Security Index Crop. (CSI) are selected as benchmark, which are compiled according to the categories in the “Guidelines for the Classification of Listed Companies” from the Asset Management Association of China (AMAC). 16 categories of indexes (excluding manufacturing) are compiled, and 27 major categories of indexes are compiled according to the classification of the manufacturing categories.

All the 16 indexes shown on Table 4 cover almost the whole industries in the China A-share stock market are included in this work to find out the impacts of multiple rounds of the COVID19 on different departments of the A-share market.

The constituent stocks of CSI 800 are composed of CSI 500 and SHSZ 300 constituent stocks together. It comprehensively reflects the overall situation of large, medium, and small market capitalization companies in China’s securities market.

Table 4. The selected indexes' name and code

INDEX CODE	INDEX NAME
H11030	AMAC Agriculture, Forestry, Animal Husbandry and Fishery Index
H11031	AMAC Mining Index
H11041	AMAC Water, Electricity and Gas Index
H11042	AMAC Construction Index
H11043	AMAC Delivery and Storage Index
H11044	AMAC Information Technology Index
H11045	AMAC Wholesale, Retail and Trade Index
H11046	AMAC Financial and Insurance Index
H11047	AMAC Real Estate Index
H11049	AMAC Culture and Sports Index
H11050	AMAC Composite Enterprise Index
H30036	AMAC Catering and Accommodation Index
H30037	AMAC Leasing Business Index
H30038	AMAC Research Technology Index
H30039	AMAC Water Conservancy Environmental Index
H30040	AMAC Resident Service Index

2.4 Research Model

The average adjusted rate of return model has a large deviation, when a bull or bear market occurs on the event day. The market index adjusted return model has a strong relationship assumption, which is not applicable in most case [4]. Market models are the most commonly used and have good predictive power [2]. This work used the market model, which is outlined as follow:

Calculate the normal rate of return:

$$R_{i,t} = \alpha_i + \beta_i * R_{M,t} \quad (1)$$

2.5 Dummy Variables

4 dummy variables representing the peaks of each outbreak in China are set up with 5-day length when taking the rapid volatility of the stock market into account.

This work first analyzed the daily gross rate of return of each index based on the index prices from 26/12/2019 to 24/12/2021. The regression results shown on the Table 5. To be clearer, bold-face is used to indicate the significant outcomes.

To be more visual, this work draws Fig. 5, the bars are in a descending sequence of its numerical values.

Table 5. The regression result of dummy variables.

	Rm	PEAK1	PEAK2	PEAK3	PEAK4
H11030	0.891	-0.016	-0.001	0.002	-0.009
H11031	0.831	-0.008	-0.001	0.005	-0.007
H11041	0.47	-0.011	-0.002	0	-0.001
H11042	665	-0.013	-0.002	0.001	-0.001
H11043	0.723	-0.01	0	-0.001	-0.002
H11044	1.032	-0.001	0.002	-0.002	0.003
H11045	0.757	-0.002	0.002	-6.80E-05	0.003
H11046	0.9	-0.002	-0.002	0.006	0.003
H11047	0.702	-0.012	-0.001	0.02	0
H11049	0.815	-0.014	0.001	-0.02	0.001
H11050	0.915	0.003	-0.003	-0.01	-0.004
H30036	0.787	-0.027	0.007	-0.03	0.005
H30037	1.196	-0.01	0.01	-0.03	0.003
H30038	1.073	0.009	0.004	-0.05	0.008
H30039	0.685	-0.013	-0.001	-0.02	0.001
H30040	1.195	0.005	0.004	-0.02	0.012

