William C. Gartner *Editor*

New Perspectives and Paradigms in Applied Economics and Business

Select Proceedings of the 2022
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Preface

Due to the global situation regarding the COVID-19 pandemic, the 2022 6th International Conference on Applied Economics and Business (ICAEB 2022), which was planned to be held in Stockholm, Sweden, during August 24–26, was held as a hybrid conference during the same time period. The decision to hold the conference in hybrid mode was made in compliance with many restrictions and regulations that were imposed by countries around the globe. Such restrictions were made to minimize the risk of people contracting or spreading the COVID-19 through physical contact.

I was honored to join this important event. First, I would like to take this opportunity to convey my appreciation to the organizing committee for untiring efforts to manage this convention. This conference focused on the latest research results in applied economics and business and provides an authoritative international exchange platform for researchers in related fields, so as to promote stimulating academic exchanges among scholars. It also provides opportunities for global partners to build business and research collaborations. The conference will be held every year to make it an ideal platform for people to share views and experiences in an international conference setting on applied economics and business.

The responses to the call-for-papers had been overwhelming from all corners of the world. Unfortunately, many manuscripts from prestigious institutions could not be accepted for this special issue due to the reviewing outcomes and our capacity constraints. This volume of proceedings contains 32 papers. Readers can absorb some of the most cutting-edge knowledge about applied economics and business from all around the world in it. Each selected paper was subjected to a double-blind peer review. We would like to express our gratitude and appreciation for all of the reviewers who helped us maintain the high quality of manuscripts included in the proceedings published by Springer. We would also like to extend our thanks to the members of the organizing team for their hard work.

Our special thanks go to all the speakers and delegates for their presence and valuable contribution to this successful event. Moreover, we would like to thank every member of the organizing and technical committee as the conference would not have been possible without their support. We hope you will find this volume of proceedings interesting and useful for your research in the future.

Saint Paul, USA   Prof. William C. Gartner

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The Relationship Between Profitability and Market Value: Evidence from Jordanian Banks

Mohammad Fawzi Shubita

Abstract The purpose of this study is to examine the relationship between profitability and the market value of the bank, and the relation between high and low profitability with market value using the bank size measured by total assets as a control variable. The study sample is the Jordanian banks listed on Amman Stock Exchange for the period from 2010 to 2020. ROE measures the return per equity invested by the owner, and it is important to know how well management is deployed the bank's equity in the pursuit of earnings. The bank market value is measured using the market-to-book value ratio. The study methods are to use the main model and benchmark model with panel and pooled OLS regression and random effect models approach with several econometrics tools like Husman test, variance inflation factor, and panel granger causality. The study's main results are that the high-profit banks have a higher market value than low-profit banks, there is a relationship between high and low ROE and market value, there is a relationship between earnings and market value, and the bank size affects the relationship between ROE and market value. About the last result, the Adj R^2 for small banks is 26.2%, which is higher than the full sample (16.9%) and large banks (14.1%). As a conclusion, the study recommends the creditors and investors benefit from the study results by concentrating more on the company's financial results before making the investment decision.

Keywords Profitability · Fair value · Banks size · Emerging market · Jordan
JEL Classification G21 · G32 · M41

1 Introduction

Two widely used performance measures for an investment center are return on investment (ROI) and return on equity (ROE). These measures allow an investor to assess how effectively and efficiently management is using assets to obtain a return. These

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measures relate the balance sheet to the income statement and indicate how efficiently the management is deploying capital to produce earnings for the firm.

Return on equity is the relationship between income and the equity investment to generate such income [1]; benefits with the application of ROE include, but are not limited to, improve projects, secure funding, comparative analysis, and discontinue ineffective products or operations. Therefore, the company's resources consist of the net assets the entity deploys in its attempts to earn a profit [2].

Total equity is the net assets and equals the residual interest in the assets of the firm after subtracting all its liabilities which refers to the firm book value. The major items of equity are capital contributions, retained earnings, treasury stock, and other comprehensive income (OCI). Market value, not book value, provides the best information about investors' expectations.

The DuPont model divides ROE into three different efficiency components can subdivide the return on equity (ROE). Firstly, the assets turnover which equal net sales over average total assets, then, the equity multiplier measures a firm's financial leverage, lastly, the net profit margin which examines a firm's efficiency in generating net profit from sales.

The study problem is that the value relevance is defined as the ability of financial statements information to summarize and the company value. Among the many factors involved in measuring the market value like the definition of income, sources, the stability, revenue relationship, and expenses, including the cost of goods sold. This analysis attempts to answer questions about the relevant income measure, income quality, the persistence of income, and the firm's earning power.

This study goal is to examine the relationship between market-to-book value ratio and ROE in Jordanian banks, the current income is a good estimator of the cash flow stream from a firm investm1ent [3–5].

2   Literature Review and Hypotheses Development

The relationship between ROE and market to book value has been studied in several markets [6–9]. Evidence of such a relationship from the markets of Jordan and emerging countries is lacking.

Leibowitz [9] studied the relationship between market-to-book value and return on equity and found that the relationship is positive when return on equity is positive and the association between MV/BV and positive return on equity is negative, but the study did not use control variables the magnitude and impact of company size, economic conditions, and industry.

Kabajeh et al. [10] investigate the association between the ROA, ROI, and ROE ratios separately and together for Jordanian insurance public firms during the study period (2002–2007). The study found a positive association between the ROA, ROI, and ROE ratios together. The results also indicated an insignificant positive association between each of return on equity ratios separately and return on investment

ratio separately. However, the findings showed no association between the return on equity ratios separately with Jordanian insurance firms market value.

Barth et al. [11] investigated how the value relevance of financial statement data changed as the new economy developed. The study assessed evolution in each amount and found increases in growth opportunities, the study found a more nuanced association between accounting information and a stock price that impacts the new economy.

In Jordan, Aldebi'e and Mustafa [12] investigated the relationship between ROE and market-to-book ratio for the industrial and service listed companies in Jordan during (2000–2009). Using cross-sectional and pooled regressions, the findings are that the relationship between market value and return on equity is negative for negative return on equity and positive for positive return on equity.

Karğın [13] investigated the value relevance of information in pre-and post-financial periods of IFRS application for Turkish listed companies from 1998 to 2011. Market value is related to earnings per share and book value by using the Ohlson model [14]. The study findings showed that the value relevance of accounting information has increased in the post-International Financial Reporting Standards period (2005–2011) considering book values.

Ball and Brown [15] showed the association between earnings and share returns [33]. It has had an important impact on empirical accounting research [14]. It is related to accounting earnings to share prices. Many studies besides Ball and Brown [15] investigated the association between financial statement information and stock prices. Ohlson's model [14] relates the market value of the company to book values, dividends, and earnings. This important model has been examined by several studies for several countries (e.g., [16]). Ali and Hwang [17] used manufacturing companies' financial statements information in 16 countries from 1986 to 1995 and reached that the value relevance of financial statements is higher for market-oriented countries rather than bank-oriented countries.

Al-Horani [18] showed that multivariate and univariate analyzes introduce evidence of value relevance of income items for listed commercial banks in Amman Stock Exchange for the period 2000–2008. Alali and Foote [19] showed that income is associated with returns and that EPS and book value per share in Abu Dhabi Stock Exchange are related to the stock price per share. Abdollahi et al. [20] reveal that audit firm size and auditor's report are significantly and positively associated with value relevance of financial information including value relevance of book value per share and earnings.

Almumani [21] study the Jordanian listed commercial banks market value ratios (EPS, dividend payout, and price–earnings ratio) and profitability ratios (ROE and ROA) impact on the market capitalization as the dependent variable measured by the total shares multiplied by market closing price per share for the period from 2010 to 2016. The findings indicated that dividend payout ratio and ROE are the most factors that influence the commercial banks market capitalization in Jordan during the research period.

Altahtamouni et al. [22] studied the indirect impact of income measured by the ROE for the Jordanian Banks on the firm market value (market value to book value)

from 2008 to 2017. The study applied the indirect model to know the ability of growth rate, capital structure, and dividend policy as mediating variables to transfer the effect of earnings to market value. Using the simple linear analysis models and the Sobel equation the research reached to a positive impact of profits on market value with the presence of debt ratio, dividend policy, and growth rate as mediating variables of this association.

Tekin [23] used fixed effects regression model panel data to examine the financial factors that influence the profitability and market value on Turkey. The research sample covered 21 listed firms in the period between 2010 and 2019. The findings showed that return on equity (ROE), leverage, return on assets (ROA), current asset turnover, asset turnover, and equity multiplier are the main factors that influence market-to-book ratio.

Several studies also addressed the relationship between earnings and market measures ([24–26]); in this study, I use ROE as an indicator for profit and market to book value as an indicator for the bank value, using the benchmark model.

Then I documented the significant differences of large and small banks, these subsamples of the banks motivated by the findings of many studies (e.g. [27–30]).

Based on that, the study hypotheses are:

H01: There is no relationship between high and low ROE and market value.
H02: There is no relationship between earnings and market value.
H03: The company size does not affect the relationship between ROE and market value.

Goal Statement
Therefore, the goal of this study is to investigate the Jordanian banks profitability measured by return on equity and the banks market values taking in consideration the bank size as a control variable to study if the bank size influence the relationship between profitability and bank market value.

3 Method

3.1 Models and Variables

The variables in this study are the return on equity (ROE) and market-to-book ratio (MV/BV). The control variable is bank size measuring using total assets. The market-to-book value is measured by dividing the market capitalization of the bank (Annual market share closing price multiply by total shares) by the total shareholders' equity. On other hand, return on equity is measured by dividing net income over total equity ([31, 32]).

The two main models of this study are:

The Main Model (Model 1)

$$MV_{it}/BV_{it} = A_0 + A_1(D)(ROE_{it}) + (1 - D)(ROE_{it}) + \varepsilon_{it}$$

where

MV_{it}/BV_{it}: is the market value to book value ratio;
ROE_{it}: is the return on equity;
D: Dummy variable that takes 0 when ROE is negative, and 1 otherwise;
A_0, A_1: OLS regression coefficients;
ε: OLS regression error.

Hayn [33] suggests that positive income has higher information content than negative income regarding the market value of the company, this main result motivated the creation of this model. However, when I try to run this model on Jordanian banks, there are only two years (observations) that the Jordanian banks generate losses, so instead of that, I classify the sample to high profit and low profit based on the banks' ROE median in the descriptive analysis section.

The Benchmark Model (Model 2)

$$MV_{it}/BV_{it} = B_0 + B_1(ROE_{it}) + \varepsilon_{it}$$

Ball and Brown [15] addressed an important relationship between earnings and share price; this model examines the return-market relationship regardless of the ROE sign or magnitude.

Study Sample
The sample includes (13) commercial banks listed on the Amman Stock Exchange. The study period is from the year 2010 to the year 2020. (13) Firms will represent the study sample, and the total observations are (143) firm-year observations.

4 Results

4.1 Descriptive Analysis

Table 1 total sample panel indicate that the market value of Jordanian banks is equal to the book value which is less than Aldebi'e, and Mustafa, [12] that indicate that Jordanian industrial and service companies in the period from 2000 to 2009 market to book value was (1.543), this decrease comes mainly from the deference in the

Table 1 Descriptive analysis

Variable	Mean	Median	Std.	Percentile 1	Percentile 99
Panel 1: High profit					
MV_{it}/BV	1.154	1.01	0.485	0.64	
ROE	10.932	10.24	2.092	8.67	
Total assets	3,545,249,292	2,190,187,366	5,027,264,611	677,216,707	
Panel 2: Low profit					
MV_{it}/BV	0.844	0.79	0.283	0.470	
ROE	5.509	6.095	2.624	−1.45	
Total assets	4,641,203,245	1,993,302,407	7,362,046,186	342,656,075	
Panel 3: Total sample					
MV_{it}/BV	0.998	0.870	0.425	0.470	2.53
ROE	8.201	8.6	3.605	−1.25	16.65
Total assets	4,097,058,275	2,061,689,519	6,313,553,180	350,714,929	26,810,513,480

study period. The Jordanian market loses a huge amount of its market value after the financial crises and recent COVID-19 crises.

However, this ratio is ideal because a greater than 1 ratio means the share is overvalued, so it has performed well, and a less than 1 ratio indicates that the share is undervalued so for the investors is considered a bad investment. A low figure could also indicate that there is something wrong with the bank. For ROE, the mean value provides insight into how the bank is using financing from net assets to grow the bank because it knows how to reinvest its income wisely, to maximize profits and productivity.

Panel (1) and panel (2) figures refer that the high-profit banks have a higher market value than low-profit banks which means that the Jordanian investor takes into consideration income statement results before making the investment decision which reflects on the variations of shares demand. The increase in total assets leads to an increase in equity, which decreases the ROE ratio because the total equity is the denominator of this ratio. Therefore, low ROE Jordanian banks have high total assets.

4.2 Correlation

As expected, high ROE banks have a significant and positive correlation coefficient with market value, but the Pearson and Spearman correlation coefficients for low ROE are positive and insignificant. This means that the profitable banks have a high market value and are more attractive to the investors than the low profitable banks (Table 2).

Table 2 Pearson correlation matrix

	Pearson	Spearman
High ROE	0.270*	0.523**
Low ROE	0.167	0.117

* 0.05 level; ** 0.01 level

5　Discussion

5.1　Regression Analysis

First: OLS Analysis

Table 3 shows the OLS findings of the association between market-to-book value and high and low ROE. In addition, Table 4 reports OLS for model 1 (the main model) and the benchmark model (model 2) after portioning the sample according to the bank size.

The adj-R^2 of the main model, which defers between high return on equity and low return on equity banks is higher than the benchmark model that does not distinguish between high and low ROE. This result is consistent with Leibowitz [9] in the United State market.

The high ROE coefficient is significant in the main model, but this is not the case for low ROE banks in the main model, so we reject the first null hypothesis and accept the alternative one, which means that there is a relationship between high and low ROE and market value.

For the second model, and as expected the ROE coefficient was significant and positive, which means that Jordanian investors take their investment decision, based on the banks' operation results, which leads to the fact that higher profit banks motivate the increase in demand for the banks' shares. This will increase the market value of the banks and encourage the Jordanian companies to concentrate more on the income statement to result to increase their market value. This discussion will lead to rejecting the second null hypothesis as follows: There is a relationship between earnings and market value.

Table 3 Regression results

	(Constant)	ROE	High ROE	Low ROE	R^2	Adjusted-R^2	F
Model (1)	0.701 (7.167)***		0.042 (4.404)***	0.025 (1.50)	0.181	0.169	15.478***
Model (2)	0.607 (7.476)**	0.048 (5.261)**			0.164	0.158	27.68***

* 0.1; ** 0.05 level; *** 0.01 level

Table 4 Regression results according to size

	(Constant)	ROE	High ROE	Low ROE	R^2	Adjusted-R^2	F
Panel 1: Full sample							
Model (1)	0.701 (7.167)***		0.042 (4.404)***	0.025 (1.50)	0.181	0.169	15.478***
Model (2)	0.607 (7.476)**	0.048 (5.261)**			0.164	0.158	27.68***
Panel 2: Small companies							
Model (1)	0.722 (10.764)***		0.030 (4.378)***	0.017 (1.440)	0.284	0.262	13.454***
Model (2)	0.664 (11.447)***	0.033 (4.849)***			0.254	0.243	23.509***
Panel 3: Large companies							
Model (1)	0.669 (3.134)***		0.054 (2.68)***	0.034 (0.993)	0.165	0.141	6.737***
Model (2)	0.533 (3.201)***	0.063 (3.526)***			0.153	0.140	12.431***

* 0.1 ** 0.05 level. *** 0.01 level

5.2 Small and Large Companies

To test the third and last hypothesis, I divide the banks into small and large banks, panel 2 that related to the small banks model (2) results refer that the Adj-R^2 is 24.3% which is more than large banks (14%) or full sample (15.8%). This is the same for the main model that Adj R^2 for small banks is 26.2% that is higher than the full sample (16.9%) and large banks (14.1%). This analysis leads to rejecting the third null hypothesis, so the company size affects the relationship between ROE and market value.

Second: Balanced Data Analysis
Pooled OLS
   Table 5 shows the pooled OLS results for the study models (Table 6).

5.3 Husman Test

Husman test helps in determining which method is better (random effect model or fixed effect model), I run this test for the two models (Models 1 and 2) [34]. The main result as Table 7 refers is that the random effect model is better. Since the probability value is more than 5%, we failed to reject the null hypothesis, which indicated that the random effect model is more preferred than the fixed one [35].

Table 5 Model (1) coefficients

Variable	Coefficient	Std. error	t-statistic	Prob.
High ROE	0.042105	0.009569	4.399906	0.0000
Low ROE	0.024274	0.016320	1.487361	0.1392
Constant	0.702664	0.097803	7.184502	0.0000
R-squared	0.181484			
Adjusted R-squared	0.169790			
F-statistic	15.52058			
Prob. (F-statistic)	0.000001			
Durbin-Watson stat	0.240008			

Table 6 Model (2) coefficients

Variable	Coefficient	Std. error	t-statistic	Prob.
ROE	0.047696	0.009063	5.262737	0.0000
Constant	0.607342	0.081153	7.483946	0.0000
R^2	0.164179			
Adjusted R^2	0.158251			
F-statistic	27.69641			
Prob. (F)	0.000001			
Durbin-Watson	0.223791			

Table 7 Husman test results

Equation number	Chi-Sq. statistic	Chi-Sq. d.f.	Prob.	Result
Model (1)	0.358628	1	0.5493	Random is better
Model (2)	0.605043	2	0.7390	Random is better

5.4 Random Effect Models

Based on Husman test results for the study equations, the random effect method is more preferred. The empirical evidence of the study model indicated the same outcomes of the OLS model previous section. The main advantage of using the random effect model is to delete heteroscedasticity problem [35]. This model uses the general least square or the principle of maximum likelihood, which is different from fixed effect and common effect that use the ordinary least square principle (Tables 8 and 9).

The above results fit with the study findings and emphasize the importance of distinguishing between high and low-profit banks because bank profitability is an important element in the banks' valuation model. This important result comes from the fact that the market-to-book ratio is used by creditors and investors to show the

Table 8 Model (1)

Variable	Coefficient	Std. error	t-statistic	Prob.
High ROE	0.035119	0.005667	6.197408	0.0000
Low ROE	0.024259	0.008891	2.728530	0.0072
Constant	0.740620	0.116742	6.344096	0.0000
	Weighted statistics			
R-squared	0.275947			
Adjusted R-squared	0.265604			
F-statistic	26.67807			
Prob. (F-statistic)	0.000000			
Durbin-Watson stat	0.847045			

Table 9 Model (2) random

Variable	Coefficient	Std. error	t-statistic	Prob.
ROE	0.038179	0.005511	6.928031	0.0000
Constant	0.685395	0.111037	6.172691	0.0000
	Weighted statistics			
R-squared	0.254824			
Adjusted R-squared	0.249539			
F-statistic	48.21694			
Prob. (F-statistic)	0.000000			
Durbin-Watson stat	0.810908			
T'				

market's perception of a share value. It is will be used to value financial and insurance firms, investment trusts, and real estate companies. This important ratio is used to investigate how much equity investors are paying for each dollar in total assets, so it is important to links this ratio with income statement figures.

5.5 *Panel Granger Causality*

I run Granger Causality Tests for the main association between market value and ROE, and the results were as follows (Table 10):

Table 10 Panel granger causality

H_0	F-stat.	Prob.
ROE does not Granger Cause MV_BV	3.51393	0.0331

From the table, the *F*-statistic is less than (5%), so we reject the null hypothesis, and return on equity does not cause the Jordanian banks' market values.

5.6 Multicollinearity

The study examines the multicollinearity problem using variance inflation factor (VIF) the whole banks sample the main model is (2.803) and VIF for the benchmark model is (1), which is less than (5) which means that there is no multicollinearity problem in the study models [35].

5.7 Discussion

The first important thing we learn to our students to do in the accounting statement analysis is to compare the financial ratios of companies with market value.

This research extended [9] work by testing the above relation on sub-samples constructed according to bank size, during the study period. This study used the same model in [12] with the main change by decomposing the sample to high and low ROE instead of negative and positive ROE, in addition, my study differs in the period and the sector.

Previous studies addressed the positive relationship between Return on Equity and MV / BV, however, [9] proved and argued that the relationship can be negative. There are several differences between the two studies markets, this study finding fits with [9] results; the association between market-to-book value and high Return on Equity is significant and it is insignificant with low Return on Equity, but [9] divide the sample to positive and negative ROE.

The above overall findings emphasize the significance of distinguishing between high and low profit banks since profitability is an important in valuation models of companies. In addition, it is even more important to do so when evaluating the performance of small and large companies.

6 Conclusion

The purpose of the study is to investigate the increase in the value relevance of Return on Equity after distinguishing between high and low Return on Equity. In addition, the findings indicate that the model explanatory power that distinguishes between high and low ROE is higher than that with the other model.

The study's results are that the high-profit banks have a higher market value than low-profit banks, there is an association between low and high return on equity and market value, and there is an association between earnings and market value.

From the study results, the main conclusion is to highlight the importance from distinguishing between high Return on Equity from low Return on Equity in their association with market value is important, especially for small Jordanian banks. Future research can use DuPont analysis on the value relevance of return on equity by decomposing it into its three main items: equity multiplier, assets turnover, and net profit margin, to examine if they have incremental information content. In addition, this study can be applied in different sectors like industry and service.

Although some recent researchers found that the value relevance of financial information declines, literature include many researches reaching that value relevance of financial information increases. Several studies findings show that adopted International Financial Reporting Standard significantly increase the value relevance of financial information. This study is consistent with the studies that reveal an increase in the value relevance of accounting information after implementation of IFRS.

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Improving on the Markov-Switching Regression Model by the Use of an Adaptive Moving Average

Piotr Pomorski and Denise Gorse

Abstract Regime detection is vital for the effective operation of trading and investment strategies. However, the most popular means of doing this, the two-state Markov-switching regression model (MSR), are not an optimal solution, as two volatility states do not fully capture the complexity of the market. Past attempts to extend this model to a multi-state MSR have proved unstable, potentially expensive in terms of trading costs, and can only divide the market into states with varying levels of volatility, which is not the only aspect of market dynamics relevant to trading. We demonstrate it is possible and valuable to instead segment the market into more than two states not on the basis of volatility alone, but on a combined basis of volatility and trend, by combining the two-state MSR with an adaptive moving average. A realistic trading framework is used to demonstrate that using two selected states from the four thus generated leads to better trading performance than traditional benchmarks, including the two-state MSR. In addition, the proposed model could serve as a label generator for machine learning tasks used in predicting financial regimes ex ante.

Keywords Regime switching · Technical analysis · Markov model · Trading

1 Introduction

Financial markets are characterised by periods of evolving, low-volatility growth separated with a disruptive, and high-volatility contractions. These regimes can be distinguished by significant changes in asset returns, variances, and correlations, laying a groundwork for accurate detection techniques to be exploited by portfolio managers. One such detection technique is the *Markov-switching regression model* (MSR), introduced by Goldfeld and Quandt in 1973 [1], and later extended by Hamilton in 1989 [2] and Krolzig in 1997 [3], which has since become one of

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the most popular statistical methods to distinguish regime shifts in economics and finance. However, the original two-state MSR model is not ideal, as two volatility states are insufficient to describe the complexities of market dynamics, and attempts to use a three- or higher-state MSRs can suffer from instability due to overlying frequent regime switches [4], which in addition adversely impacts portfolio returns by increasing the costs of trading. Furthermore, volatility by itself is not an infallible indicator of up- or down-trending markets. This paper improves on the current state of the art by combining the two-state MSR with the use of *Kaufman's adaptive moving average* (KAMA) [5], a method that is both stable (avoiding spurious regime shift detections) and accurate in locating the times of onset of regime switches. This combination generates four detected regimes based not on volatility alone, allowing, ultimately, a focus on those two market states with the greatest trading value, namely low-variance bullish and high-variance bearish, with trading results that will demonstrate the utility of the method.

2   Background and Related Work

2.1   Two-State Markov-Switching Regression (MSR) Model

The model to be described here is also known as the *two-state Markov-switching dynamic regression model* [3] and will be used throughout this paper as a fundamental part of the proposed regime-switching model, as well as (in its unenhanced version) one of the models used for performance comparison.

The key to the MSR model's widespread use is its ability to incorporate observed characteristics of asset returns, such as asymmetries, autocorrelation, and volatility clustering [6]. This gives a way to separate the underlying process y_t into S_t states ('regimes') at times $t \in \{0, 1, \ldots, T\}$, where $S_t \in \{0, 1, \ldots, k\}$. Assuming the process y_t refers to daily log returns $\ln r_t$, the model can be specified as

$$\ln r_t = \mu_{St} + \ln r_{t-1}\beta_{St} + \sigma_{S_t}\varepsilon_t, \varepsilon_t \sim N(0, 1),$$

where μ_{S_t} is a state-dependent intercept, β_{St} is a state-dependent coefficient of lagged log returns, and σ_{S_t} is a state-dependent volatility [3]. With $S_t \in \{0, 1\}$, the governing dynamics of the underlying regime S_t are considered to follow a time-homogeneous Markov chain with fixed transition probabilities $p, q \in [0, 1]$,

$$\begin{pmatrix} p & 1-p \\ 1-q & q \end{pmatrix},$$

where

$$p = \Pr(S_t = 0 | S_{t-1} = 0), \ q = \Pr(S_t = 1 | S_{t-1} = 1). \tag{2}$$

If $(\delta, 1 - \delta)$, with $\delta = \Pr(S_t = 0) \in [0, 1]$, is the initial distribution of the Markov chain, then the model is completely specified by the vector of parameters $\theta = (p, q, \mu_0, \mu_1, \beta_0, \beta_1, \sigma_0, \sigma_1, \delta)$ [4], and the estimation of θ is performed using Gibbs sampling, a type of Markov chain Monte Carlo algorithm described in [7].

If $\hat{\theta}_t$ denotes the estimate of θ_t, then for the two volatility states $i \in \{0, 1\}$ the probabilities at time $t \in \{0, 1, \ldots, T\}$ are given by

$$p_t^i = \Pr\left(S_t = i \mid \ln r_t; \hat{\theta}_t\right), \tag{3}$$

in which $S_t = 0$ and $S_t = 1$ are the low- and high-volatility periods, respectively. $p_t^i = \Pr\left(S_t = \mid r_t; \hat{\theta}_t\right)$ estimates the probability of a low- ($i = 0$) or high ($i = 1$)-volatility regimes at time t; the higher the p_t^i, the more likely the process is persistent [4].

2.2 Kaufman's Adaptive Moving Average (KAMA)

The popularity of moving averages in trading strategies has prompted the creation of many different forms of these trend-following indicators. Some of these, such as simple moving averages, are better at smoothing the underlying price, and some, such as the zero-lag moving average, are better at minimising the lag, though these objectives cannot be achieved simultaneously. An adaptive moving average is, however, a specific class of moving average that attempts to do so, accounting for both trend and volatility factors to balance the smooth-lag issue [5]. (Note: From this point on, this paper will use the terms 'adaptive moving average', 'Kaufman's adaptive moving average', and the abbreviation 'KAMA' interchangeably.)

The calculation of KAMA begins with determining an *efficiency ratio* (ER). The ER helps KAMA identify and adapt to ever-changing asset conditions by measuring the relative speed of price movement from one period to another. Assuming a daily frequency over time $t \in \{0, 1, \ldots, T\}$, the ER is defined by

$$\text{ER}_t = \frac{M_t}{V_t}, \tag{4}$$

where

$$M_t = P_t - P_{t-n}, \quad V_t = \sum_{i=1}^{n} |P_t - P_{t-i}|, \tag{5}$$

and the momentum, M_t, is the change in closing price P over a period of length n (n-period) and the volatility, V_t, is the sum of the absolute value of daily closing price changes during an n-period. The efficiency ratio is constrained to $0 \leq \text{ER} \leq 1$, such that a significant price change as a proportion of low volatility will bring ER closer to 1, whereas a minor price change as a proportion of high volatility will yield an ER

closer to 0. In other words, values close to 1 indicate a clearly defined trend in the price, whereas values nearing 0 indicate a consolidating and directionless market.

The ER is embedded into KAMA's full formula as a part of its scaled smoothing coefficient C. Considering again the daily frequency over time $t \in \{0, 1, \ldots, T\}$, the adaptive moving average is computed as

$$\text{KAMA}_t = \text{KAMA}_{t-1} + C_t(P_t - \text{KAMA}_{t-1}), \tag{6}$$

where the scaled smoothing coefficient C over time t is expressed as

$$C_t = [\text{ER}_t(k_s - k_1) + k_s]^2. \tag{7}$$

k_s and k_l in the above are smoothing constants relevant to a pair of different (short-term and long-term) simple moving averages over n period, calculated as

$$k_s = \frac{2}{n_s + 1}, \ k_1 = \frac{2}{n_1 + 1}, \tag{8}$$

where n_s and n_1 refer to shorter and longer time windows, respectively [5].

By combining the trending aspect of moving averages and the volatility factor of the ER, KAMA is able to both identify the global price trend and to accurately locate larger turning points. Thus, the potential trader would not need to frequently switch position by buying and selling over local price swings [5]. MSR models also seek to determine the current state of the process with highest probability, in order to avoid switching states too often. However, the main difference is that KAMA is primarily used to capture the global trend, bullish, or bearish, whereas an MSR model detects disruptions in the variance of the underlying series.

2.3   Related Work

Since they were first introduced by [1], MSR models have been discussed broadly in economic literature. Their performance has been analysed on macroeconomic variables, such as GDP [2] and inflation [8], and they have been additionally applied to financial time series, such as equities [6] and foreign exchange [9].

The original two-state MSR model is, however, not optimal, for reasons discussed in the Introduction. However, as also discussed previously, extension to three-state MSR models comes at a cost, since they are deemed unstable due to their tendency to shift regimes too frequently [4]. There are also concerns about potential overfitting, as beyond the two-state model, it is necessary to pre-estimate the optimal number of states, applying each version of the MSR model to each asset in order to find the optimal number of states [10], and hoping that the same optimal number of regimes will continue in future. Finally, these multi-state MSR models do not solve the issue

of overly frequent switches—on the contrary, there is a high potential of increasing them.

However, there is another potential solution to finding a better partition of the market dynamics [11], which is to overlay the two-state model with moving averages, which method allows partitioning without frequent state switches, resulting in a four-state model in line with classic Wyckoff theory [12]. But although the model of [11] has been found to add value in equity strategies, it is constrained by the data required to calculate a necessary technical indicator, which requires period-high and -low prices. This limits application of the model to assets with a recorded history of high and low prices, even when their closing prices have been available for a much longer time. The work of this paper has taken inspiration from that of [11], replacing the custom Keltner Channels [13] in that model with KAMA, which does not require the recording of high and low prices; as will be seen in the Results section, the new model is both highly effective and applicable to a wide range of financial assets.

3   Data

Setting up the proposed and benchmark models requires daily closing price data only. There are 56 assets in total, divided into four classes: equities (24 data sets), exchange rates (FX) (13 data sets), commodities (12 data sets), and fixed income (seven data sets), with details given in Table 1. The choice of these assets is based on the extent of their use in the financial industry (for instance, major equity markets for stock indices, G10 countries for FX), to ensure there will be sufficient liquidity to minimise the risk of market manipulation. In addition to the above-mentioned assets, a cash index is also used in the trading strategy detailed later in the Methodology section. The rationale behind the use of a cash index stems from its low volatility and ever-rising trend. With the rare exception of periods of negative interest rates, such as after the financial crisis of 2008–2009, it is nearly impossible to lose while betting on cash in the longer term, which makes it a useful 'money-parking' tool.

As can be seen in Table 1, the start dates for the data sets vary, though are usually in the 1980s–1990s. The end dates are 26/03/2021 for equities, foreign exchange, commodities, and the cash index, and 08/01/2021 for fixed income. For each asset, that 85% of the data closest to the start date is used for optimisation of the KAMA model, using procedures to be described below, while that 15% of the data closest to the end date is used for out-of-sample testing.

4   Methodology

This section is constructed as follows: first, the process of combining the two-state MSR model with KAMA is described. Second, the optimisation of the KAMA component within the combined model is outlined. Third, benchmark models used

Table 1 56 assets used in portfolio construction in this work

Asset class/asset	Start date	Asset class/asset	Start date
Equities (indices)		*Commodities (futures)*	
MSCI USA	31/12/1987	Aluminium	17/05/2001
MSCI Emerging Markets	31/12/1987	Brent Crude Oil	23/06/1988
NASDAQ 100	31/12/1987	Coffee	31/12/1987
Stoxx 600	31/12/1987	Copper	06/12/1988
Eurostoxx	31/12/1987	Corn	31/12/1987
DAX	31/12/1987	Gold	31/12/1987
CAC 40	31/12/1987	Live Cattle	31/12/1987
FTSE MIB	01/01/2000	Natural Gas	03/05/1990
FTSE 100	31/12/1987	Nickel	31/12/1987
Nikkei 225	31/12/1987	Soybeans	31/12/1987
Hang Seng	31/12/1987	Sugar	31/12/1987
Shenzen Composite	06/01/2002	Wheat	31/12/1987
TSX Composite	31/12/1987	*Fixed income (ETF)*	
ASX 200	31/05/1992	US Long Bonds 7–10 Years	26/07/2002
MSCI USA Cons. Discret	31/12/1994	US Short Bonds 1–3 Years	26/07/2002
MSCI USA Cons. Staples	31/12/1994	US Ultra-Long Bonds 20 + Years	26/07/2002
MSCI USA Comm Svs	31/12/1994		
MSCI USA Energy	31/12/1994	US Treasury Inflation Protected Securities ('TIPS') Bonds	5/12/2003
MSCI USA Financials	31/12/1994		
MSCI USA Healthcare	31/12/1994		
MSCI USA Industrials	31/12/1994	USD-denominated Emerging Markets Bonds	19/12/2007
MSCI USA I.T	31/12/1994		
MSCI USA Materials	31/12/1994	US High Yield Corporate Bond	11/04/2007
MSCI USA Utilities	31/12/1994		
Foreign exchange (raw currencies)		US Investment Graded Corporate Bond	26/07/2002
AUD/Japanese Yen	31/12/1987		
Swiss Franc/USD	31/12/1987	*Supplementary (index)*	
DXY	31/12/1987	USD Cash 3-Month Rebalancing	31/12/1987
Euro/Russian Rubel	01/01/2000		
Euro/US Dollar	31/12/1987		
UK Pound Sterling/USD	31/12/1987		
USD/Australian Dollar	31/12/1987		
USD/Canadian Dollar	31/12/1987		
USD/Danish Krone	31/12/1994		

Table 1 (continued)

Asset class/asset	Start date	Asset class/asset	Start date
USD/Japanese Yen	31/12/1987		
USD/Norwegian Krone	31/12/1987		
USD/New Zealand Dollar	31/12/1987		
USD/Swedish Krona	31/12/1987		

for performance comparison are briefly discussed, and finally, the trading strategy, which assesses the tested models' abilities to separate regimes, is described.

4.1 Combining the Two-State MSR Model with KAMA

The proposed regime-switching model is initiated with a two-state MSR model to detect high- and low-variance periods for each selected asset. Considering states $S_t \in \{0, 1\}$, and the 50% level as a cut-off point for smoothed probabilities in the MSR model, this initial phase of model construction results in the separation:

- Low-variance regimes, defined as ones where the filtered probability of state $S_t = 0$ is higher than 50%.
- High-variance regimes, defined as ones where the filtered probability of state $S_t = 1$ is higher than 50%.

KAMA then works as an overlay to divide these low- and high-volatility periods into bullish and bearish regimes. However, its practical application also requires a mechanism to generate trading decisions, and for this purpose, Kaufman's adaptive moving average is embedded within a construction called the *filter* which generates a signal to enter or exit positions of interest. Over a t-day period, the filter f is computed as $f_t = \gamma \sigma (\text{KAMA}_t)$, where

$$\sigma(\text{KAMA}_t) = \sqrt{\left(\sum_{t=1}^{n} x_t^2 - \frac{\sum_{t=1}^{n} x_t}{n} \right)},$$

is the standard deviation of the change in KAMA over n days, where $n \leq t$, $x_t = \text{KAMA}_t - \text{KAMA}_{t-1}$, and the parameter γ is as discussed in the Background section.

Calculating both KAMA and the filter allows the construction of a strategy for trading in both bullish and bearish regimes:

- Bullish, hence buy, when KAMA advances above its low over a prior period of n days by a value greater than the filter.
- Bearish, hence sell, when KAMA descends below its low over a prior period of n days by a value greater than the filter.

Combining the above with the MSR model's results, the proposed regime-switching model, which we will refer to as the *KAMA + MSR* model, separates the underlying price series into four regimes:

- Low variance and bullish when the filtered probability of state $S_t = 0$ is higher than 50%, and KAMA rises above its low over a prior period of n days by a value greater than the filter.
- Low variance and bearish when the filtered probability of state $S_t = 0$ is higher than 50%, and KAMA falls below its low over a prior period of n days by a value greater than the filter.
- High variance and bullish when the filtered probability of state $S_t = 1$ is higher than 50%, and KAMA rises above its low over a prior period of n days by a value greater than the filter.
- High variance and bearish when the filtered probability of state $S_t = 1$ is higher than 50%, and KAMA falls below its low over a prior period of n days by a value greater than the filter.

However, while all four regimes are of academic interest, not all are equally valuable for trading. The second and third are likely to be less useful because in the first of these cases, the potential for profit is low, while in the second, the risk is overly high. In preliminary experiments, this was confirmed by the low Sharpe ratios obtainable during these periods. Thus, in the trading results to be reported in Sect. 5, active trading is carried out only in the first and fourth of the above-listed regimes.

4.2   Optimisation of the KAMA Component of the Model

The MSR component of the KAMA + MSR model does not require optimisation, as it is parameter-free. In contrast, the KAMA model requires the optimisation, over the training period that comprises the initial 85% of the data, of $\theta_h = (n, n_s, n_l, \gamma)$, that vector of parameters discussed in the Background section, where n is a moving window for the efficiency ratio ER and the filter f, n_s is a moving window for a short-term smoothing constant k_s, n_1 is a moving window for a long-term smoothing constant k_1, and γ is the control parameter in the filter f term.

Beginning with the initial vector of parameters θ_h, the algorithm constructs the proposed regime-switching model by overlaying the calculated KAMA on a two-state Markov-switching dynamic regression. Based on the outcome of this initial combination, the model splits each asset price into multiple periods ('segments') which are classified as being in one of the four regimes. Subsequently, the price slope (bullish vs. bearish) and log returns volatility (low vs. high variance) of each segment is computed, so that the optimised model's accuracy can be inspected. The parameter values are then adjusted to optimise performance during the training period.

The test of meaningful separation of regimes is done using a method based on K-Means clustering [14], with a two-step walk-forward cross-validation and a custom scoring function. In order to implement cross-validation, the regime slope

and volatility data is split into non-shuffled training and validation sets, whereby training is 50 and 75% of the training data set in the first and second steps, respectively, and the consecutive 25% of the training data is used for validation in both steps. The clustering ability of K-Means is employed on the sliced training sets to investigate whether the already refined regimes differ by slopes and volatilities. Given that this will be a four-state model, K-Means here assumes four clusters; the clustering algorithm additionally uses ten random initialisations of centroids, the same random seed for each model, and 300 maximum iterations per initialisation. The K-Means method then predicts clusters for the validation sets, and the generated predictions are contrasted with the model's initially chosen regime labels.

To achieve this, the KAMA parameter optimisation algorithm uses a custom function called the *misclassification score*. This scoring function groups clusters and regime labels into a 4×4 matrix in order to analyse the dominant number of detected segments (periods of time that fall into a given class) within each row and column, as in Table 2 to follow, and perform appropriate actions.

The misclassification score initially loops over rows to subtract the dominant number of segments from the row sum. Thus, in the example, in Clusters 1 and 3, since there is only one regime detected, the score is 0, which indicates lack of misclassification within this cluster. However, in Cluster 2, there are 6 segments (out of 15) whose underlying slope and volatility characteristics do not resemble the dominant label, high variance, and bearish, so the score is 6. In Cluster 4, there are two dominant labels, each mismatched (with respect to the other) with a score of 3, and we would in a case like this assign an overall score for the cluster of 3. The number of misclassifications per cluster is then summed up to indicate how many segments have been inaccurately labelled by the optimised model. The total number is finally divided by the length of the predicted dataset to form a ratio that can be compared between optimisation trials. Ideally, the final misclassification score should equal 0, representing a perfect alignment between the K-Means discovered clusters and the proposed regime-switching model, though this degree of alignment is unlikely in practice and hence the optimisation algorithm is run 50 times to find the best available vector of parameters θ_h for the training period, which are saved for use in the test period.

4.3   Benchmark Models

The most obvious candidate as a benchmark is the two-state MSR model, being a component of the proposed KAMA + MSR model; comparison of MSR with the proposed model will reveal the value of the KAMA component. Initial experimentation determined that the model of [11], developed for equities, was not effective over the full range of asset classes considered in this work. In addition, this model requires knowledge of price highs and lows, and this data was not available for the full desired training period, that stretched back into the 1980s–1990s. This model

was thus set aside. Additionally, while a three-state MSR model [15] was considered, it was found to be unstable (as discussed previously, multi-state MSR models typically have this associated difficulty) but to be effective when its three states were reduced to two, by removing that state which had medium variance, and it was in this form included in the set of benchmark models. It should be noted that the two chosen benchmark models, like the MSR component of the proposed model, are parameter-free and hence do not need a training period parameter optimisation.

4.4 Implementing a Trading Strategy for Performance Testing

The trading strategy requires an allocation of weights (adding to 100%) between the asset and cash. These are optimised over the training period (earliest 85% of the data, for each asset), by comparing the effectiveness of 1000 random weight allocations. Both annualised returns and the adjusted Sharpe ratio (ASR) [16]

$$\text{ASR}_t = \text{MAR}_t / \sigma_t^{\frac{\text{MAR}_t}{\text{abs}(\text{MAR}_t)}} \tag{10}$$

are calculated, on a per-segment basis. The adjusted Sharpe ratio is a valuable measure because it penalises negative variance especially strongly, while treating positive returns in the same manner as the standard Sharpe ratio. MAR_t in the above denotes mean excess annualised return over t days, σ is the annualised volatility, and $\text{abs}(\text{MAR}_t)$ denotes mean excess annualised return over t days calculated from only positive excess returns. In this work, mean excess annualised returns equal mean annualised returns, as for simplification the risk-free rate is set to 0.