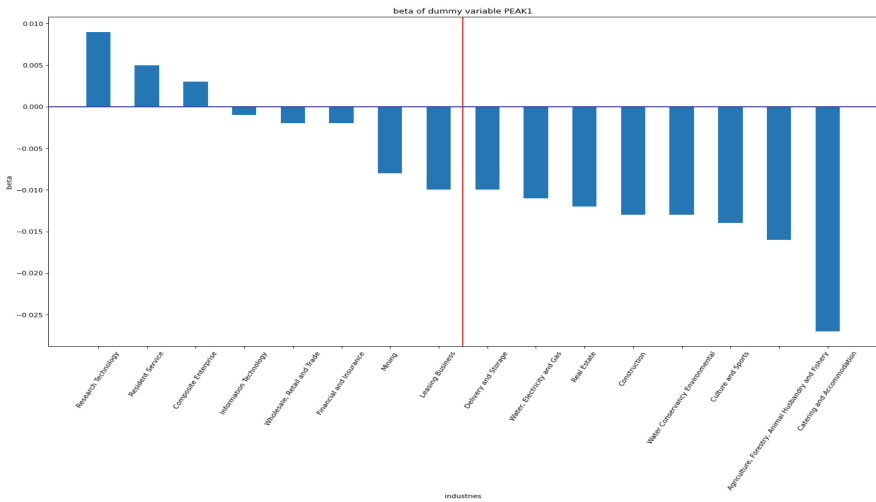


Fig. 5. Betas of dummy variable PEAK1

The bars on the left side of the vertical red line have the nonsignificant results while the right-side ones are significant. That is to say, approximately half of the industries suffered negative shock of the occurrence of PEAK1 of the COVID-19 at 20 January 2020. And the positive impact of PEAK1 on different industries is not statistically significant [5]. Moreover, the industry that suffered the most in the first epidemic is the Catering and Accommodation Industry, with nearly -0.03 beta of this dummy variable. The industries of Agriculture, Forestry, Animal Husbandry and Fishery, Culture and Sports, Water Conservancy and Environment, Construction, Real Estate, Water, Electricity and Gas, and Delivery and Storage also suffered negative shock during the first peak. It may be due to some common peculiarities in these industries, such as the fact that the main business cannot be completed through online office [6–8].

The industry of Research Technology, Resident Service and Composite Enterprise have had positive affected by the epidemic, the industry of Mining and Leasing Business also suffered negative influences, but they are not statistically significant. Information Technology, Financial and Insurance, and the Wholesale, Retail and Trade industries seemed not be influenced by the epidemic [9, 10].

Back to Fig. 1, PEAK 2 had a positive influence on the leasing business industry, while PEAK3 had a positive influence on the Financial and Insurance Industry.

From Fig. 1, a trend that the later the peak occur, the less negative influence it would have on all the 16 industry indexes. There were over 8 industries had suffered negative affect of the first peak, while no industries show any significant evidence on the effect of the fourth one.

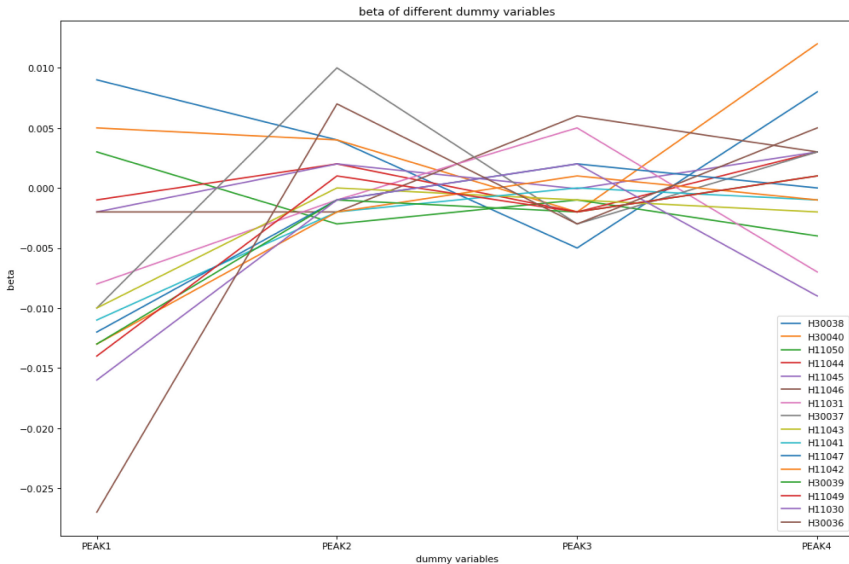


Fig. 6. Beta of different dummy variables

Figure 6 shows the industries' changes of beta in different time periods. From Fig. 6, by drawing all the betas of different peaks of different indexes, this work found that the

occurrence of the first peak brought the largest negative influence on about half of the industries, while the numerical values of different industries of the later 3 peaks became more evenly distributed around 0.

3 Conclusions and Recommendations

China's stock market can achieve its current performance thanks to the timely adoption of a dynamic zeroing policy by the Chinese government, timely and effective control of the epidemic, and minimize the impact of the epidemic on the Chinese stock market. Unlike the static zeroing policy, which requires the suspension of residents' lives and production activities, China's dynamic zeroing policy not only quickly extinguishes dozens of locally spread cases and cluster epidemics and effectively reduces deaths, but also ensures a good economic operation and balances the relationship between epidemic prevention and control and economic and social development.

This article used regression analysis method to empirically explore the impact of multiple rounds of outbreaks of COVID-19 on various Chinese industries. Only the first outbreak of the pandemic had had negative influences on the index prices, and the impact of the following rounds were too small to have statistical significance. The first-round outbreak hit the traditional industries heavily but hardly affected the technology, financing, and business industries which have developed a new business model based on the Internet.

Thanks to the dynamic-zero policy promoted by Chinese government, the following rounds almost have no significant negative influences on the indexes prices, but only had positively affected the financing and insurance industry and the leasing business industry. Looking at the latest outbreak happened in Nanjing which peak occurred at 10 May 2021, we can come up with the conclusion that this outbreak hadn't affected Chinese people's normal life, or at least had not affected the stock market.

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