Inevitably, the asset returns are diminished by two-way transaction costs, i.e. ones incurred during both buying and selling. Table 3 to follow, lists the costs assumed in this work, as given in [17] (these values being considered in the industry to be conservative and useful estimates of costs):

Table 2 Example grouping matrix; matrix entries denote the number of detected segments

Cluster	Low variance/bullish	Low variance/bearish	High variance/bullish	High variance/bearish
Cluster 1	1	0	0	0
Cluster 2	0	5	1	9
Cluster 3	0	0	2	0
Cluster 4	3	0	3	0

The differing costs between the classes of assets stem from the sizes of these markets and the potential influence a trader may have on them. For instance, it is difficult to have any significant impact on foreign exchange, unless the trader is an intervening central bank. Additionally, since in this research raw currencies are traded, there are no brokerage commissions, and the only cost remaining is the bid-ask spread. In the case of commodities, the trader must account for brokerage fees, as well as the bid-ask spread on futures contracts. However, only on rare occasions would the trade be large enough to significantly move the entire market. For equity indices and fixed income ETFs, the full cost is taken into consideration, since on top of commissions and the bid-ask spread, there is a potential market impact.

The KAMA + MS-DR model is finally compared to the benchmark models, in relation to both annualised returns and ASR, via a 'winning score ratio', WS, calculated as

$$\text{WS} = \frac{\left(Z_{\text{winner}} - Z_{\text{runner-up}}\right)}{Z_{\text{winner}}}, \tag{11}$$

where Z_{winner} refers to the model with the highest annualised returns or adjusted Sharpe ratio, and $Z_{\text{runner-up}}$ refers to the second-best method. By computing the ratio in the above equation, it is possible not only to indicate the winner, but also by how much better it is relative to its closest opponent. After the winning score ratio has been obtained for both weighted annualised returns and the adjusted Sharpe ratio, the two resulting ratios are combined as an average to reveal the model with the most effective risk-reward approach to detecting financial regimes. This combination is done as an equally weighted average; depending on an investor's preference either returns or Sharpe ratio could be more highly weighted, but a ratio of 1:1 is the most reasonable assumption in the absence of such a stated preference.

5   Results

The results of using the KAMA + MSR and two benchmark regime detection models within the out-of-sample test periods (last 15% of the data, for each asset considered) are presented in Table 4. It is clear that the proposed model performs strongly, in each of the two scoring metrics, for equities and fixed income. In the case of equities, the notably higher adjusted Sharpe ratio for KAMA + MSR points at a good balance between returns and volatility, which suggests a solid blend between the use of trend in predicting regime switches within KAMA and the use of variance for this purpose in Markov-switching regression. It is also worth pointing out that the proposed model achieves such results regardless of the equity region. Whether it is the USA, Europe, or Emerging Markets, the KAMA + MSR model seems to be resistant to both global and local shocks (though more indices, in particular from the Emerging Markets region, could strengthen this argument).

Table 3 Two-way (buy, sell) trading costs for each asset class

Asset class	Brokerage commissions (%)	Bid-ask spread (%)	Market impact (%)	Total cost (%)
Equities	0.14	0.13	0.53	0.8
Currencies	0	0.13	0	0.13
Commodities	0.14	0.13	0	0.27
Fixed income (ETFs)	0.14	0.13	0.53	0.8

Table 4 Out-of-sample trading performance results, in which *MSR 2S* refers to the two-state MSR model, *MSR 3S → 2S* to the three-state MSR model converted to two-state form, and *KAMA + MSR* to the regime detection model proposed in this work

Average winning score ratio: Highest adjusted Sharpe ratio			
	MSR 2S	MSR 3S → 2S	KAMA + MSR
Equities	0.03	0.03	**0.33**
Commodities	**0.25**	0.24	0.13
FX	0.09	**0.29**	0.15
Fixed Income	0.06	0.01	**0.22**
Average winning score ratio: highest weighted annualised returns			
Equities	0.08	0.03	**0.10**
Commodities	0.02	0.12	**0.27**
FX	**0.22**	0.02	0.19
Fixed Income	**0.25**	0.00	0.18
Combined average winning score ratio			
Equities	0.11	0.06	**0.43**
Commodities	0.27	0.35	**0.40**
FX	0.31	0.31	**0.35**
Fixed Income	0.31	0.01	**0.40**

Bold signifies the highest scores achieved in each asset class

Results for commodities and foreign exchange are more mixed, as can be seen from the table. However, after combining the two winning scores, the KAMA + MSR model can be seen to have the overall best performance of those models tested, with an especially strong result, again, for equities and fixed income (Table 4).

6 Discussion

This paper presented an enhancement of the two-state Markov-switching regression model (MSR) by the addition of Kaufman's adaptive moving average (KAMA),

resulting in a new model, which we term the KAMA + MSR model. Unlike multi-state MSR models, which seek only to subdivide variance (e.g. for a three-state MSR, into low, medium, and high variance), and which have proven both unstable and to result in large trading costs, KAMA + MSR seeks to instead identify regimes as combinations of variance and market trend (bull or bear), with an accurate timing of onset of each state, and without overly frequent regime switches. The proposed model initially discovers four states, of which two combinations (low-variance bullish and high-variance bearish) were used actively in the trading strategy, with the remaining two (low-variance bearish and high-variance bullish) being periods, in which it was deemed wisest to refrain from action. Due to the use of both variance and trend measures to detect regime switches in the KAMA + MSR model, it proved able to outperform, on average, the comparison models in each asset class considered. However, we note that such an outcome could in principle be due to the strategy itself (asset vs. cash), and hence intend to implement alternative strategies in future work.

There are three further ways in which the work of this paper could be extended. First, and most importantly, though the proposed model overall outperformed the benchmark models, this outperformance was less pronounced for foreign exchange and commodities, and it is possible that an alternative to Markov switching could do better in combination with KAMA in these cases. Second, as already mentioned, the current trading strategy discards two of the four discovered regimes as being likely to be unprofitable; however, more complex trading strategies, for example, using derivatives-based hedging, could potentially make use of these regimes. Finally, and most importantly for future work, the KAMA + MSR model's ability to smoothly and accurate distinguish regimes will allow it to be used as a regime label generator for machine learning tasks in which the aim is to predict such regimes ex ante.

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Elephant and Ant: Do Equity Investors Care About Firm's Carbon Emission?

Yangmengchi Ding

Abstract   This paper investigates whether investors in the US market are concerned about corporate carbon emissions. We find that carbon emissions can predict future stock return only for firms in the high-emission industries. The analysis method used continues the single ranking method of Fama French. The results indicate that investors care more about carbon emissions for dirty companies. To provide further evidence for investors' attention channel, we find that the relationship between carbon emissions and future stock returns is significant only after 2016, when the Paris Agreement was signed and investors began to pay attention to climate change.

Keywords Carbon emissions · Stock return · Industry code (SIC) · Investor attention

1   Introduction

Global climate change has a great impact on the environment, economy and human life all over the world. According to CNBC, an example is hurricane Harvey, which caused more damage because the global warming [1]. From 2015 to 2016, the impact of El Ni ñ o on the world reached its peak, which causes a global food shortage seriously affects the food supply [2]. Therefore, climate change had a massive impact on society in the world. Based on the IPCC, the world faces unavoidable multiple climate hazards over the next two decades with global warming of 1.5 °C (2.7 °F) so that risks for society will increase, including infrastructure and low-lying coastal settlements [3]. More and more weather extremes are occurring simultaneously, causing cascading impacts that are increasingly difficult to manage, which have exposed millions of people to acute food and water insecurity, especially in Africa, Asia, Central and South America, on Small Islands and in the Arctic.

Under this circumstance, climate finance has become a topic of particular concern in the case of climate change. This paper investigates whether investors in the US

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market are concerned about corporate carbon emissions and what is the asset pricing implications. It is important not only for the financial market but also for the mitigation actions. For example, Barack Obama has spoken at the opening of the United Nation Conference on Climate Change (COP21), "Nearly 200 nations have assembled here this week–a declaration that for all the challenges we face, the growing threat of climate change could define the contours of this century more dramatically than any other [4]." In addition, the World Bank's climate change fund management unit is home to climate finance initiatives that deliver innovative and scalable climate and environmental action, with more than \$5 billion in capital for these initiatives. According to the plan of the World Bank, the first task of the above measure is to establish partnerships to develop new financial instruments for low carbon and climate change adaptation development [5]. Another task is to establish a supportive policy and regulatory environment to help reduce capital costs and remove project barriers, which may also promote private sector capital to finance and scale up climate action. Therefore, developing climate finance has become a meaningful way to achieve sustainable development.

At present, the financial industry, which occupies the core position of the modern economy, plays an essential role in solving the problems of environmental deterioration and resource shortage and maintaining sustainable economic development. Therefore, climate finance has become a hot topic at present. The one-sided pursuit of high-speed economic growth has led to excessive industrialization and urbanization, excessive consumption of resources and deterioration of the environment. Due to the above news and the literature (e.g., IPCC), it can be seen that climate finance has become an essential topic in financial research and the focus of various countries and institutions. In this case, climate change has gradually entered the attention of investors and may pay more and more attention. Furthermore, global warming caused by carbon emissions is a fundamental environmental problem in climate change. Here, enterprises with large emissions are compared to elephants, while enterprises with small emissions are ants. Then, a question needs to be explored here: whether investors pay attention to the carbon emissions of their investment enterprises, and under what circumstances, such as time, will investors care more about environmental issues?

In this paper, we first find that, in general, the market stock return is not sensitive to carbon emissions. For example, we divide all the data into five groups according to carbon emissions and use the data with each group for portfolio sorting. After the calculation and analysis, we did not find the relationship between the top and bottom portfolio, which seems to suggest that investors do not care about carbon emissions when investing in stocks in the market. Here, we need to use data to illustrate that in the first group, the average return of the portfolio is 0.96%, and the return of the fifth portfolio is 0.84%, where the difference is 0.12% and the t-value is -0.459. The above data shows that the relationship between stock return and carbon emissions is insignificant.

The above conclusion is contrary to what we hear from the news or investor forums. Therefore, we are wondering do investors really not pay attention to the carbon emissions of enterprises? Is it possible that investors only pay attention to

the carbon emissions of some enterprises? For example, investors ignore the carbon emissions of some clean industries, financial industries, sales industries, software technology and other industries because the carbon emissions of their industries are relatively negligible compared with those of high-carbon emission industries such as power, transportation and mineral processing. Therefore, we consider that when investors invest, they only care about enterprises in industries with high-carbon emissions. Thus, when analyzing the top 30% of enterprises with relatively large carbon emissions separately, it is expected to find that investors are modestly very concerned about their carbon emissions of these enterprises. The first 30% of enterprises in high-carbon emission industries also continue to use the method of portfolio sorting divided into five groups according to carbon emissions. From the results obtained, the average return of the first portfolio is 1.5%, the average return of the fifth portfolio is 0.6%, the gap between them is -0.9% and the t-value is -2.66. Then, in this group of data analyses of high-carbon emissions, we can get obvious results. The relationship between market stock return and enterprise carbon emissions is significant, showing that for enterprises in industries with high-carbon emissions, investors will pay great attention to the changes in their carbon emissions when investing in them.

We expect that the above relationship can only be seen in large companies, but small companies should not. Therefore, we reanalyzed the above analysis for small companies. As we expected, investors are not more concerned about the effect of carbon emissions. In details, if we classify carbon emissions of the enterprises involved in data from large to small, we can extract the enterprises in the range of 30% before and after. Therefore, after the previous analysis of these enterprises, the conclusion is that for enterprises with significant emissions, that is, the top 30% after ranking, investors are relatively concerned about the carbon emissions of enterprises in industries with high-carbon emissions. However, in the last 30%, that is, the enterprises with smaller carbon emission industries, investors do not pay much attention to the carbon emission of enterprises in their industry. As a result, there is no significant relationship between the profit and the bottom of the market. For example, the average return rate of the first portfolio is 0.7%, the average return rate of the fifth portfolio is 0.9%, the gap between them is 0.2% and the t-value is 0.659.

For the previous hypothesis experiment, more investors pay attention to carbon emissions, which leads to different market returns of different carbon emissions. Therefore, we expect that when investors pay more attention to the issue of enterprise carbon emissions, the relationship between it and market returns will be more substantial. Furthermore, the Paris Agreement is the world's most significant and most concerned international agreement on environmental protection such as carbon emissions. Therefore, before and after the signing of the Paris Agreement is the critical time node to compare the intensity of investors' attention to the impact of enterprises on the environment.

To provide further support for our investors' attention channel, we conduct a subsample analysis. On December 12, 2015, after two weeks of negotiations, the United Nations Climate Change Conference finally reached a landmark Paris Agreement: it marks the beginning of a new global climate order [6]. On the same day, leaders of more than 170 countries gathered at the United Nations headquarters in

New York to jointly sign the Paris Agreement on climate change, promising to control the global temperature rise within two degrees [6]. According to Reuters, on June 26, 2019, a group representing 477 investors who managed more than \$34 trillion in assets worldwide sent an open letter to "governments around the world," to suggest that governments took urgent action to achieve the objectives of the Paris Agreement. Another example is about institutional investors. The Asian infrastructure investment bank (AIIB) announced that all its investment projects will be entirely consistent with the relevant objectives of the Paris Agreement on July 1, 2023 [7].

Therefore, we conject that after the signing of the Paris Agreement in 2016, investors would pay more attention to enterprises' environmental protection and environmental protection measures. Thus, the focus on corporate carbon emissions will naturally be much higher than before 2016. On this basis, it can be inferred that if the enterprise market data and carbon emission data before and after 2016 are analyzed, it is expected that the market performance of industries or enterprises after 2016 will be closely related to carbon emission compared with that before 2016. The actual results show that the relationship between the market performance of industries and enterprises is very close compared with that before 2016.

We divide the sample data into two sections according to the time of signing of the Paris Agreement. Using the same analysis, divide the two data sections into five groups for portfolio sorting. We hope to get that all the results in the second paragraph, that is, in 2016, are significant. After data analysis, it is found that the data can indeed be the projection before we determine it. According to the data of the results obtained, before 2016, the average rate of return of the first portfolio was 1.2%, the average rate of return of the fifth portfolio was 0.7%, the gap between them was -0.5% and the t-value was -1.50. After 2016, the average return of the first portfolio is 2.1%, the average return of the fifth portfolio is -0.01%, the gap between them is about -2.5% and the t-value is -2.14. It can be seen that before 2016 is not significant, but the economic reputation was much smaller. However, after 2016, market return and enterprise carbon emissions have become a prominent and significant relationship. In this article, we conduct two robust checks. First, we take equal-weighted, compared with value-weighted analysis, as the primary robust test. After we finished all the equal-weighted data analysis and data, we found that the conclusion was consistent with the main conclusion. This result shows that our calculation and analysis result is not dominated by individual large companies but a universal conclusion.

Our paper contributes to the literature from several aspects. First, our paper contributes to the literature on carbon emissions and stock returns. The conclusions of previous literature are mixed. Firstly, according to the research results of Patrick and Marcin (2021), according to the global carbon premium, institutional investors pay more attention to their carbon emissions, especially in 2015 [8]. In addition, in the study of concern about global warming, Choi et al. (2019), the results show that investors are less sensitive to temperature change and global warming, and their inference can conclude contrary to the previous literature [9]. This paper contributes to this series of literature by showing that investors only care about the carbon emissions of some enterprises. We found that investors only pay attention

to the carbon emissions of enterprises with significant emissions. Take time as the dividing point, classify the enterprise carbon emission and make specific conclusions on the enterprise carbon emission and enterprise market performance. According to the different situations of different industries and other times, whether investors are concerned about the company's carbon emissions can be genuinely and in detail. It can be concluded that this result gives the relationship between past market performance and enterprise carbon emissions and provides some preliminary basis for the existing market evaluation system. Finally, it lays more foundation for predicting future market performance and trends.

Our paper also contributes to the literature on inventors' limited attention. It is also described in the previous literature. In the article named causes and demands of limited attention, the limited attention is defined as the limited speed at which the brain processes information [10]. Under certain circumstances, all animals will be affected by attention restriction and change according to the living environment. According to SA and JF's (2005) [11], in making many markets: limited attention and the allocation of effort in securities trading, it is also clearly explained that the results of the research on the experts of the New York Stock Exchange show that limited attention enables the experts studied to allocate their energy to their most active stocks during the increase of activities, resulting in a reduction in the frequency of price improvement. The transaction cost of the remaining allocated shares increases. This effectively proves that investors in stock trading are affected by limited attention. In addition, in S and WY (2019), stock ranking and some media data are used to analyze investors' concerns and the conclusion is undeniable—enterprises with high ranking and high frequency of media discussion and publicity [12]. Our paper contributes to the literature by showing that, we found that investors only paid attention to the carbon emissions of large emission enterprises, and investors began to pay more attention to carbon emissions only after carbon emissions became a hot spot. After the Paris Association, environmental protection and global carbon emissions gradually attracted worldwide attention and gradually became a hot spot.

2 Data

The stock return data in the paper is from Center for Research of Security Prices (CRSP). The CRSP is a widespread database when researchers study the securities prices and the other data. In the paper, the database named CompuStat provides fundamental data that covers the fundamentals and market data of more than 32,500 listed companies traded on exchanges in the USA or Canada and provides more than 5000 data items [13]. It can help colleges and universities conduct in-depth academic research by obtaining ultra-long annual data since 1950, quarterly data since 1962 and daily price data since 1984 [13]. The article's necessary data is about the financial data such as total debt and retained earnings.

In the article, the ESG data is from S&P Global Trucost. ESG data is the leading data in this database, and it is also the data on carbon emissions mainly used in

this paper. ESG is simply a comprehensive indicator of the environment, society and corporate governance. Unlike traditional financial indicators, ESG examines the company's quality from the perspective of the environment, society and corporate governance. It is a new enterprise evaluation method. According to Trucost 2022, ESG investment originates from social responsibility investment (SRI) and is the three most important factors in social responsibility investment. ESG investment originated in Europe and America. The first ESG fund in the USA was established in 1971, and the first ESG index was established in 1990, and in 2006, the United Nations established the principle of responsible investment organization [14]. In the early stage of its establishment, more than 80% of the signatories came from Europe and America [14]. Therefore, ESG investment was widely recognized in Europe and America–at that time. Through the preparation and release of corporate social responsibility reports, enterprises can systematically sort out and analyze various responsibility risks and promote the improvement and improvement of internal management; it is conducive to the implementation of the sustainable enterprise strategy in all work; it is conducive to meeting the needs of various stakeholders and improving the corporate image and influence [14]. According to the official information of Trucost 2022, the environmental data of the Trucost database measures the environmental impact of more than 15,000 companies in crucial aspects. These data can be used to assess environmental costs, identify and manage environmental and climate risks and conduct peer and portfolio analysis from a climate and environmental perspective. In addition, we can use Trucost environmental data for ESG data integration, report the climate performance and exclusion screening of the portfolio and evaluate the climate risk exposure of the portfolio.

In the Trucost database, the data used in this paper is carbon emission data. All institutions follow the standards for measuring the company's carbon emissions under the greenhouse gas agreement. From the source, carbon emissions include direct emissions from production, indirect emissions from energy use and emissions from the company's business activities such as product use and waste treatment. The measurement of carbon emissions includes three dimensions:

Scope 1, the direct emissions of enterprises owned or controlled by the company include the carbon emissions caused by fossil fuels used in production [14].

There is Scope 2, which is the indirect emission caused by the purchased heat, steam and electricity consumed by the company [14].

Scope 3 refers to the emissions caused by the company's operations and products but not from the company's control, including the emissions from the production of purchased materials, product use, waste treatment and outsourcing activities [14].

For each caliber, the total amount (TOT), increment and emission indicators of carbon emission are counted. In addition, some indicators are supplemented according to the data provided by the Trucost, including carbon direct and indirect, which corresponds to 1/2 of the scope. However, the scope is more comprehensive, and GHG is direct and indirect, which measures the impact of the company's direct and indirect carbon emissions on the environment and is measured in US dollars.

We choose US equity market as our testing venue for several reasons. First of all, the USA has ranked first and second in the world in carbon emissions for 30 years, and

its per capita emissions are also the largest. And the USA has always been the most active in the United Nations and the world. In addition to the change in the policy on carbon emissions under President Trump. But overall, the countries with the largest average policies and publicity on carbon emissions. This is why the analysis of the impact of carbon emissions on stock return is dominated by the US market.

In addition, the Wall Street stock market in the USA is the most influential stock market in the global stock market. First of all, it is the largest stock market. The US stock market has a great influence on the world stock market and the whole world economy. One of the most important reasons is that the volume of the US stock market, measured by amount, is the largest in the world. In the US wealth ranking, the world's 500 largest enterprises are announced every year, such as general motors, Siemens, Microsoft group, Wal Mart and so on. Most of the world's top 500 large enterprises are American and are listed on the Wall Street stock market in the USA. Moreover, the businesses of these companies are all over the world. Their trends, profitability and the rise and fall of stock prices will affect the rise and fall of global stock prices, as well as the global economy and employment. Finally, the US stock market is a global investment capital, including many investment funds, individual investors, group investors and so on. The US stock market brings together almost all the funds in the world. Every move of the US stock market is important and has attracted the attention of investors all over the world.

One is the hegemonic position of the US dollar. Whether after the Bretton Woods system or the world oil crisis, the US dollar has always been in the hegemonic position and has not been shaken. Because the exchange rate in each period fluctuates very much, it is very complex to not convert the dollar to each currency in each period, which will cause a lot of inaccuracies in data and have a great impact on the content analyzed in this paper.

3   Carbon Emissions and Stock Return

The results of this paper mainly use portfolio sorting as the primary analysis method to combine the company's financial report data, market stock return and carbon emissions with seeing the relationship between the environment and stock return. First, the CUSIP and PERMNO numbers need to be matched. After matching these two elements, the three data can be effectively combined. After combining the three data, the data mainly focusing on the company's financial report is formed, and six data on carbon emission are added, including carbon emission scope 1–3. Based on the above data, each of the above carbon emission data is divided into ten groups and sorted by size. Then use the absolute value of the total number of shares in the issued market and multiple shares to obtain the company's market value, and then calculate the company's market value at the end of December in monthly units. Here, set the annual financial report time in June of each year, so it is necessary to calculate the data from June of N years to July of N + 1 year. This forms a year's data. Based on this year's data, the value-weighted return and equal-weighted return of each month are

made. The two returns of each month are required to find the difference between the maximum and minimum values, which is named dif. Finally, find the average value of the data in value-weighted return and equal-weighted return and *t*-test. The results can analyze whether carbon emissions impact the return of stocks. Before portfolio sorting, the conversion between CUSIP and PERMNO is needed, which is helpful for later merging. This portfolio sorting needs to perform separate data analysis for each scope. Finally, the definition of a fiscal year is also important, because first of all, a standard is artificially formulated that is, the company will release the financial report in June of each year, and the subsequent July will be an entire fiscal year.

After the above demonstration and data analysis, it can be seen that investors do not care about enterprise carbon emissions. In other words, carbon emissions have nothing to do with the return on investment, but is it true. In order to further study the relationship between carbon emissions of investors and invested enterprises, we also need to deepen the details of the research and integrate the data. Then, for the element of enterprise carbon emissions, the industry differentiation of enterprises has become the primary element. The reason is that each industry has different average emissions, and due to different business operations and product ranges, the carbon emissions of some enterprises are enormous and may continue to increase under some conditions of economic development in the future. On the contrary, some types of industries are similar to the tertiary industry, that is, the carbon emissions of the service industry are small compared with some energy industries. Such a contrast gap creates inaccuracy in the first part of the analysis (Table 1).

This paper mainly uses portfolio sorting as the primary analysis method to combine the company's financial report data, market stock return and carbon emissions to see the relationship between the environment and stock return. First, the CUSIP and PERMNO numbers need to be matched. After matching these two elements, the three data can be effectively combined. After combining the three data, the data mainly focusing on the company's financial report is formed, and six data on carbon emission are added, including carbon emission scope 1–3. Based on the above data, each of the above carbon emission data is divided into ten groups and sorted by emission size. Then, use the absolute value of the total number of

Table 1 Carbon emission

	Carbon emission					
	Low	1	2	3	High	Dif
Scope#1	0.0096**	0.0119***	0.0101**	0.0113***	0.0084***	−0.0012
	(2.0973)	(2.7190)	(2.2234)	(3.0946)	(2.7369)	(−0.4587)
Scope#2	0.0086**	0.0121***	0.0099**	0.0107***	0.0093***	0.0007
	(2.2274)	(3.0065)	(2.3883)	(2.7120)	(2.7176)	(0.3831)
Scope#3	0.0090**	0.0102**	0.0112***	0.0104**	0.0094***	0.0004
	(2.0163)	(2.3191)	(2.6891)	(2.5200)	(2.8415)	(0.1823)

1% is ***, 5% is **, 10% is *

shares in the issued market and multiple shares to obtain the company's market value, and then calculate the company's market value at the end of December in monthly units. Here, set the annual financial report time in June of each year, so it is necessary to calculate the data from June of N years to July of N + 1 year. This forms a year's data. This year's data shows the value-weighted return each month is made. The two returns of each month are required to find the difference between the maximum and minimum values, which is named dif. Finally, find the average value of the data in value-weighted return and equal-weighted return and t-test. The results can analyze whether carbon emissions impact the return of stocks. Before portfolio sorting, the conversion between CUSIP and PERMNO is needed, which is helpful for later merging. This portfolio sorting needs to perform separate data analysis for each scope. Finally, the definition of a fiscal year is also important because, first of all, a standard is artificially formulated, that is, the company will release the financial report in June of each year, and the subsequent July will be an entire fiscal year.

For the problem of industrial carbon emissions, the most specific industry classification standard of the SIC code is used here. SIC code is the abbreviation of the standard industrial classification code, which consists of four digits and is established by the US government to determine the main business of commercial institutions. Facilitate data collection, description and analysis to enhance uniformity and comparability, and statistical data are provided by various federal government agencies, including state agencies and private organizations. The classification covers all economic activities: agriculture, forestry, fisheries, hunting and killing, mining, construction, manufacturing, transportation, communications, electricity, natural gas and health services, wholesale trade, retail trade, finance, insurance and real estate, individuals, enterprises, professions, repair, entertainment and other services, public administration [15]. SIC code is four digits, and its main components are divided into two parts. The first two digits are the first industry classification codes, and the last two digits are the second industry codes, that is, the codes of specific or subdivided industries under the first industry. The first two digits, the first industry code, are mainly used here. The first industry code ranges from 01 to 99, the order of enterprise carbon emissions from large to small. Therefore, the selected interval is set as SIC code, and the first 30 and the last 70 of the first two digits are compared. The reason for selecting the head and tail is that the contrast difference of average carbon emissions of enterprises at both ends is the largest. Under the substantial contrast difference, the purpose of analyzing the correlation between enterprise carbon emissions and market stock return can be achieved. The carbon emissions of enterprises in the top 30 of the SIC code are relatively large—Elephant—and those in 70 are relatively small—Ant. By analyzing these two groups, respectively, we can get where investors pay attention to enterprise carbon emissions: the relationship between investment return in market performance or stock price and enterprise carbon emissions.

This table reports the average and T-values of carbon emissions of industries with small and large carbon emissions in the USA and takes the SIC code as the main test condition for analysis in value-weighted. We analyzed the company data of the US stock market in the past 70 years and divided it into two samples using SIC code. Every company has a SIC code. Each company's industry can be determined

Table 2 SIC industry carbon emission

	Carbon emission					
	Low	1	2	3	High	Dif
Industry small	0.0070	0.0103**	0.0103**	0.0088	0.0086***	0.0016
	(1.6003)	(2.2872)	(2.2604)	(1.4456)	(2.6374)	(0.6597)
Industry large	0.0149***	0.0111***	0.0100***	0.0079***	0.0057	−0.0092***
	(3.3697)	(3.0969)	(3.6683)	(2.7170)	(1.5117)	(−2.6577)

1% is ***, 5% is **, 10% is *

according to different SIC codes, so SIC codes can be used to distinguish two groups of data. In the data, SIC is taken as the standard. In the first group, 1–30 industries with large displacement in SIC code and 70–99 industries with small displacement in the second group. At the end of December every year, we first select the company's market share price and then find out the number of shares issued by each company. Finally, the company's market value is calculated by multiplying the share price by the number of shares issued. Then, the market value of companies with low-carbon emissions in each US market is ranked by five single portfolios. The ranking continues the single ranking method of Fama French and adds the element of large carbon emission companies with SIC code as the test standard. In parentheses are the statistics of the *t*-value. Our sampling period is 1950e2016*** and * * * are 10%, 5% and 1%, respectively.

In Table 2, the significant level of carbon emissions starting from the SIC number of the industry between 01 and 30 is functional, which means that the stock return of the industry in this range is significantly related to carbon emissions. The maximum and minimum enterprise carbon emissions of the data obtained in this SIC range are −0.009, and the *t*-value is −2.65. On the contrary, the *t*-value of carbon emission and return in the range of SIC code 70–99 is 0.659; there is no significant correlation between carbon emission and stock return. Therefore, the relationship between stocks and carbon emissions is relatively weak. In other words, there is no result to explain its relationship. According to the top-down analysis results of SIC industry data on the carbon emission industry, the results show that investors only care about companies in high-carbon emission industries.

4   Paris Agreement and Investors Attention

After analyzing the relationship between carbon emissions, stock returns and their value by industry segmentation, the time interval is added to the analysis process as a main additional analysis element. First of all, as described in the previous analysis, the range of data used in this paper spans 70 years. Many things can analyze the relationship between carbon emissions and the market in such an extended period. So the first thing to be put forward here is the Paris Agreement of 2015. On December

12, 2015, nearly 200 parties to the United Nations Framework Convention on climate change reached the Paris Agreement at the Paris climate change conference [16]. This is the second legally binding climate agreement after the Kyoto Protocol, which has made arrangements for global action against climate change after 2020. According to regulations, the Paris Agreement will enter into force on the 30th day after the date of deposit of instruments of ratification, acceptance, approval or accession by at least 55 parties to the United Nations Framework Convention on climate change (whose greenhouse gas emissions account for at least about 55% of the total global emissions) [16]. On April 22, 2016, the high-level signing ceremony of the Paris Agreement was held at the United Nations headquarters in New York. UN Secretary-General, Ban Ki-Moon, announced that on the first day of the opening for signature of the Paris Agreement, a total of 175 countries signed the agreement, setting a record for the most significant number of signatories on the first day of the opening for signature of international agreements [17]. "We promise to control the global temperature rise within two °C," this is the famous Paris Agreement, so why take the Paris Agreement as the primary time dividing line? First of all, the Paris Agreement is a legally binding multilateral consensus document consistent with the Kyoto protocol. The agreement enters into force only when it is signed by at least 55 participating countries and accounts for more than 55% of global emissions [18]. After the agreement enters into force, the contents stipulated in the text of the treaty will be legally binding on all parties unless the parties decide to withdraw. After reading through the agreement's text, we find that most of them are procedural provisions, based on establishing broad, long-term goals and focusing on how to achieve these goals; countries take differentiated actions based on the principles of common but differentiated principles and respective capabilities.

All countries must formulate and publish long-term strategies for low-emission growth; submit a low-carbon strategy for 2050 and beyond to the Secretariat by 2020 [17]. This is different from the Kyoto Protocol, which has a strong legal binding force. In addition, one of the highlights of the Paris Agreement is that three long-term goals, including global temperature rise, adaptation and funding, have been established for the first time [17]. First, the global average temperature rise should be controlled below two °C above the pre-industrialization level, and efforts should be made to limit the temperature rise to 1.5 °C above the pre-industrialization level. Second, improve the ability to adapt to the adverse effects of climate change and enhance climate resilience and low greenhouse gas emission development that does not threaten food production; The third is to make the capital flow conform to the path of low greenhouse gas emission and climate-adaptive development. These contents fully illustrate the importance of the Paris Agreement. After the Paris Agreement, global warming, carbon emissions of each country and other elements have been introduced into the path of economic, scientific and technological development. Therefore, it can be said that since the signing of the sub-agreement, investors in various countries began to pay attention to enterprise carbon emissions. Then, by comparing the time before and after 2016, we can analyze whether investors begin to care about carbon emissions after 2016, that is, whether the relationship between carbon emissions and the stock market is apparent (Table 3).

Table 3 SIC industry carbon emission before 2016

	Carbon emission					
	Low	1	2	3	High	Dif
Industry large	0.0120	0.0091	0.0088	0.0064	0.0065	−0.0055
	−2.8212	−2.5986	−2.9981	−2.0658	−1.6499	(−1.4994)
Industry small	0.0131	0.0119	0.0094	0.0123	0.0075	−0.0056
	(2.5775)	(2.3811)	(1.9727)	(2.4858)	(1.9563)	(−1.5463)

1% is ***, 5% is **, 10% is *

This table reports the average and *T*-values of carbon emissions of industries' carbon emissions in the USA before 2016 and takes the SIC code as the main test condition for analysis in value-weighted. We analyzed the company data of the US stock market in the past 70 years and divided it into two samples using SIC code. Every company has a SIC code. Each company's industry can be determined according to different SIC codes, so SIC codes can be used to distinguish two groups of data. In the data, SIC is taken as the standard. In the first group, 1–30 industries with large displacement in SIC code and 70–99 industries with small displacement in the second group. Analyze the data after the 2016 Paris Agreement. At the end of December every year, we first select the company's market share price and then find out the number of shares issued by each company. Finally, the company's market value is calculated by multiplying the share price by the number of shares issued. Then, the market value of companies with low-carbon emissions in each US market is ranked by five single portfolios. The ranking continues the single ranking method of Fama French and adds the element of large carbon emission companies with SIC code as the test standard. In parentheses are the statistics of the *t*-value. Our sampling period is 1950e2016*** and * * * are 10%, 5% and 1%, respectively.

The analysis results show that before 2016, the return on investment and stock price is not affected by the enterprise's carbon emissions, and the relationship coefficient between them does not show an obvious connection. The data of the top 30 enterprises with high-carbon emissions in the SIC code in Table 4 shows that the difference between the highest and lowest data is −0.5%, and the *t*-value is −1.49. The *t*-value of enterprises with lower carbon emissions in the latter 30 is −1.54. This means that before 2016, investors in most markets do not pay attention to the carbon emissions of enterprises.

This table reports the average and *T*-values of carbon emissions of industries' carbon emissions in the USA after 2016 and takes the SIC code as the main test condition for analysis in value-weighted. We analyzed the company data of the US stock market in the past 70 years and divided it into two samples using SIC code. Every company has a SIC code. Each company's industry can be determined according to different SIC codes, so SIC codes can be used to distinguish two groups of data. In the data, SIC is taken as the standard. In the first group, 1–30 industries with large displacement in SIC code and 70–99 industries with small displacement in the second group. Analyze the data after the 2016 Paris Agreement. At the end of

Table 4 SIC industry carbon emission after 2016

	Carbon emission					
	Low	1	2	3	High	Dif
Industry large	0.0213	0.0148	0.0092	0.0122	(0.0001)	(0.0215)**
	(1.1471)	(1.0142)	(1.0026)	(1.2092)	(−0.0101)	(−2.1439)
Industry small	0.0235	0.0179	0.0151	0.0151	0.0132	−0.0103
	(1.5008)	(1.2960)	(1.5469)	(1.2408)	(1.0735)	(−1.3946)

December every year, we first select the company's market share price and then find out the number of shares issued by each company. Finally, the company's market value is calculated by multiplying the share price by the number of shares issued. Then, the market value of companies with low-carbon emissions in each US market is ranked by five single portfolios. The ranking continues the single ranking method of Fama French and adds the element of large carbon emission companies with SIC code as the test standard. In parentheses are the statistics of the t-value. Our sampling period is 1950e2016*** and * * * are 10%, 5% and 1%, respectively.

Whether it is a high-carbon emission industry or a low-carbon emission industry, the market response to its carbon emissions is weak. However, after 2016, the Paris Agreement has given new significance to enterprises' carbon emissions and has gradually become one of the essential elements and standards for formulating investment plans and plans. After 2016, the data of high-carbon emission enterprises in the top 30 of the SIC code in Table 4 shows that the difference between the highest and lowest data is −2.1%, and the t-value is −2.14. The t-value of enterprises with lower carbon emissions in the last 30 is −1.39. From the data analysis results, there is a good correlation between the company's carbon emissions and the market return after 2016, which confirms that investors begin to pay close attention to the company's carbon emissions after 2016, which will affect the trend of investment funds and ultimately the market performance. The performance of stocks in the market is related to the company's carbon emissions.

5　Robustness Checks

The above paper mainly uses the method of value weight to analyze all the data to get the relationship between the carbon emission of listed enterprises and market data or performance, to explain or clarify the attention and attention of investors to the carbon emission of invested enterprises. However, in the existing research and the value-weighted analysis of market data, the equal weight analysis method can also be used to analyze the existing data, which can make up for some shortcomings and deficiencies in the use of value-weighted according to the previous analysis. The equal weight preparation method is adopted to give each index component stock the same weight, and through regular adjustment, ensure that a single component stock maintains the

same weight [19]. In the past, the target index of index funds mostly used the market value-weighted index preparation method, that is, the component equity weight is calculated based on the market value of listed companies. For example, equal weight index funds may become a new direction in the product design of index funds in the future. Compared with the market capitalization-weighted compilation method, the equal weight index compilation method has two advantages: first, it avoids the phenomenon that the larger the value of the component stock market, the higher the weight in the market capitalization-weighted index compilation method. The market value-weighted index takes the component stock market value as the weighting factor. The greater the component stock market value, the higher its weight in the index. The stock market value is equal to the capital stock multiplied by the stock price, that is, the higher the stock price, the greater the weight of the stock in the index. This goes against the value investment principle to some extent. The equal weight index compilation method gives the same weight to the index component stocks, and through the regular adjustment mechanism, the index component stocks are sold high and low to avoid the above risks. Then, compared with large market capitalization companies, medium and small market capitalization companies tend to perform better in the medium and long term. Therefore, in a certain period, the performance of an equal weight index can also exceed that of the market value-weighted index.

Then, the equal-weighted method is used again to repeat the previous analysis process. In this analysis, whether for the 70 years, the corporate carbon emissions of the overall single portfolio sorting of US listed companies are analyzed to divide the size of corporate carbon emissions. Then, the relationship between some market performance and corporate carbon emissions is analyzed based on the Paris Agreement—2016. This proves once again that investors are concerned about corporate carbon emissions. After the analysis again, the three conclusions that can be drawn are consistent with the results of using value-weighted. According to the comprehensive analysis of the 70 years data of the USA, investors almost ignore the carbon emissions of enterprises, that is to say, the relationship between some performances of the stock market and the carbon emissions of enterprises is relatively weak.

This table reports the average and T-values of carbon emissions of industries with small and large carbon emissions in the USA and takes the SIC code as the main test condition for analysis in equal-weighted before and after 2016. We analyzed the company data of the US stock market in the past 70 years and divided it into two samples using SIC code. Every company has a SIC code. Each company's industry can be determined according to different SIC codes, so SIC codes can be used to distinguish two groups of data. In the data, SIC is taken as the standard. In the first group, 1–30 industries with large displacement in SIC code and 70–99 industries with small displacement in the second group. At the end of December every year, we first select the company's market share price and then find out the number of shares issued by each company. Finally, the company's market value is calculated by multiplying the share price by the number of shares issued. Then, the market value of companies with low-carbon emissions in each US market is ranked by five single portfolios. The ranking continues the single ranking method of Fama French and adds the element of large carbon emission companies with SIC code as the test standard.

Table 5 Robust test

	Carbon emission					
	Low	1	2	3	High	Dif
Scope#1	0.0213	0.0148	0.0092	0.0122	−0.0001	−0.0215**
	(1.1471)	(1.0142)	(1.0026)	(1.2092)	(−0.0101)	(−2.1439)
Scope#2	0.0239	0.0072	0.0115	0.0077	0.0035	−0.0204
	(1.2073)	(0.4311)	(0.9321)	(0.5818)	(0.2983)	(−1.6046)
Scope#3	0.0213	0.0088	0.0083	0.0082	0.0042	−0.0170
	(1.0470)	(0.4700)	(0.4018)	(0.6977)	(0.3651)	(−1.2741)

1% is ***, 5% is **, 10% is *

In parentheses are the statistics of the t-value. Our sampling period is 1950e2016***
and * * * are 10%, 5% and 1%, respectively.

In Table 5, after adding the SIC industry code and grouping the enterprises based
on the enterprise carbon emission, the data analysis is carried out, and the same result
is obtained again, that is, investors are only more concerned about the carbon emission
of the top 30% of the enterprises with the SIC industry code. When investors formu-
late investment strategies for enterprises with high-carbon emissions, it pays more
attention to the carbon emission of enterprises. Under the same grouping conditions,
the results of data analysis before and after 2016 remain unchanged. In contrast, after
2016, investors began to pay attention to the carbon emissions of enterprises in the
invested assets. The information expressed by enterprises in the market is strongly
related to their carbon emissions.

6 Conclusion

A low carbon economy is an economic model based on low energy consumption,
pollution, and low emission. Under a low carbon economy, to analyze and predict the
market performance of enterprises and evaluate the value of enterprises according
to the market performance, it is necessary to understand that the needs of investors
and their changes will affect the market performance and valuation of enterprises.

This paper analyzes from three angles. Firstly, according to the market data of
the USA, the widespread use of portfolio sorting comes to the weak significant level
between enterprise-specific carbon emissions and enterprise asset pricing. However,
if different industries with carbon emissions select 30% of the sectors before and after
and conduct the same test, investors are relatively concerned about industries with
high-carbon emissions. When testing the relationship between the market perfor-
mance of sectors with high-carbon emissions and carbon emissions, the results show
a significant characteristic level. It is concluded that after the signing of the Paris
Agreement on carbon emissions, investors will pay more attention to the carbon emis-
sion of the industry, especially after the signing of the Paris Agreement. According

to the final conclusion, after the Paris Agreement in 2016, investors' enterprises paying more attention to carbon emissions are mainly concentrated in industries with high-carbon emissions.

Many analysis directions can be based on our results in the future literature. For example, it can be analyzed based on different industries to check whether investors pay great attention to particular enterprises. In addition, for different cultural results, we can also analyze whether investors pay extra attention when investing in different cultural circles. Finally, more high-frequency data can be used to analyze the impact of investors' investment behavior in a specific period or the publicity and speculation of the news media.

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A Review of the Applicability of Value Investing in China's Capital Markets

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Abstract When the foreign capital market has formed a value investment law system, China's capital market is still full of various investment concepts and has not formed an effective and unified investment logic, but the market cannot practice the value investment concept, and speculators are still active in the market. By reviewing and combing the relevant literature on the research on the concept of value investment at home and abroad, this paper synthesizes the results of existing research and explores the applicability of the concept of value investment in China's A-share market. The study found that China's current capital market is still in an emerging stage of development, the market is full of various investment ideas and factions, and the current government and regulators should combine the country's unique economic system, market status and macroeconomic policies. Launch a macro policy that is suitable for the current situation of China's capital market, and the concept of value investment is in China's capital market. The research conclusions of this paper summarize the applicability of value investment theory in the Chinese market. On the one hand, make a certain theoretical basis for the development of China's current capital market.

Keywords Value investing · China capital market · Literature analysis

1 Introduction

Value investment is to invest in a group of valuable creative, sustainable performance growth of the company, and the greatest value is social value, that is, in line with the value trend of the times, in line with the trend of international economic development. Value investing must have cash flow and growth. Value without growth is a value

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trap, and growth without value is pseudo-growth. Contrarian investing, buying a good company when it is undervalued.

At present, in the literature that tests the effectiveness of value investment, most of them use a multi-group comparison method, that is, by selecting indicators that reflect fundamentals or valuations, and then analyzing the correlation between indicators and stock price returns or comparing the average stock price returns of different indicator values to determine whether there is excess return on value portfolio stocks, so as to determine whether value investment is applicable.

- Fundamental indicators: At present, there are many indicators that reflect the financial fundamentals of enterprises, including net profit, operating income growth rate, return on net assets, operating profit margin, etc. Judging from the survey of investors, investors are most concerned about the profitability of enterprises, so they choose the return on net assets indicator of enterprises to comprehensively reflect the fundamentals of enterprises. A higher numeric value indicates a better fundamental. The basic indicators mainly include Return on Net Assets (ROE), Return on Assets (ROA), Current Ratio, Relative Growth Ratio of price-to-earnings ratio (PEG) DuPont Analysis, etc.
- Valuation indicators: The price-to-earnings ratio is the most common valuation indicator used in the current stock market to reflect whether there is a bubble in the stock price, and the price-to-earnings ratio (P/E) is equal to the stock price divided by earnings per share, the larger the value, the larger the bubble. This article chooses the reciprocal (E/P) of the price-to-earnings ratio to reflect the valuation of the stock, the higher the value, the higher the valuation, indicating the greater the value of its investment.
- Yield indicator: Expressed by the weighted share price yield of the stocks in the annual portfolio, the annual range is from January 1 to December 31. The total share capital of each stock in the portfolio is used as a weight, which is similarly treated when calculating fundamental and valuation indicators.
- Control variables: The market return rate, shareholding ratio of institutional investors and turnover rate are selected, among which turnover rate represents investor sentiment.

2   Literature Review

2.1   Current Status of Domestic Research

The research on value investment has been studied for a long time by scholars at home and abroad. Domestic scholar Douzhi, Lin (2004) according to the statistical results of the time series, found that the fundamentals of a listed company play a certain role in supporting the company's stock price, with the advancement of time, the support has an increasing trend, which can show that more and more rational investors appear in the Chinese stock market, and they pay more attention to the

value of the company itself which is not speculated according to price fluctuations [1]; (2004). Empirical research using stock price information of listed companies in China's A-share market from 1998 to 2002 as data found that value-based investment concepts can indeed obtain excess returns and beat the market [2]. Yanchun,Wang and Lingnan,Ouyang (2005) found that the use of value investment strategies cannot only achieve excess returns, but also the concept of value investment has played a positive role in promoting the stable development of China's securities market, advocating that investors establish the concept of value investment [3]; Qiheng,Han and Qiguang,Yu (2005). By studying the historical stock data of listed companies in China's A-share market from 1994 to 2005, and using the rolling strategy method, the study found that value investment is effective and can run through the bull and bear markets [4]. JunxianJiang [5] found that China's stock market has the external conditions for realizing value investment to a certain extent. At the same time, he thought the value investment strategy in the Chinese securities market is effective, which should based on investors establishing the correct investment outlook and values. [5].

Chao,Luo [6]: Empirical analysis proves that value stock portfolios can obtain excess returns, and empirical tests and regression analyses are conducted to prove the validity of value investment theory [6]; Yingsen,Liu [7] based on the concept of value investment, he believes that whether the capital market is effective can be tested by value investment. At the same time, he thought the value investment strategy in the Chinese securities market is effective, which should based on investors establishing the correct investment outlook and values. [7]; Lan,Zhou [8] through in-depth analysis of the concept of value investment, combined with the perspective of modern portfolio theory, analyzed the same and contradictory points of value investment and believed that the value investment strategy can be in China. Combined with empirical research, it is found that the value investment strategy based on the development (financial) indicators of listed companies in the Chinese securities market can obtain excess returns [8].

2.2 Current Status of Foreign Research

Foreign scholar Benjamin Graham's value investment theory "Securities Analysis": Graham opposes speculation and insists on long-term investment. He believes that he should buy undervalued stocks when investing. Since the price of the stock is undervalued, as the market and the investor continue to correct, the stock price will eventually return to its own value, at which point the investor can get excess returns. Stock prices fluctuate, but these fluctuations revolve around their own intrinsic value fluctuations [9], Philip Fisher's growth stock theory: Qualitative analysis that values the business and management capabilities of the enterprise, growth-oriented; Fisher's investment strategy is the core of growth value investment, and the investment ideas he invests can be summarized as: corporate profits must grow relatively; and these companies expand their capital through profits to continue to invest. At the same time,

a company must have good development prospects, must have excellent management support, management should take into account long-term development and short-term profitability, develop the company's long-term development strategy and daily operations, and when the enterprise is in trouble, the management needs to put forward countermeasures; finally, the development of a company is inseparable from the company's employees, whether the employees of the enterprise are in a good working atmosphere and corporate culture, whether there is a harmonious relationship between employees [10]. Basu,S. [11] was the first to use financial metrics in the study of value investing, and he divided stock sample data into P/E levels and verified the returns of the portfolio. Warren Buffett has also said that the "high ROE + low P/E" strategy has not failed in the A-share market, but has performed more robustly, in a shorter period of time, the underlying stocks will be affected by various market news and fluctuations, but in the long term, the strategy is clearly effective [11]; Lakonishoik et al. (1997) Taking stocks on the US stock market as a sample, they divided the sample data into value stock portfolios and non-value stock portfolios, and then studied the portfolio returns of the sample stock data during the study period, and found that the average yield of the value stock portfolio was 10% higher than the average yield of the non-value stock portfolio after adjusting for the relevant risk factor. The above shows that the use of value investment strategies in the US securities market can obtain excess returns, not only in the mature US stock market, but also in some other foreign securities markets, research on the effectiveness of value investment has a similar conclusion [12].

Brandes Institute [13] found similar results in the UK, Japan, France, Germany, Canada and Austria: Value stocks also yield higher yields [13]. Galdi and Lopes [14]: A study of the Brazilian securities market, by comparing the investment rates of return of various investment strategy portfolios, found that Brazil's current capital market institutions are still immature, and investors can obtain excess returns through value investment strategies to select portfolios [14]. Ko et al. [15]: Through a study of the Taiwan stock market, it is found that portfolios using value investment strategies have significantly higher yields than other active strategies, and the specific return rates are related to the timing of trading and the trading cycle [15].

3   Conclusions

In summary, although the value investment theory has grown over the past 20 years in Chinese capital market, due to the relatively short history of China's capital market development, the irrational component in today's immature market is large, and the overall efficiency is not high; market information disclosure needs to be further improved in order to effectively reduce the negative impact of information asymmetry, and market supervision and other mechanisms also need to be continuously improved. Theoretically, when the market development is mature enough, the speculation opportunities will be reduced, and companies that do not conform to the law

of market development and have a low degree of value will continue to be eliminated; companies with excellent performance, high investment value and great future potential will be loved by investors, and value investment theory will become the general recognition in the market.

Based on the above research, this article proposes the following suggestions:

3.1 Improve the Market Operation Mechanism

Reduce the transaction costs of market transactions, enable more investors to join the market, improve the degree of market transaction activity, enhance market effectiveness and enhance market vitality, accelerate the speed of information disclosure of listed companies and reduce information asymmetry impact on small- and medium-sized investors. When the market effectiveness is improved and the information is disclosed in a timely manner, the stock price can be adjusted according to the latest information, reducing arbitrage opportunities.

3.2 Appropriate Introduction of Foreign Assets

The main reason for the prevalence of speculation in the A-share market is due to the lack of the corresponding leadership of the correct investment concept, and if high-quality foreign funds are introduced from the mature capital market, because the source of capital introduced is mostly developed countries with mature markets, so it can be used as a vane for small- and medium-sized investors to carry out value investment operations, making it easier for small- and medium-sized investors to accept the concept of value investment. In turn, it promotes small- and medium-sized investors to practice the concept of value.

3.3 Resource Allocation Reform

The Chinese domestic market is a typical "capital market"" and a "policy market", and the government should base it on the current China's A-share market. The problems existing in the stock market should be reformed in resource allocation, and the structure of resource allocation should be optimized, so as to guide the direction of capital flow of retail investors in the market to a certain extent, and at the same time, supervision should be strengthened to create a good market order for small- and medium-sized investors, so that small- and medium-sized investors are full of confidence in practicing the concept of value investment.

3.4 Stabilize Investors' Psychological Expectations and the Volatility of the Capital Market

From the perspective of macro policies, we should stabilize investors' psychological expectations and the volatility of the capital market. Since China's capital market has not formed a mature and systematic investment style and concept, the stability of the capital market depends greatly on the rational expectations of investors, and the "herd effect" caused by pro-cyclical one-way expectations and the "herd effect" of short-term operation of securities investment will lead to abnormal fluctuations in the securities market, which will ultimately damage the interests of investors and affect the stable and healthy development of the capital market. The macroeconomic policies have a significant impact on the medium- and long-term expectations of the capital market, so the formulation and implementation of macroeconomic policies should be based on stability, strengthen counter-cyclical adjustment, reduce cyclical capital market fluctuations, and thus ensure the stable and healthy development of the capital market. In terms of macro policies, we actively guide investors' expectations and timely and effectively transmit macro policy change signals to investors, which is conducive to investors making more stable investment decisions under rational circumstances.

3.5 Develop Multi-level Capital Markets and Build a New Ecological Environment for Investment Risk Management in China's Capital Markets

The new ecological environment of multi-level capital market and risk management improves the governance of stakeholders on the basis of protecting the legitimate interests of investors, aiming to promote the confidence of small- and medium-sized investors in the market and strengthen the activity of China's capital market. Investors (internally) and stakeholders (externally) work together to govern together.

3.6 Construct a Reasonable Tax System

It is necessary to construct a reasonable tax system to incentivize investors to form a value investment concept from the perspective of taxation. China's current tax system for the capital market is based on capital gains which do not levy taxes, but stock dividends are levied, so at present, investors are more inclined to encourage capital gains to obtain income, to avoid taxation; and the concept of value investment advocates investors to hold for a long time, from the perspective of dividend issuance to obtain income. When a sound and reasonable policy can fit a correct concept, this concept is more likely to be practiced by investors.

3.7 Improve the Information Disclosure System and Supervision of Listed Companies

Compared with institutional investors, small- and medium-sized investors have limited access to listed company information, there is information asymmetry, and the current financial fraud problems of domestic listed companies are frequent; improving the information disclosure system and supervision of listed companies will help improve market effectiveness and reduce speculative opportunities, which is conducive to cultivating investors to practice the concept of value investment.

3.8 Improve the Dividend Distribution Policy of Listed Companies

Because there is no statutory dividend distribution policy in China's A-share market at present, most listed companies in the market have few dividends, or even do not issue dividends; investors cannot obtain benefits from the perspective of long-term holding of stocks, and investors are rarely willing to hold stocks stably for a long time, so they are more inclined to obtain capital gains through stock price rises in the secondary market and look for speculative opportunities. Improving the corresponding dividend distribution policies of listed companies is conducive to strengthening investors' confidence in listed companies and the market, which not only helps to stabilize the volatility of listed companies and capital markets, but also helps investors to hold stocks for a long time and practice the concept of value investment.

The research contribution of this paper, from a theoretical point of view, through the summary and analysis of the relevant views of the existing value investment concept, refining, and combining the original basic concept of value investment, enriches the application scope of value investment theory; in practice, this paper can better practice value investment in China's capital market through theoretical analysis, combined with the current situation in China's capital market, and the top-down analysis of finding target companies.

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Enterprise Economy and Management

Web Presence and Multilingual Management in the Tourism Sector: An Analysis of Active Tourism and Ecotourism Corporate Websites from Southern Spain

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and María-Dolores Olvera-Lobo

Abstract The availability of a corporate website, specially if it is translated to other languages, can be a great ally for companies to reach international audiences at a very reduced cost. This is of paramount importance for business sectors highly dependent on international clients, which is the case of tourism, and for regions with strong tourism flows, such as Andalusia (Spain). The aim of this paper is to analyze the web presence and the multilingual dissemination of corporate information of Andalusian small and medium-sized enterprises (SMEs) from two emerging tourism sectors: active tourism and ecotourism. To meet this aim, a sample of 343 companies has been analyzed via frequency analysis and decision trees. Results show that, despite the web presence of the analyzed companies being strong—nearly 80% of them had a website—most of them were lacking the competitive advantages of offering a translated website and, in the cases where translations were available, the language diversity was scarce.

Keywords Corporate websites · Corporate information · Multilingual dissemination · Translation · Tourism

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1 Introduction

Nowadays, it is essential for companies operating in the tourism sector to reach international clients. To meet this aim, information and communication technologies (ICTs) play a key role, given that, thanks to globalization, they allow to spread messages and reach people in nearly any corner of the globe at a very reduced cost, which is especially relevant for small and medium-sized enterprises (SMEs). As a result, the use of ICTs is an appropriate indicator of the ability of companies for competing in international environments, including those with strong tourism flows, which is the case of Spain [1, 2]. More specifically, according to the official reports, the region of Andalusia, located in the south, is among the third main tourist destinations in Spain for international visitors [3, 4]. Consequently, tourism is one of the main sources of income of the Andalusian economy [5]. In addition, the current health situation, caused by the COVID-19 pandemic, has meant a change of paradigm in tourism, resulting in the demand for safe and uncrowded destinations that allow for activities in the nature or open spaces has considerably increased [6]. In this sense, rural and active tourism, as well as ecotourism are emerging as growth sectors [7].

Nevertheless, companies—particularly SMEs—face frequent challenges when accessing new international markets [8–10], many of them caused by cultural and language barriers. To overcome these obstacles, the effective dissemination of corporate information is of paramount importance. Thus, the availability of communication channels, such a corporate website, becomes indispensable to reach international target audiences, as it does not subject to geographical limitations and, in addition, it allows companies to generate a friendly environment, foster engagement and develop branding strategy [8, 11, 12]. Therefore, the availability of a translated website contributes to the internationalization process of SMEs and helps them to overcome cultural and linguistic barriers of users form diverse linguistic and socio-cultural contexts [13–15].

On another note, SMEs, which accounts for 99.8% of enterprises in the European Union—save for the financial sector—are key players in the global economy. According to the last official data, around 74% of European SMEs have a corporate website [16]. The figures are similar for Spain given that 99.9% of its business fabric is made of SMEs, and 81.9% of them belong to the service sector, in which tourism is included. In addition, around 78% of the Spanish SMEs have a corporate website [17]. Focusing on Andalusia, this region is the third region with the largest number of SMEs in Spain, as it accounts for 15.6% of them. In Andalusia, 82% of the SMEs operate in the service sector [18]. Finally, according to the official data, this autonomous region follows the European and national trend given that around 70% of the Andalusian SMEs have a corporate website [17].

In the light of the previously described scenario, the focus of this paper is on Andalusia, which apart from being the most populated region in Spain [19], has a very rich and diverse linguistic and cultural context due to tourism and migration [3, 20]. The aim of this paper is to analyze the web presence and the multilingual dissemination of corporate information of Andalusian SMEs from two emerging

tourism sectors: active tourism and ecotourism. Active tourism is understood as touristic activities that involve physical effort, and a certain level of controlled risk, which are carried out mainly in natural environments. On its part, ecotourism is focused on the observation of the natural environment from an ethic and sustainable approach. To meet this aim, the two sectors will be analyzed both together and separately in order to stablish comparisons among them.

2 Methodology

2.1 Sample Description

The sample of study was selected using the information from the Tourism Establishments and Services Search Engine (Buscador de Establecimientos y Servicios Turísticos) offered by the government of the autonomous region of Andalusia (Junta de Andalucía). The data were collected between the months of December 2021 and March 2022. The sample comprised 343 companies included in the sectors corresponding to ecotourism and active tourism, according to the Tourism Establishments and Services Search Engine. In the case of ecotourism, 165 companies were initially included in the sector. However, these companies were reviewed in order to identify those which were not real companies, such as nonprofit organizations or companies which had ceased their business activity. Once these companies were discarded, the final sample for the ecotourism sector was formed by 160 companies. With regard to ecotourism, the search engine retrieved 1270 companies, nevertheless, in order to have samples similar in size to allow for comparisons, the sample for this sector was limited to the 183 companies having the "Andalucía Segura" (Safe Andalusia) quality label, given by the Andalusian government. Thus, the final sample was comprised of 343 companies, of which the active tourism sector accounted for 53.4% (183 companies) of them and the ecotourism sector accounted for the remaining 46.6% (160 companies).

The companies were located throughout Andalusia, and all the Andalusian provinces were represented, as it is shown in Fig. 1. Jaen was the province with most representation (17.8% of the companies), followed by Seville (14.3%), Cadiz (13.7%), Malaga (13.4%), Almeria (12–2%), Granada (11.7%), Huelva (9.6%), and Cordoba (7.3%).

The geographical distribution of the companies according to the sector they belonged is shown in Table 1 and Fig. 2. It can be observed that most companies from the active tourism sector were located in Malaga and Cadiz, whereas in the case of ecotourism Jaen and Seville were the provinces with the largest number of companies.
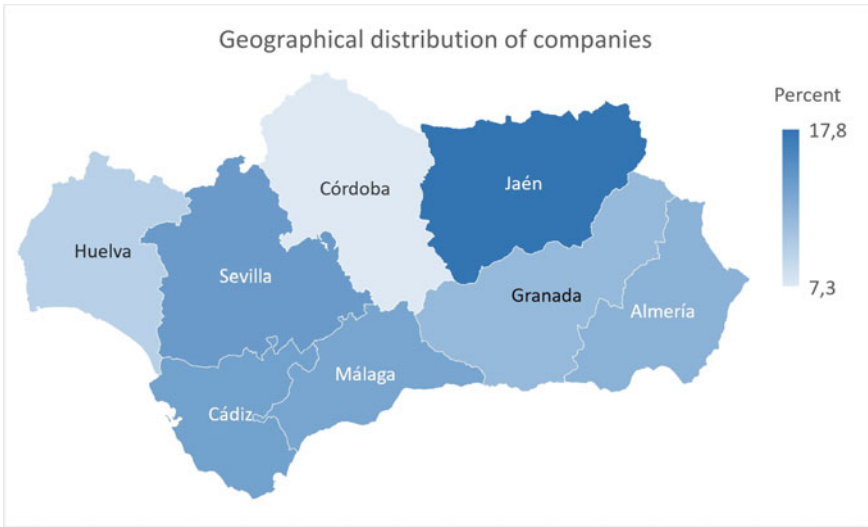
Fig. 1 Geographical distribution of the sample

Table 1 Geographical distribution of the sample according to the sector of the companies

Sector	Province	Frequency	Percent	Sector	Province	Frequency	Percent
Active tourism	Almeria	19	10.4	Ecotourism	Almeria	23	14.4
	Cadiz	34	18.6		Cadiz	13	8.1
	Cordoba	11	6.0		Cordoba	14	8.8
	Granada	24	13.1		Granada	16	10.0
	Huelva	21	11.5		Huelva	12	7.5
	Jaen	14	7.7		Jaen	47	29.4
	Malaga	37	20.2		Malaga	9	5.6
	Seville	23	12.6		Seville	26	16.3
	Total	183	100.0		Total	160	100.0

2.2 Analysis Criteria and Instruments

Once the sample was selected, the following data were collected: name of the company, location, website availability (yes or no), website URL (if available), and translation languages (if applicable). The corporate websites were located both using the data available in the Tourism Establishments and Services Search Engine search engine or via Internet searches using the companies' names. In some cases, it was not possible to locate the corporate website, or it could not be effectively verified the belonging of a website to a given company, in those cases, it was determined that
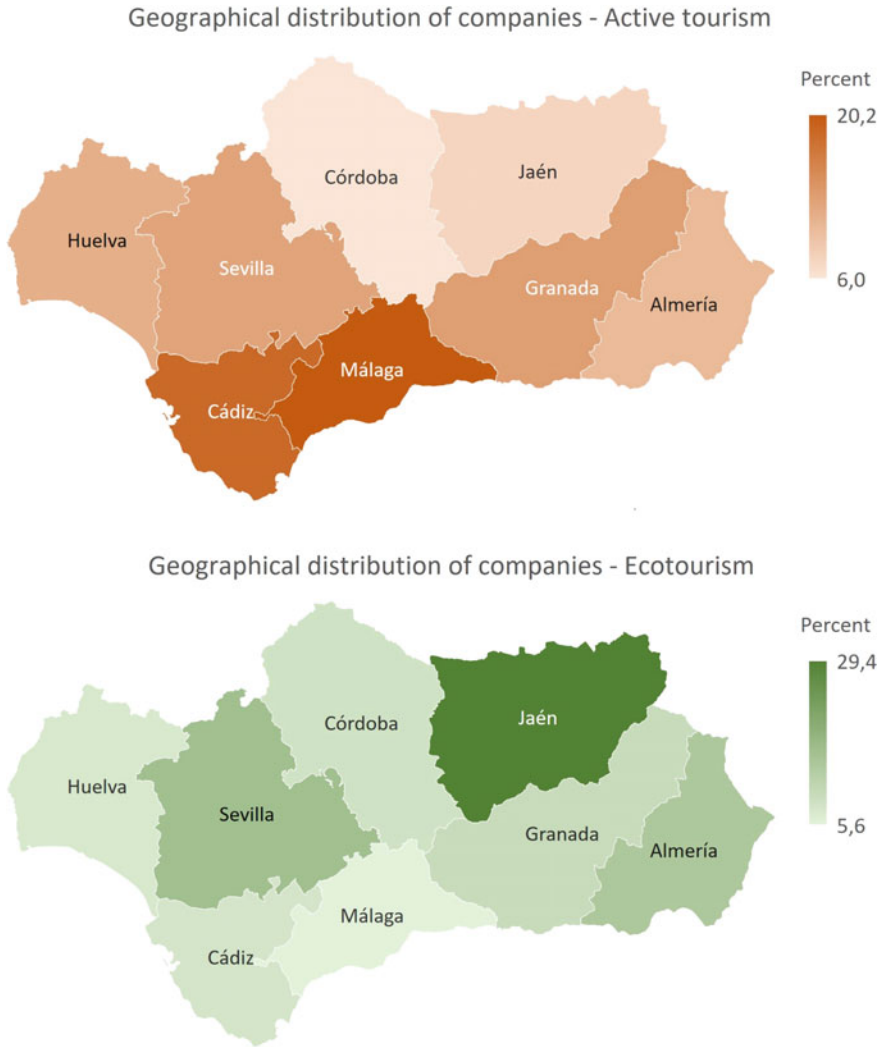
Fig. 2 Geographical distribution of the sample according to the sector of activity of the companies

the company did not have—or it was impossible to locate—a corporate website. In addition, broken links and websites under construction were also omitted.

The data were analyzed using SPSS statistical package via the analysis of frequencies and descriptive statistics. In addition, CHAID decision trees were performed in order to determine any possible relation between the analyzed variables. Finally, MS Excel was used for chart creation.

3 Results

3.1 Corporate Websites

Concerning the availability of a corporate website, Table 2 and Fig. 3 show the results of the frequency analysis. In total, 79.3% of the analyzed companies had a corporate website. The analysis of each of the sectors shows that those companies belonging to the active tourism industry were more likely to have a corporate website, as 86.9% of the analyzed companies had one. On the other hand, the figures of the ecotourism sector are somewhat lower—70.6% of the analyzed companies had a corporate website.

The CHAID algorithm was then used in order to identify if any of the variables—sector or location of the companies—influenced the fact of a company having or not a website. The summary of the model (Fig. 4) shows that the sector of the companies—active tourism or ecotourism—had predictive validity (p = 0.000, Chi-square = 13.750, df = 1). On the contrary, the location did not have statistical significance. As a result, and, in line with the results of the frequency analysis, the CHAID algorithm also proved that companies belonging to the active tourism sector were more likely to have a corporate website.

Table 2 Availability of a corporate website

	Active tourism	Ecotourism	Total
Yes	159 (86.9%)	113 (70.6%)	272 (79.3%)
No	24 (13.1%)	47 (29.4%)	71 (20.7%)

Fig. 3 Availability of a corporate website
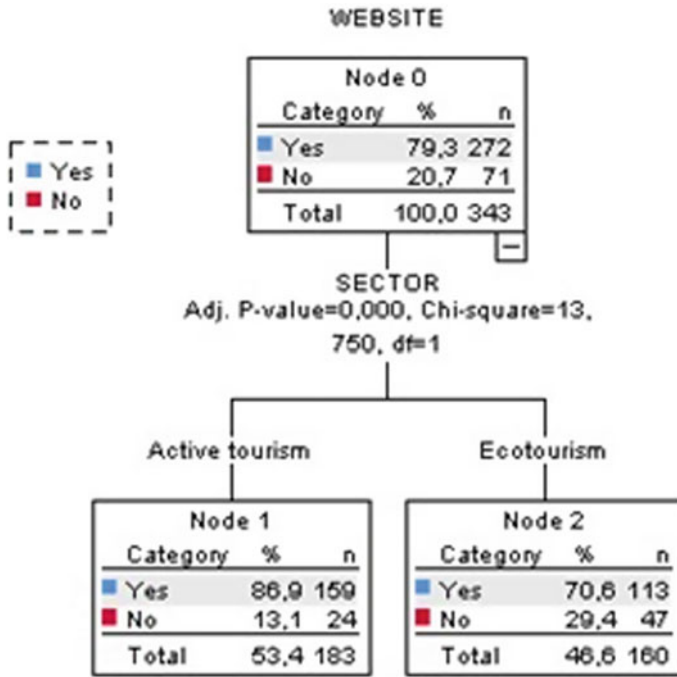
WEBSITE

Fig. 4 Decision tree using the CHAID method for the variable website

3.2 Translated Website

Concerning the availability of translated versions of the corporate websites, the results of the frequency analysis are shown in Table 3 and Fig. 5. It can be observed that less than a half (41.9%) of the companies that had a corporate website translated its content. As in the previous case, the active tourism sector comprises more companies translating their websites (44%) than the ecotourism sector (38.9%).

CHAID algorithm was again used to determine if the sector or the location of the companies influenced the fact of offering a translated version of their corporate websites. In this case, the summary of the model (Fig. 6) shows that the location of the companies had predictive validity ($p = 0.003$, Chi-square $= 18.012$, df $= 1$), whereas the sector of the company did not have statistical significance. Consequently, those companies located on the provinces of Cadiz, Granada, Jaen, Malaga, and Seville

Table 3 Availability of a translated website

	Active tourism	Ecotourism	Total
Yes	70 (44%)	44 (38.9%)	114 (41.9%)
No	89 (56%)	69 (61.1%)	158 (58.1%)
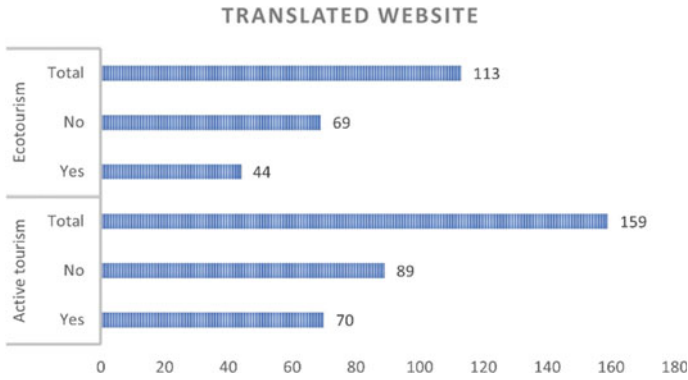
Fig. 5 Availability of a translated website
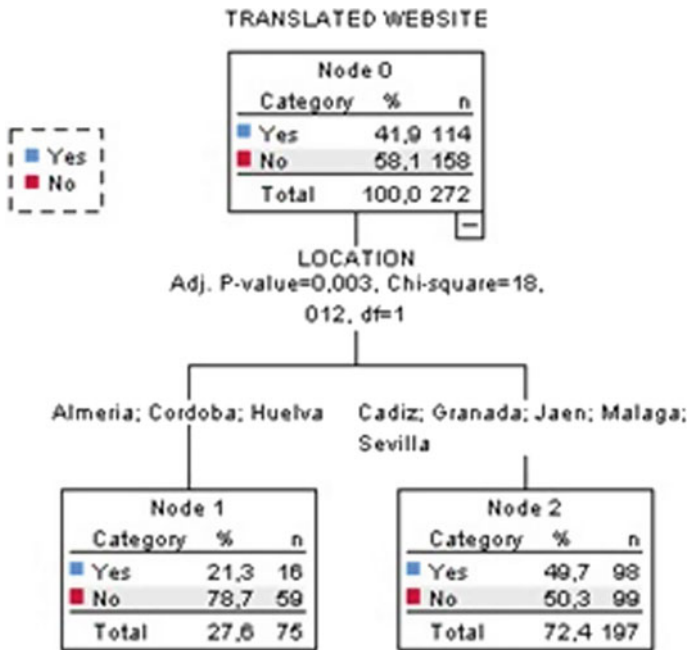
Fig. 6 Decision tree using the CHAID method for the variable translated website

were more likely to translate their websites than those located on Almeria, Cordoba, or Huelva.

Concerning the languages available in the analyzed websites—identified according to the ISO 639-4:2010 standard [21], as it is shown in Figs. 7 and 8. The prevalent language was Spanish in 97.7% of the cases. It is worth mentioning the fact that, despite being all the analyzed companies Spanish, six companies did not

Languages available

Fig. 7 Languages available in the analyzed websites

AVAILABLE LANGUAGES BY SECTOR

■ Active tourism   ■ Ecotourism
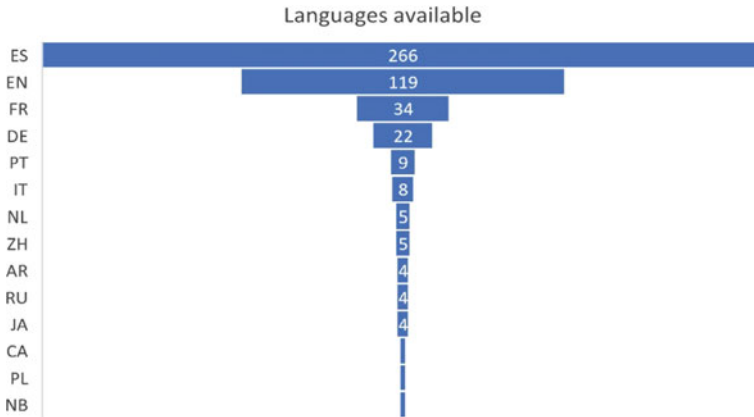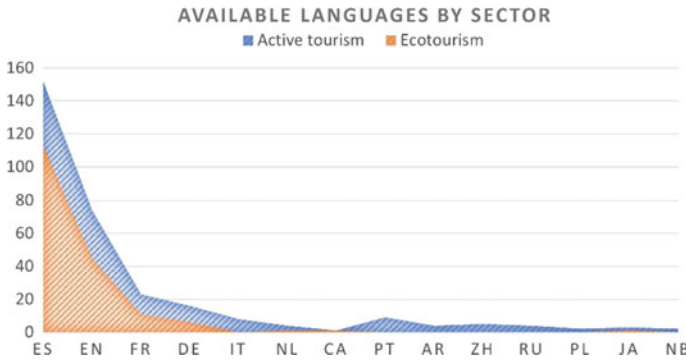
Fig. 8 Available languages in the analyzed websites by sector

offer the content of their websites in Spanish but in English (4 websites), German (1 website) or in both, English and German (1 website). English was the second most common language, accounting for 43.7% of the analyzed websites, followed by French (12.5%) and German (8.1%). The rest of the languages—Portuguese, Italian, Dutch, Chinese, Arabic, Russian, Japanese, Catalan, Polish and Norwegian—were minoritarian languages, present in less than 10 websites each.

It is also remarkable the fact that the active tourism sector offers a wider diversity of languages than the ecotourism sector (Fig. 8). For instance, Italian, Portuguese, Arabic, Chinese, Russian, Polish, and Norwegian were only offered in websites from the active tourism sector.

After determining if the companies translated or not their websites, an analysis of the number of languages available in each website was carried out including the 114 companies which offered their websites translated to, at least, two languages. On average, companies offered their websites translated to 2.82 languages ($\sigma = 1.654$).

Companies from the active tourism sector offered their websites in 3.07 languages, on average ($\sigma = 1.98$), whereas those dedicated to ecotourism had an average of 2.41 languages ($\sigma = 0.787$). In Fig. 9, it is shown a hierarchical representation of the number of languages available in the websites of the sample. As previously mentioned, the ecotourism sector presents lower rates as the maximum number of languages was five, while for active tourism the maximum is ten languages.

Finally, in Table 4, the exact figures for each of the sector, both individually and jointly can be observed. It is worth noting that the percentages are calculated for the total amount of companies which had a translated website of each sector—70 for active tourism, 44 for ecotourism, and 114 for both sectors jointly.
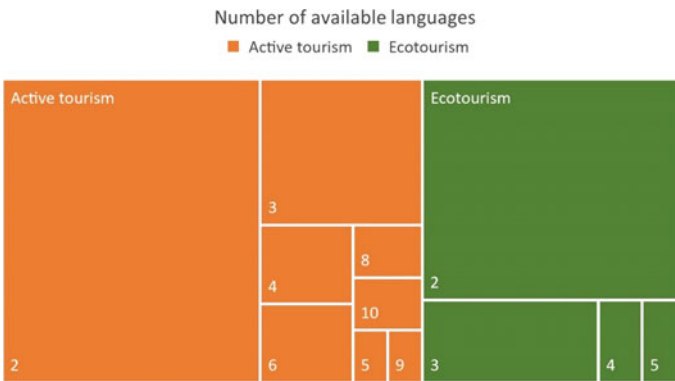
Fig. 9 Number of available languages in the translated websites of each sector

Table 4 Number of available languages in the translated websites

	Active tourism	Ecotourism	Total
2	43 (61.4%)	32 (72.7%)	75 (65.8%)
3	13 (18.6%)	8 (18.2%)	21 (18.4%)
4	4 (5.7%)	2 (4.5%)	6 (5.3%)
5	1 (1.4%)	2 (4.5%)	3 (2.6%)
6	4 (5.7%)	–	4 (3.5%)
7	–	–	–
8	2 (2.9%)	–	2 (1.8%)
9	1 (1.4%)	–	1 (0.9%)
10	2 (2.9%)	–	2 (1.8%)

4   Conclusions

This paper aimed to study the web presence and the multilingual management of corporate website of Andalusian SMEs from the active tourism and ecotourism sector, as well as to identify key drivers influencing the fact or having or not a website and translating its content.

Firstly, the results obtained show a remarkable web presence among the analyzed companies, given that nearly 80% of them had a corporate website. These results offer figures slightly higher than those offered by official reports focused on Europe and Spain [16, 17]. If compared with other business areas, such as health or horticulture, the data from the tourism industry is remarkable higher, as those studies showed that only around half of the analyzed companies had a corporate website [22–24]. More specifically, the results of the frequency analysis along with the CHAID algorithm indicate that those companies belonging to the active tourism sector were more likely to have a corporate website than those from the ecotourism field. In addition, it was found that the location of the SMEs did not seem to influence the fact of having or not a website.

Secondly, when it comes to the multilingual management of corporate website, less than a half of the analyzed websites—41.9%—were translated. These results are surprising, given the dependance of the tourism sector on international customers and the competitive advantages provided from the multilingual dissemination of corporate information [8, 11, 12]. As in the previous case, the figures of the active tourism sector—44%—are slightly superior to those of the ecotourism sector—38.9%. Moreover, CHAID algorithm showed that, concerning the translation of corporate website, the location of the companies did have an impact on it, thus, those companies based on Cadiz, Granada, Jaen, Malaga, or Seville were more likely to translate their websites than those located in the rest of the Andalusian provinces.

Thirdly, Spanish language was found in 97.7% of the websites, which was surprising given that all the analyzed companies were Spanish but not all of them offered this language in their websites. Apart from Spanish, the most common languages were English, French, and German. As in the previous analysis, the active tourism sector offered a wider diversity of languages than the ecotourism sector. In addition, it was found that, on average, if companies translated their websites, they normally did it only to one language, besides Spanish. Nevertheless, this figure increased to three languages on average in the case of active tourism.

This study has shown that, despite the web presence of Andalusian tourism companies being strong, most of them are lacking the competitive advantages of offering a translated website when it comes to reach international audiences and potential customer and clients. In this sense, future research lines could include other regions or geographic areas and other touristic and business sectors, as well as, exploring the perception of both companies and users regarding digitalization and internationalization process. Finally, it would be advisable to conduct more research on other aspects such as the cultural adaptation of multilingual corporate websites.

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Game Theory in Outlets—How Should Stores Maximise Profit?

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Abstract The concept of the outlet store was firstly developed by Anderson-Little in 1936. Through the prolonged history of this special model of discount business, it has been proven to bring various positive effects to most shops. I will give a brief introduction to this business model, explaining the function of the outlet's store to their mother company. This paper will put the main focus on implementing game theory, the Hotelling model, to give a new approach to potentially analyse and explain the mechanism behind the competition between outlets and the normal store. In this paper, I have found the equilibrium and more importantly, how the travel cost and quality difference can affect the profit for each store. The results show that the consumers prefer lower-quality products to maximise profit. The normal store wants higher travel costs, but outlets want lower to maximise their profit.

Keywords Game theory · The Hotelling model · Outlets

1 Introduction

1.1 Introduction to Outlets

Outlets are for the dumping of old fashioned and leftover stock by implementing a special discount. It can be seen in nearly many countries nowadays. With its desirable features, including the high price-performance ratio and convenience, it has developed into a large and growing component of many firms' retailing revenue.

Outlets are not only made up of high-end luxury brands, but more than 50% of the total brands can also be considered entry-luxury or middle-end brands [1]. The store uses the luxury brand to attract consumers to come to the outlets; while the luxury brands are not affordable for every consumer, people pursuing goods will consume some products in the outlets which drive the sales of the other brands.

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1.2 Reasons for Setting up the Outlets

To the consumers, outlets provide an excellent opportunity for those who are eager to own and consume some well-known branded goods but are not financially capable/only willing to spend less. For example, a leather bag sold in a normal store may become a canvas bag in outlets (same product but different material) [2], yet there will still be a significant number of people who love this brand and buy this "low quality" product. This enables them to maximise their utility in enjoying and owning the product from a well-known brand by using the least amount of money possible.

For the firms, besides the costs that are directly involved in the factors of production and retailing, a storage cost sometimes becomes a great part of the overall expenditure. Unless the stockpile is efficiently sold out within a limited time, there will be an unavoidable fee for storage [3]. It will not be a rational decision for the firms to pay the high warehouse cost but not be able to gain back much return. Moreover, with the increasingly fierce competition in the retail industry, the rapid change of fashion leads to a high offshelve rate. When sales do not match the total supply which leaves an excess unsold stock and the inventory cannot be turned into cash, it will highly impact the firm's cash liquidity [4]. Making some discounts in the normal store might not be enough to meet the firm's goal of selling the whole inventory and especially some products are short in size [3]. In order to effectively withdraw all the possible funds as well as avoid the potential loss in the future, the firms require a particular retail channel to keep up the cash flow. It is more cost-effective to put in a discount store/factory than in a warehouse. Outlets are born to be specialised in selling those "unwanted" old-fashioned goods from the normal store and they are in a state of discount all year round. As an investigation shown by Donald in 2016, if the outlet stores are shut down, the profit for the firms will decrease by 23%, and the rate of putting up the new products will reduce by 16% [1]. This indicates that with the collaboration with outlet stores, the firms are able to provide higher quality and newer products in their normal store, preventing the brand dilution effects.

For the manufacturers, outlets give them the chance to clear the products that are overproduced, outdated, or slightly off in quality [4]. As long as the customers don't mind whether they are one step behind fashion or quality, they can spend less money buying authentic goods. Thus, the outlets market is a mutually beneficial solution for firms and consumers.

1.3 Competition Between Outlets and Their Original Firm

Outlets are usually located in the suburbs, which may be caused by the following reasons. First, the outlet mall usually appears as a collection of stores [5], implying a large area of land is required for setting up. It is hard to find a place that can be considered both cheap and large in the city centre, but setting up in the suburb can

satisfy both conditions. So, the low warehouse cost in the suburb will reduce the fixed cost of selling products. The suburb can provide a larger space for the Outlet stores as well as cheaper rents. Outlets mall also ensures a high footfall compared to a single shop, making the selling process more accessible and attractive.

Some products sold in the outlets are specially made by the firms. They might develop a separate production line for the outlets' market, differentiated by the materials and details of the products. For example, the firms might use the upper leather for the normal store but split leather for the outlets. A worker of "Gap" disclosed that the products sold in the outlet store had never seen the light of day in the normal store [1]. The products use outdated fabrics and styles, saving R&D and advertising expenses, thus reducing production costs [6]. Firms are specially producing products for the outlet stores, yet limiting the awareness of this kind of process for the consumers. One of the main attractive factors for the outlets is that the consumers think they can get a similar/slightly lower quality as the normal store. Thus if the firms make the information about this separate production line public, it will no doubt create a huge dilution impact on the brand. The willingness and demand from the consumers to buy products in the outlets will decrease as a result.

Outlets are usually located in the suburbs, in places that can be reached by cars [5]. The warehouse-style storefront format in the outlet mall will give consumers a sense of parity [7], further ensuring they will get the best deal they could get. The cost of travelling, including the time and fuel cost, will cause them to become more purposeful. The cost affects their opinion by considering how many items they bought in outlets can be regarded as a worthwhile trip [1]. People who prefer window shopping are unlikely to go to the outlets since it is far and costly. Firms that sell products with high price elastic can implement price discrimination against the consumers by forcing them to travel all the way to suburbs to enjoy discounts [7]. The relatively low price in outlet stores does not shift the consumers who are focusing on the quality and fashion of the products as well as convenience in achieving the goods. It enables the firms to expand their customer base without lowering prices in their normal store [1].

1.4 Game Theory and the Hotelling Model

The competition between the outlets and normal shops can be considered game-theoretically by using the Hotelling Model with vertical and horizontal differentiation. The Hotelling model usually takes into account the distance between two firms selling close homogeneous products [8]. This means that the demand is less than infinitely elastic or that firms do not always have an incentive to undercut rival's prices. There are four reasons why the Hotelling model is suitable to apply under this context.

The first reason is that the goods sell in the outlets and the normal store are all from the same brand, indicating the overall products are extreme similarity besides

considering a few differences in fashion and quality. The above reason suits the basic requirements of the Hotelling model.

Another reason is that most consumers believe there is little to no doubt that the outlet stores are selling goods cheaper and of lower quality than the normal stores. There might be some products with the same quality or as fashion as the normal store, but it is unlikely to be a great amount. So it is interesting to see how the discounted price can attract the consumers to travel far to the outlet store to obtain those cheaper goods by using the Hotelling model.

The main reason for a successful outlet store is its attractive price. It is usually 30–70% off the price compared to the normal store [2]. Thus, the price level of the goods draws the consumers to buy in outlets.

Lastly, horizontal differentiation could also imply under this context by considering the distance between the stores. Since outlets are usually located in the suburb in order to achieve cheap rent and maintenance costs, there is a travel cost involved in the buying process, which could affect consumers' decisions.

With the above four reasons, I justified that the Hotelling model is suitable to analyse the competition between the outlets and normal stores in the city centre.

I use the Hotelling model with horizontal and vertical differentiation to find profit-maximising strategies between the normal shops and the outlets. To simplify the model, I normalise the distance for the consumers to the normal stores as 0 and the distance to the outlets to 1. Thus, consumers living in the city centre have to bear an additional cost travelling to the outlets. I denote the unit travel cost as 't'. In addition, for the vertical differentiation, I use the taste parameter to measure the consumer preferences over the quality differences between shops. Finally, the cost of production has also been included. By setting up the model, I have found the Nash Equilibrium strategies for the optimum prices and demands for each shop. I also analyse the relationship between the travel cost and quality difference in regards to the profit for each store. This paper concludes that the equilibrium price depends on all factors, including travel cost, consumer taste and expected quality loss. To achieve the goal of profit maximisation, the shops should make the quality difference between the shops as high as possible.

The paper will proceed as follows. I review the related literature in Sect. 2. In Sect. 3, I describe the Hotelling model and set up the basic equation for calculating the profit for each store. I further find the Nash equilibrium price and demand for both stores in Sect. 4. In Sect. 5, I discuss the welfare of each store as well as how the travel cost and quality difference can affect the profit of the store. Section 6 concludes and gives suggestions for future extensions.

2   Literature Review

This paper aims to evaluate the competition between the normal stores and the outlet store in selling the same branded products. There are a variety of prior researches have contributed to my essay during the process.

Coughlan and Soberman have introduced the history and future of the outlets as well as provided other factors potentially affecting the consumers' decision [9], including the service level and experiential factor. These give future areas of extension [10]. From the perspective of why firms set up Outlet stores, Deneckere, and Mcafee investigated how low-quality goods can create an inverse impact by increasing the profit of the firm and expanding their market share [11]. Wang has explored the development of the outlets market in China [6], showing its absolute advantage in targeting middle-class consumers. Donald's work has contributed to a further analysis of the benefits of firms in setting up the outlet store by reducing the marginal cost [1]. Lopez-Menchero has also forecasted the future development of the outlet store [12]. This paper combines the different perspectives of setting up the outlet store, the game-theoretic logic and the potential economic reasons behind it.

More generally, this paper uses game theory to offer a completely different view of the mechanism behind the outlets. Zhang [2] has already shown some of the mechanisms in the outlets, including the reasons for the outlets to be located in the suburb and the different products sold in outlets than the normal retailing store. Hoch et al. [13] have also pointed out that the products sell in the outlets are more price elastic [13]. This essay will focus on applying the Hotelling model to the outlets and potentially explaining the behavioural economics behind the market. The product differentiation in the Hotelling model and how it affects the choice of consumers in a game-theoretical situation is explored by Ansari and Steckel [14]. Naven has explored the way of reaching perfect equilibrium in the Hoteling model at different stages of the competition [15]. The contribution of this paper is to analyse the competition between the outlets and their normal shops using game theoretical meth-ods. It will help to explain further how the normal stores and the outlets compete and benefit each other.

3 Model

Here I use the Hotelling model with both horizontal and vertical differentiation with some modifications. First, consider a market with a shop in the center i and its outlets in the suburb j. Firm i and j are selling vertically differentiated products. The differentiation comes from the uncertain quality of products selling in the outlets. Suppose that firm i selling product with quality $s_i = [\underline{s}, \overline{s}]$. Firm j sells the products with probability $\mu \in [0, 1]$ that they have the same quality as their normal shop s_i, and with the remaining probability, $1 - \mu$, to sell the out-of-date products with some lower level of quality $s_j < s_j$.

Consider that consumers living in the city have a unit demand and there is a taste parameter θ. This taste parameter shows the willingness of a consumer who would like to buy the most fashioned and high-quality goods. Consumers are uniformly distributed on a range $[\underline{\theta}, \overline{\theta}]$ with density $(\underline{\theta}, \overline{\theta})^{-1}$ and I assume that $\overline{\theta} > 2\,\underline{\theta}$. When a consumer with taste θ buys from the store i in the city center, his utility is given by

$$u(\theta, s_i, p_i) = \theta s_i - p_i \tag{1}$$

where $p_i \geq 0$ is the price set by firm i. When the consumer buys from the outlets in the suburb, his expected utility function is given by

$$E\big[u\big(\theta, s_i, s_j, p_j, \mu\big)\big] = \theta\big[\mu s_i + (1 - \mu)s_j\big] - p_j - t \tag{2}$$

where $p_j \geq 0$ and $p_j < p_i$. Without loss of generality, I normalised the distance between the center and the suburb to be 1, where the normal store locates at 0 and the outlet store locates at 1. The value t measures the travel cost per unit of distance. Hence, the travel cost of a consumer living in the city to the outlets is t, which not only includes the monetary term, but the potential time uses as well. For simplicity reason, I assume t is exogenous, and $t < 4c$.

Consumers go to the stores that give them a higher utility. There are indifferent consumers who have the same utility going to the normal store or the outlets. Therefore I have the following equation:

$$u(\theta, s_i, p_i) = E[u(\theta, s_i, s_j, p_j, \mu)] \tag{3}$$

$$\theta\big[\mu s_i + (1 - \mu)s_j\big] - p_j - t = \theta s_i - p_i \tag{4}$$

By rearranging the equation, I find the taste level θ^m of the indifferent consumer.

$$\theta^m = \frac{pi - pj - t}{(1 - \mu)(s_i - s_j)} \tag{5}$$

Consumers who have $\theta > \theta^m$ prefer to buy from the normal store with higher quality and prices, whereas those with tastes parameter $\theta \leq \theta^m$ will buy from outlets. Thus, the demand for the normal store and outlets will be $\bar{\theta} - \theta^m$ and $\theta^m - \underline{\theta}$ respectively.

I define

$$\Psi \equiv (1 - \mu)\big(s_i - s_j\big) \tag{6}$$

to be the expected quality loss that consumers get from buying in the outlets, in other words, it also measures the expected gain of quality when buying from the normal store. Therefore, the utility function of buying from the outlets can be written as,

$$E[u(\theta, s_i, \psi, \mu)] = \theta[s_i - \psi] - p_j - t \tag{7}$$

Assume all shops have marginal cost $c \geq 0$, the profit for the normal store i is:

$$\pi_i(pi - c)(\underline{\theta} - \theta^m) \tag{8}$$

and profit for the outlets j is:

$$\pi_j (pj - c)(\theta^m - \underline{\theta}) \tag{9}$$

4 Nash Equilibrium

By substituting θ^m, I obtain π_i as a function of prices and qualities. Firm i's problem is thus

$$\max_{p_i} \pi_i = (p_i - c)\left(\overline{\theta}\frac{p_i - p_j - t}{\psi}\right) \tag{10}$$

The first-order condition gives the best response function of price p_i.

$$p_i^*(p_j) = \frac{\overline{\theta}\psi + p_j + t - c}{2} \tag{11}$$

Similarly, I can use the same method to obtain the profit function of the outlet store as well as use the first-order condition to find the best response function for π_j to give the maximum profit for the outlet store.

$$\max_{p_j} \pi_j = (p_j - c)\left(\frac{p_i - p_j - t}{\psi} - \underline{\theta}\right)$$

$$p_j^*(p_i) = \frac{p_i - t + c - \underline{\theta}\psi}{2} \tag{12}$$

Solving two equations simultaneously, I find the unique set of the Nash equilibrium prices of the two stores.

$$p_i^* = \frac{(2\overline{\theta} - \underline{\theta})\psi + t - c}{3}$$

$$p_j^* = \frac{(\overline{\theta} - 2\underline{\theta})\psi - (t - c)}{3}$$

From the best response functions, I can interpret that p_i and p_j are strategic substitutes. The difference between the travel cost and cost of production, i.e., $t - c$, plays an important role. If the difference increases, it is more expensive going to the outlets, thus the normal stores are more attractive. The equilibrium price for normal stores, p_i^* will increase as the $t - c$ increases, whereas the equilibrium price for the outlets, p_j^* will decrease. The difference in the quality is also crucial since the consumers are always in favour to maximise their utility. When the expected difference ψ increases, the normal stores are more appealing. I then substitute in p_i^* and p_j^* into the taste

parameter, obtaining

$$\theta^{m*} = \frac{\overline{\theta} + \underline{\theta}}{3} - \frac{t}{\psi} \tag{13}$$

and the demand for each store are as follows

$$x_i^* = \frac{2\overline{\theta} - \underline{\theta}}{3} + \frac{t}{\psi} \tag{14}$$

$$x_j^* = \frac{\overline{\theta} - 2\underline{\theta}}{3} + \frac{t}{\psi} \tag{15}$$

Due to the slight differences between the products selling in the normal store and outlets are slightly different, they end up with different levels of equilibrium demand. The transport cost involved in the model indicates the responsiveness of the consumers to switch to the low price goods.

5   Welfare Analysis

Having found the Nash equilibrium of p_i^*, p_j^*, x_i^* and x_j^*, the profit of the firms can be expressed as follows,

$$\pi_i^* = \left(p_i^* - c\right)x_i^* \tag{16}$$

$$\pi_j^* = \left(p_j^* - c\right)x_j^* \tag{17}$$

Substituting in the values, p_i^* and x_i^*, which I found in the previous steps, I obtain:

$$\pi_i^* = \left(\frac{(2\overline{\theta} - \underline{\theta})\psi + t - 4c}{3}\right)\left(\frac{2\overline{\theta} - \underline{\theta}}{3} + \frac{t}{\psi}\right) \tag{18}$$

Differentiating the previous equation against t, I find the relationship between the location of the outlet store and the profit of the normal store.

$$\frac{\partial \pi_i^*}{\partial t} = \frac{4(\overline{\theta} - \underline{\theta})}{9} + \frac{2t - 4c}{3\psi} \tag{19}$$

$$\frac{\partial^2 \pi_i^*}{\partial t^2} = \frac{2}{3\psi} > 0 \tag{20}$$

The second-order condition is positive due to $\psi > 0$, given it is the expected quality loss from buying from the outlets. This means that there is a minimum point between travel cost and profit of the normal shop. Since the relationship can be considered as a parabola due to the fact that it is a quadratic equation in the first place, there exists, t^*, which is the turning point (as well as the minimum point) of π_i^*. By solving the first-order condition, I find the value t^* to be,

$$t_i^* = 2c - 2\psi(2\bar{\theta} - \underline{\theta}) \tag{21}$$

From the above equation regards to t_i^*, profit π_i^* decreases when $t < t_i^*$ and it increas-es when $t > t_i^*$. I interpret this situation as a trade-off between the travel cost and the price effect. This relationship follows the logic that since the travel cost is getting more expensive, there will be a reducing utility for the consumers to go to the outlets. When the travel cost t increases, the equilibrium price for the normal shop p_i^* increases, whereas the equilibrium price for the outlets p_j^* decreases. Then when the travel cost is not very high, i.e., $t < t_i^*$, consumers would prefer to buy from the cheaper store as the price effect outweigh the travel cost. However, if the travel cost is too expensive, consumers would rather be buying from the center given that they can have a better quality product at a slightly higher price.

Adding on, the relationship between the expected quality gain from buying in the normal store to the profit of the normal store can be illustrated as following,

$$\frac{\partial \pi_i^*}{\partial \psi} = \frac{(\bar{\theta} - \underline{\theta})^2}{9} + \frac{t^2 - 4ct}{3\psi^2} \tag{22}$$

Applying the second-order differentiation to the above equation, I obtain,

$$\frac{\partial^2 \pi_i^*}{\partial \psi^2} = -\frac{2(t^2 - 4ct)}{3\psi^3} \tag{23}$$

Since I have previously assumed $t < 4c$, then I have the second order condition be positive, concluding a minimum value to the curve between the expected quality gain, ψ and profit, π_i^*. To solve the turning point for ψ^* in the first-order condition, I obtain the critical value ψ^* as follow:

$$\psi_i^* = \frac{\sqrt{3t(4c - t)}}{\bar{\theta} - \underline{\theta}} > 0 \tag{24}$$

Since there is a minimum point for π_i^*, the equilibrium profit will decrease if $\psi < \psi_i^*$, and it will increase with if $\psi > \psi_i^*$. This means that when the expected quality loss is not high enough, the higher the quality loss, the lower the profit that gained by the original shop. There is a clear trade-off between the quality of the product and the price effect. If the quality difference between the products in the normal store and outlets is zero, the normal store will have high profit since there is

no travel cost involved in buying from the city. As a result, all the consumers will choose to go to the normal store. When there is a small difference, i.e., $\psi < \psi_i^*$, the price of the products in the normal store will become more expensive. In this situation, the price effect out-weighs the quality difference, thus more people choose to go to the outlets. Once the quality, ψ, has become larger than the critical point, there will be a significant difference in the quality of the products, thus more consumers will choose to buy in the normal store.

In short, both factors t and ψ are affecting the profit π_i^*, in a similar way. If the outlets are close to the normal store, meaning there is little/no travel cost, consumers might choose to buy in outlets since products are cheaper. When the travel cost is high, $t > t_i^*$, consumers prefer to buy from the center as it is more convenient and less cost for travelling. Similar logic applies for the increase in ψ, which is the rise in expected quality in the normal shop, in other words, the increase in expected loss from buying in outlets. Consumers prefer to go to outlets until the expected quality loss, ψ, is too big and they might choose to buy in the normal store. The existence of t and ψ explains the difference in price for outlets and the normal store.

Similarly, as the way I find π_i^*, I obtain the profit function, π_j^*, by subbing in the value for p_i^*, and p_j^*, for the outlet store as follow,

$$\pi_j^* = \frac{(\bar{\theta} - 2\underline{\theta})\psi - t - 2c}{3}\left(\frac{\bar{\theta} - 2\underline{\theta}}{3} + \frac{t}{\psi}\right) \tag{25}$$

I then use differentiation to find how the travel cost and expected product quality lost will affect the profit of the outlet store.

$$\frac{\partial \pi_j^*}{\partial t} = \frac{2(\bar{\theta} - 2\underline{\theta})}{9} - \frac{2t + 2c}{3\psi} \tag{26}$$

To have a clearer image of the relationship, I use the secondorder condition against t, obtaining, since I have previously assumed $t < 4c$, then I have the second order condi-tion be positive, concluding a minimum value to the curve between the expected quality gain, ψ and profit, π_i^*. To solve the turning point for ψ^* in the first-order condition, I obtain the critical value ψ^* as follow:

$$\psi_i^* = \frac{\sqrt{3t(4c - t)}}{\bar{\theta} - \underline{\theta}} > 0 \tag{27}$$

Previously, I have concluded that ψ is always positive. The second derivative shows that there is a local maximum point regarding t. Since the relationship between π_j^* and t is displayed as a quadratic curve, I have found the critical level of the travel cost which gives the maximum level of profit,

$$t_j^* = \frac{(\bar{\theta} - 2\underline{\theta})\psi}{3} - c \tag{28}$$

t_j^* is the critical point of the profit parabola. Profit for outlets, increases when $t < t_j^*$ and decreases when $t > t_j^*$. This situation can be explained by the trade-off between the travel cost and the price effect. When $t < t_j^*$, the price of the goods sold in outlets are becoming cheaper, the price effect outweighs the travel cost. Consumers, there-fore, prefer to buy in outlets, resulting in an increase in profit. People who are willing to go to the outlets are usually more price elastic [13]. Lower selling price might encour-age the consumers to travel and explore. On the other hand, when $t > t_j^*$, consumers might consider the distance/travel cost to the outlets to be too high, thus preferring to go to the normal store in the city center.

Next, taking into account the expected product quality lost in the outlets, by using the first-order condition, I get

$$\frac{\partial \pi_j^*}{\partial \psi} = \frac{(\bar{\theta} - 2\underline{\theta})^2}{9} + \frac{t^2 + 2ct}{3\psi^2} \tag{29}$$

By definition, $(\bar{\theta} - 2\underline{\theta})^2$ and ψ are always positive. In view of the fact that both $\frac{t^2+2ct}{3\psi^2}$ and $\frac{(\bar{\theta}-2\underline{\theta})^2}{9}$ always lie in the positive area. The profit for the outlets shares a positive correlation with respect to ψ, regardless of the travel cost and production cost. I can conclude that the outlets get more profit when they sell products of lower quality. According to the Nash equilibrium price strategies, lower quality means a lower price of the products. For this group of consumers, the effect on price outweighs the effect of quality. This might explain why the firm set up outlets. It is more profitable for selling products with lower quality at a lower price in the suburb.

6 Conclusion

Operating an outlet store has become a popular strategy by firms, yet there are limited economics essays explaining the mechanism/reasons behind the system. The application of game theory in determining the Nash equilibrium gives another perspective on viewing how the outlets work.

This paper considers many factors between the normal store and the outlets, including quality difference, the chance of obtaining the same products in two shops, travel cost, consumer taste and cost of production. The main contribution of this paper is the Nash equilibrium of the profit for each firm and how they can collaborate to obtain the maximum output.

I have analysed two important factors that affect firms' profits: quality difference and travel costs. From the model, the quality difference shares a direct relationship with the profit of the outlet store. When there is a clear quality difference between the outlets and the normal store, $\psi > \psi_i^*$, the profit is likely to be higher for both stores as the price difference is large. However, it is more complicated for the travel cost. As for travel costs, the response in profit acts differently. I found that there exist two critical levels of the travel costs t_i^* and t_j^* for the original store and the outlets

respec-tively. When t is less than t_i^*, the profit decreases for the normal store, whereas when t is more than t_i^*, the profit increases for the normal store. On the other hand, for the outlet store, the profit increase when t is less than t_j^*, whereas when t is more than t_j^*, the profit for the outlets decreases. Those relationships might explain the reason why we have normal stores selling higher quality products in the city center, whereas the outlets selling low-quality products in suburbs.

There are still a few questions left, for example, in my model, for simplicity reasons, I have assumed all the people are living in cities with travel costs, t, if they go to the outlets or no travel cost to the city center. However, in the real-life context, people can live between cities, meaning that there might also involve a cost when they decide to go to the city center. As an extension for this, I can set up travel cost $t(x)$, as a function of the distance between consumers and the stores.

Furthermore, I have set travel costs, t, being exogenous, which is not realistic. The firm actually has the power to determine the location of the outlet store in order to maximise its profit. Thus, firms can control the level of travel fares of their customers. A different t value might lead to a different equilibrium strategy for firms.

Considering the diverse strategies that the stores can implement, there should be more factors involved in the decision-making process. For example, the service level tends to be higher in normal stores [10] or the difference in the experiential factor. Therefore, there are more directions and areas affecting consumer preference worth discussing.

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Comparison the Anchoring Effect Application in Employee Management in Silesian Voivodeship with Prague, Moravian-Silesian Region, and Vysočina Region

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Abstract Behavioral aspects are very important for successful human resource management. This fact is becoming more and more apparent. Therefore, the paper deals with behavioral economics, human resource management, and the enterprises with 100+ employees. More precisely, the paper focuses on the degree of the anchoring effect, i.e., the degree of the use of the instruments for influencing and persuasion that managers apply to manage their employees. This paper builds on the results of previous researches and further develops these results. The authors used the questionnaire to identify how much the anchoring effect is applied in enterprises with 100+ employees. The main goal of the paper is to compare the anchoring effect application in employee management in Silesian Voivodeship (Polish region) with three Czech regions which are Prague, Moravian-Silesian region, and Vysočina region. The comparison applies to enterprises with 100+ employees. The second goal of the paper is to find out how often the anchoring effect is used in the Silesian Voivodeship. The authors set one hypothesis, and the results of the paper rejected it. The basic assumption led the authors of this paper to this research. The authors predicted that managers of Silesian Voivodeship companies use anchoring methods less often than the three regions mentioned above, i.e., the managers of Prague companies, the managers of Moravian-Silesian region companies and the managers of Vysočina region companies. Confirmation or rejection of the above-mentioned assumption is discussed in more detail.

Keywords Anchoring effect · Behavioral economics · Enterprises with 100+ employees · Nescience of the anchoring

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1 Introduction: The Previous Research, Behavioral Economics and Behavioral Management

Manipulation is usually considered an unethical approach to leadership, but manipulation is a more complex phenomenon than just an unethical way of acting in leadership. Our research will demonstrate through an empirical study that there are various types of manipulation through anchoring. The anchoring is one of the basic parameters and aspects of the behavioral economics.

Over the last three years, the author of the paper (together with other authors) has conducted two researches in the field of behavioral management. This paper builds on the results of this two previous researches and further develops these results. These two researches had two main objectives:

1. To find out how much the managers of enterprises with 100+ employees use the anchoring effect to anchor their employees. This survey was carried out successively in three Czech regions, namely, in Prague, in the Moravian-Silesian Region, and in the Vysočina Region [1].
2. Comparison of these resulting values.

These two previous researches included three hypotheses. These hypotheses were based on several assumptions. The authors predicted that anchoring effect for influencing employees are used much more often than is assumed. The authors also predicted that managers of Prague companies use anchoring methods more often than managers of companies from other Czech regions [2].

These two researches have achieved many results and contexts. Here are some of these results:

- the managers in Czech Republic still do not use the anchoring effect too often;
- that if managers know and use the anchoring effect, they use it relatively often;
- that the level of the application of the anchoring effect is higher in Prague than in Moravian-Silesian region;
- the difference in the use of anchoring effect between Prague and Moravian-Silesian region is not very significant;
- approximately 88.8% of managers of the enterprises with 100+ employees in Vysočina region know the concept of anchoring effect;
- approximately 56.25% of the managers of the enterprises with 100+ employees in Vysočina region have ever tried the anchoring effect or use it regularly;
- approximately 37.5% of the managers of the enterprises with 100+ employees in Vysočina region used an anchoring effect sometimes, but they used it very rarely and irregularly;
- approximately 9.38% of the managers of the enterprises with 100+ employees in Vysočina region use the anchoring effect on average at least once a month;
- approximately 9.38% of the managers of the enterprises with 100+ employees in Vysočina region use the anchoring effect on average at least twice a month.

More detailed values from previous research will be seen in the third chapter of this paper.

The authors also stated that it is possible to carry out similar research in other cities. In their conclusions, the authors literally stated: "The results of the research provide further support for the understanding the anchoring effect, in particular in the awareness of the anchoring effect and its intensity of use. In the future, it is possible to carry out similar research in other cities of the Czech Republic or abroad. Authors believe that this simple research will help initiate further research in this interesting field of behaviour economics."

As mentioned, the paper deals with the issue of behavioral economics. It is therefore necessary to define this scientific discipline theoretically.

The discipline of behavioral economics challenges much conventional economic thought—which works on the basis that, overall, humans make rational decisions— by focusing instead on the 'irrational' cognitive biases that affect our decision-making. These seemingly inbuilt biases mean that certain kinds of economic decision-making are predictably irrational [4]. Behavioral economics incorporates ideas from psychology, sociology, and neuroscience to better predict how individuals make long-term decisions. Often the ideas adopted include present or inattention bias, both potentially leading to suboptimal outcomes [5]. Principles of behavioral economics are implemented in researches in praxis, e.g., home dinner vegetable [8].

We learn of all-too-common issues of self-control and overconfidence vis-a-vis money, and how these irrationalities influence financial markets where rational choices are supposed to reign. Richard Thaler [12] builds on Nobel-prizewinning psychologist Daniel Kahneman´s prospect theory, the idea that people make decisions on the basis of quick judgments rather than a thorough assessment of the probable outcome [3].

Some authors [9] attempt to bring a degree of intellectual clarity to the potentially important contribution that behavioral economics can make to public policy.

Knowledge of behavioral economics is widely used in marketing, authors [10] successfully link marketing theory with practice, locating marketing ideas and applications within wider global, social, and economic contexts. Tversky and Kahneman did experiments and found out that people do not act only by logic thinking. Their behavior and decisions are influenced intuitive reaction and mental state [13]. These authors together with Thaler contributed to an establishment of two new fields of study, experimental economics, and behavioral economics. Both of them are on the border of psychology and economics. There are many new hypotheses in the science of behavioral economics and at the same time, the behavioral economics evaluates, how the results of the decision are influenced by decision process and external influences. The current research in this field of study is focused on two areas. In the first one, the research identifies and segments deviations from the rational choice theory. We can call them systematic failures in individual behavior based on various mistakes in the decision-making process. The second area then deals with this distortion in practice and in the market environment [14].

We use knowledge from above-mentioned fields for a small questionnaire to find out and verify an anchoring effect. The anchoring is called also focalism and means

a form of cognitive bias for an individual to rely too heavily on an initial piece of information offered when making decisions.

This paper therefore deals with exerting influence in leadership, namely manipulation and anchoring.

This article makes a contribution to the literature on manipulation through leadership storytelling, offering a more systematic empirical analysis and a more nuanced view of the topic than previously existed by outlining how managers engage in manipulative storytelling and what kind of ethics they link to their manipulation in leadership.

2   Methods: Fundamentals for the Next Chapter

The main goal of the paper is to compare the anchoring effect application in employee management in Silesian Voivodeship with three Czech regions which are Prague, Moravian-Silesian region, and Vysočina region. The comparison applies to enterprises with 100+ employees. Authors set the following hypothesis:

H1: Managers of Silesian Voivodeship enterprises with 100+ employees use anchoring effect at least 10% more often than weighted average of the three groups of managers, which are managers of Prague enterprises with 100+ employees, the managers of Moravian-Silesian region enterprises with 100+ employees, and the managers of Vysočina region enterprises with 100+ employees.

As it is visible, first the main goal and the hypothesis of the research were presented. The individual methods applied in this paper will be now described, i.e., the questionnaire survey and the anchoring effect.

2.1   Questionnaire

The paper is based on quantitative research using a questionnaire survey. Data for the research was obtained through an online anonymous questionnaire survey that was realized since the September 15, 2021 till the November, 8, 2021. The original deadline for the collection of responses was set on the October 18, 2021. Due to the relative small number of responses, the duration of the questionnaire survey was extended till the November 8, 2021.

The questionnaire was sent to 167 enterprises with 100+ employees in Silesian Voivodeship and its surroundings. The questionnaire was sent to the responsible management of the selected enterprises. The author wanted to achieve a high rate of return, so the questionnaire was created to take only about three minutes to complete.

2.2 *Knowledge of Sophisticated Management Methods*

An important parameter for fulfilment of the goal of the paper is the assumption that knowledge of sophisticated management methods will be higher in an economically more advanced region than in a less developed region. That's what the authors [7] talk about. They describe the expectations of a higher level of managerial skills and knowledge in regions depending on the growth of two factors. The two factors are the size of the gross domestic product (GDP) by region and the number of enterprises with 100+ employees with the registered office in the region.

According to the CZSO, the gross domestic product in Prague in 2019 was approximately CZK 1,577,000 million CZK. In Moravian-Silesian Region, this value was about CZK 516,000 million CZK. In Vysočina region, this value was only about CZK 221,268 million CZK (Table 1; Fig. 1).

Based on the study of the same source (CZSO), it can be stated that in 2019, the number of enterprises with 100+ employees was about 250 in Prague, about 250 in Moravian-Silesian region, and about 145 in Vysočina Region. There were about 310 such enterprises in the whole Silesian Voivodeship in 2019.

The above connections are the reason why the hypothesis assumes the greater level of use of the anchoring effect in the Silesian Voivodeship. The Silesian Voivodeship therefore has the greater parameters, both GDP (the average value of GDP of all three examined Czech regions is smaller) and the number of enterprises with 100+

Table 1 GDP development in selected years

GDP development in selected years in mil CZK	2015	2016	2017	2018	2019
Prague	1,235,668	1,292,589	1,374,988	1,487,999	1,576,699
Moravian-Silesian region	434,859	449,737	470,767	499,986	516,237
Vysočina region	180,763	187,295	200,238	205,678	221,268
Silesian Voivodeship	1,229,351	1,256,363	1,328,963	1,381,217	1,428,210
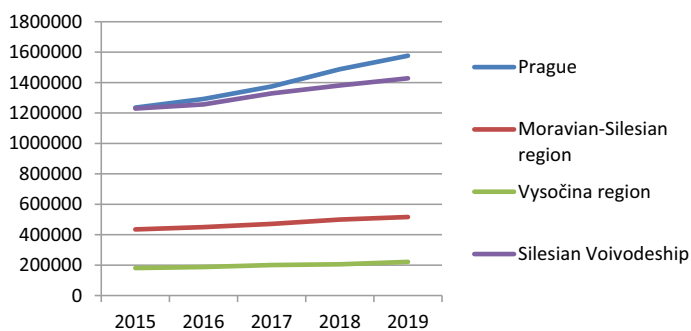
Fig. 1 GDP development in selected years

employees. There are therefore prerequisites for greater knowledge and the use of complex management methods.

The reasons why the above values are taken only until 2019 are the following:

- hypotheses from this research and from previous researches were drawn up at the beginning of 2020;
- in 2020, all economic data were affected by the pandemic;
- the time period is not important at all (a long-term view for creating the hypothesis is essential).

2.3   How Does the Anchoring Effect Work?

By definition, the anchoring effect is a heuristic where initial exposure to a number serves as a reference point. This number then influences later judgments about value. Simply stated, once an anchor is set, other judgments are made in reference to the anchor. Once the anchor has been established, we evaluate whether it's high or low and then we adjust our estimate to that amount. This mental process finishes early because we are not sure of the real amount. Therefore, our estimation is not usually far from the anchor. We have a huge tendency to use small pieces of information that we are offered to trigger decisions and estimates. The authors [11] showed that the strength of the anchor effect depends on the applicability of activated information. Other authors [6] review 40 years research on this very robust finding which occurs with many different judgments.

Basic anchoring occurs if people pay sufficient attention to the anchor value. Knowledgeable people are less susceptible to basic anchoring effects. Anchoring appears to operate unintentionally and nonconsciously in that it is difficult to avoid.

Anchoring effect has widespread influence, including on professionals who are well-educated on the related topic.

3   Paper Results

As mentioned above, the questionnaire was sent to 197 enterprises with 100+ employees in Silesian Voivodeship. The 81 managers from Silesian Voivodeship sent back the completed questionnaire. Thus, the rate of return was approximately 41.1%. The questionnaire survey also included a brief explanation of the anchoring effect.

It is evident that the author of the paper achieved a relatively high rate of return on completed questionnaires. The author assumes that the reasons for this high rate of return are mainly due to the fact that:

- the duration of the questionnaire survey was extended till the November 8, 2021;
- the questionnaire was created to take only about three minutes to complete.

Both of these reasons have been mentioned in the research methodology. These reasons are given here only for the presumed explanation of the high rate of return on the completed questionnaires.

3.1 The Description of the Required Research Data

The established hypothesis is: "Managers of Silesian Voivodeship enterprises with 100+ employees use anchoring effect at least 10% more often than weighted average of the three groups of managers, which are managers of Prague enterprises with 100+ employees, the managers of Moravian-Silesian region enterprises with 100+ employees and the managers of Vysočina region enterprises with 100+ employees". The values of the use of the anchoring effect from Prague, from the Moravian-Silesian region and from Vysočina region are determined from previous research and are as follows (Table 2).

Therefore, data from the Silesian Voivodeship are needed to verify the established hypothesis.

The most important results, which confirmed or refuted the established hypothesis, related to the knowledge of the anchoring effect and to the intensity of use of the anchoring effect. Managers who knew the anchoring effect had four choices. The first was that they did not use the anchoring effect to influence their employees. The second option was that they used an anchoring effect sometimes, but they used it very rarely and irregularly. The third option was that they use the anchoring effect on average once a month. The fourth option was that they use the anchoring effect on average at least twice a month.

It was offered to give respondents more options for answering. Finally, the author decided to give respondents only four options for answering because:

- the solved problem is still relatively unknown;
- the authors wanted to achieve a high rate of return.

Table 2 The application of the anchoring effect in three Czech regions

The application of the anchoring effect	Did not use (%)	Rarely and irregularly (%)	On average once a month (%)	On average at least twice a month (%)
Prague	37.2	27.9	20.9	14
Moravian-Silesian region	42.9	31.4	14.3	11.4
Vysočina region	43.8	37.5	9.4	9.4
Total (arithmetic average)	41.3	32.27	14.87	11.60
Total (weighted average)	40.93	31.80	15.45	11.83

Table 3 The knowledge of the anchoring effect

The knowledge of the anchoring effect	Yes (%)	No (%)
Prague	89.6	10.4
Moravian-Silesian region	89.7	10.3
Vysočina region	88.8	11.2
Silesian Voivodeship	90.1	9.9
Total (arithmetic average)	89.55	10.45
Total (weighted average)	89.68	10.32

3.2 The Results of the Enterprises with 100+ Employees from Silesian Voivodeship

The Knowledge of the Anchoring Effect

The 73 managers know the anchoring effect (out of 81 managers).

This question was not important to verify the hypothesis. The significance of this question was only to slightly manipulate the respondents and thus achieve credible answers in other questions. Nevertheless, let's show a comparison of the Silesian Voivodeship with Prague, Moravian-Silesian region, and Vysočina region.

It can be assumed that the values in Table 3 are influenced by the effort of managers to show that they know sophisticated management methods. Real results would be probably worse. However, this fact is not the subject and purpose of this paper.

The Application of the Anchoring Effect

Significant results:

- the first option (did not use the anchoring effect to influence their employees) = the 29 managers;
- the second option (used an anchoring effect sometimes, but they used it very rarely and irregularly) = the 26 managers;
- the third choice (use the anchoring effect on average once a month) = the 11 managers;
- the fourth option (use the anchoring effect on average at least twice a month) = the 7 managers.

3.3 The Evaluation of the Results

The authors evaluated a lot of context. Only those contexts that are decisive in relation to research hypothesis will be presented.

- Approximately 90.1% of managers of the enterprises with 100+ employees in Silesian Voivodeship know the concept of anchoring effect (73 out of 81).

- Approximately 60.27% of the managers of the enterprises with 100+ employees in Silesian Voivodeship have ever tried the anchoring effect or use it regularly (44 out of 73).
- Approximately 35.62% of the managers of the enterprises with 100+ employees in Silesian Voivodeship used an anchoring effect sometimes, but they used it very rarely and irregularly (26 out of 73).
- Approximately 15.07% of the managers of the enterprises with 100+ employees in Silesian Voivodeship use the anchoring effect on average at least once a month (11 out of 73).
- Approximately 9.59% of the managers of the enterprises with 100+ employees in Silesian Voivodeship use the anchoring effect on average at least twice a month (7 out of 73).

We can find the result for verifying the hypothesis and thus the result for fulfilling the main goal from Table 4. Both values of the percentage difference are less than 10%.

The Hypothesis Is Therefore Rejected

Table 5 shows the rate of using the anchoring effect in the Silesian Voivodeship. This fulfills the second goal of the paper.

Table 4 Comparison the anchoring effect application in Silesian Voivodeship with three Czech regions

The application of the anchoring effect	Use anchoring effect (companies that know this effect) (%)	Use anchoring effect (all incoming responses) (%)
Three Czech regions (weighted average)	59.08	52.84 (another result from the previous research)
Silesian Voivodeship	60.27	54.32
Percentage difference (converted to percentages from percentages)	2.01	2.80

Table 5 The rate of using the anchoring effect in Silesian Voivodeship

The application of the anchoring effect	Did not use (%)	Rarely and irregularly (%)	On average once a month (%)	On average at least twice a month (%)
Three Czech regions (weighted average)	40.93	31.80	15.45	11.83
Silesian Voivodeship	39.72	35.62	15.07	9.59

4   Discussion

The main goal of the paper was to compare the anchoring effect application in enterprises with 100+ employees in Silesian Voivodeship with enterprises with 100+ employees in three Czech regions which are Prague, Moravian-Silesian region, and Vysočina region. The authors predicted that managers of Silesian Voivodeship companies use anchoring methods at least 10% more often than weighted average of the managers of three Czech regions. Authors set one hypothesis in the beginning, and the results say that this hypothesis was rejected.

The second goal of the paper was to find out how often the anchoring effect is used in the Silesian Voivodeship. The results showed that the anchoring effect is used more often in the Silesian Voivodeship than in three regions of the Czech Republic. The fact that the hypothesis was rejected shows that the difference in the use of anchoring effect between Prague, Moravian-Silesian region, Vysočina region, and Silesian Voivodeship is not very significant.

The results further show that if managers know and use the anchoring effect, they use it relatively often. All results clearly show that the largest rate of use of the anchoring effect is in Prague.

According to the author, the research was limited by the following four parameters:

- the surveyed companies were not only from Jihlava (the capital of the Vysočina Region) but also from its surroundings (there are not so many enterprises with 100+ employees in Jihlava as in Prague)
- the surveyed companies were not only from Ostrava (the capital of the Moravian-Silesian region) but also from its surroundings (there are not so many enterprises with 100+ employees in Ostrava as in Prague);
- a huge part of enterprises with 100+ employees in the Czech Republic have foreign owners;
- the sample of respondents from the Vysočina region was not very large.

The results of the research provide further support for the understanding the anchoring effect, in particular in the awareness of the anchoring effect and its intensity of use.

In the future, it is possible to carry out similar research in other regions of the Czech Republic, in other regions of Poland, and in other countries in general. Author believes that this simple research will help initiate further research in this interesting field of behavior economics by using more specific questionnaire.

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Credit Rating of Chinese Companies Based on XGBoost Model

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Abstract With the outbreak of the COVID-19 epidemic, the global economy is on the downswing and the credit crisis is coming. In order to prevent credit risk and further standardize credit rating methods, this paper innovatively introduces the machine learning method-XGBoost model to credit rating based on financial indicator data of 1021 listed Chinese companies in 2020 and real bond default data in 2021. By comparing with the logistic regression model, it is found that the XGBoost model has better prediction effect, and its output index importance score can provide guidance for enterprises to manage their own credit ratings.

Keywords Credit rating · XGBoost model · Real bond default data

1 Introduction

Credit rating is a third-party agency that provides creditworthiness information to society, thus reducing the asymmetry of information in the capital market [1], which can be used by creditors to decide whether to purchase bonds or issue loans and by debtors to manage their credit rating. Since Moody's rated railroad bonds in 1902, the credit rating market has gained significant development, covering various industries in various countries. However, with the outbreak of the financial crisis in 2008, some scholars considered credit rating as one of the important factors triggering the financial crisis and questioned the validity of credit rating [2], and investors' trust in credit rating was reduced, thus the credit crisis broke out. To further regulate the development of the credit rating industry, prevent credit risks, and promote the healthy development of the financial industry, the global financial regulatory authorities have gradually carried out the reform of the credit rating industry, and the credit rating market in China is also being improved.

According to the assessment objects, credit ratings are classified as corporate credit ratings, securities credit ratings, national sovereign credit ratings, and other

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credit ratings. As an important part of corporate credit rating, listed companies are related to the smooth development of China's economy and the fundamental interests of investors. However, China's credit rating started late, the system of the credit rating market is not ideal, and the rating methods of rating agencies are relatively outdated. A credit rating method suitable for listed companies is of practical significance to promote the development of the rating market. In addition, due to the outbreak of the New Crown epidemic and the global economic downturn, rating agencies were pointed out to further aggravate the crisis of the New Crown epidemic at the G20 meeting on July 18, 2020 [3], and it is urgent for rating agencies to further regulate the rating system. In the process of economic recession to recovery caused by the COVID-19 epidemic, financial institutions bear the major task of providing funds for enterprises or other debtors, and how to help financial institutions judge whether to provide credit is an inescapable responsibility of rating agencies. Therefore, this paper will construct a credit rating model applicable to listed companies to further improve the methodological system of rating, restore market confidence, and protect the interests of investors.

Credit rating methods have evolved from subjective and qualitative in the early days to objective and quantitative in the later years. Moody's is one of the three authoritative international rating agencies, and its credit rating has five dimensions, including size, operating conditions, profitability, financial leverage and debt coverage ratio, and financial policies, and experts will score each indicator and then weight the final result of credit score. This method is usually based on experts' empirical judgment and is more subjective. To avoid this drawback, Altman developed a z-value model to predict whether a firm is about to go bankrupt by selecting five indicators from 22 financial ratios [4]. Wiginton et al. first applied the logistic regression model to credit rating [5] and found that the logistic model outperformed the traditional linear model. Wang et al. added regularization terms to the traditional logistic regression model and integrated it, considering the imbalance of the data, and found that the lasso-logistic integrated model outperformed the ordinary logistic regression model [6]. With the advent of the big data era, more and more factors affect credit rating, i.e., more and more dimensions of data indicators, machine learning algorithms represented by support vector machine (SVM),neural networks and XGBoost started to be applied to credit rating. Shams et al. used the SVM model and Multiple Logit model for Iranian banks' individual and corporate customers for credit rating and found that SVM model has more explanatory power than multiple logit model [7]. Zhou constructed a support vector machine model based on the nearest point of the kernel edge subspace for credit risk study of financial institutions to achieve effective classification of target customer credit defaults [8]. Yu et al. applied multilayer neural networks to credit evaluation and achieved good results [9]. Zhong et al. [10] compared and analyzed BP neural networks, ELM methods, I-ELM methods, and SVM methods and found that ELM methods and BP neural network methods showed better evaluation results in credit evaluation [10]. Li et al. applied the XGBOOST model to a personal loan scenario and found that it outperformed the logistic regression model in terms of feature selection and classification ability

[11]. Zhou et al. compared three classifiers, GBDT, XGBoost, and LIGHTGBM, and found that XGBoost has better predictive power for P2P lending data [12].

The above rating methods have achieved high prediction levels, but for the credit evaluation of listed companies, many scholars use "whether it is marked ST" as a label, but it is not directly related to the default risk of listed companies. As a result, this paper undertakes credit evaluations using real bond default data from listed companies. In addition, because the widely used logistic model and SVM model cannot explain the economic meaning of each indicator, the XGboost model can rank the importance of features, which can be a good guide for enterprises to manage their credit. Therefore, this paper will use the XGBoost algorithm for credit evaluation of listed companies.

2 Data

2.1 Data Source

The original data is mainly obtained from the bond section indicators of the CHOICE financial data terminal. According to the research content of corporate credit rating, this paper selects listed Chinese companies in the section of "all outstanding bonds" as the research object and selects their financial indicators in 2020 as the research sample. Since the default sample is small, the existing research mainly adopts whether the listed company is ST as the prediction label, but "whether it is ST" is not equal to the listed company's bond default, so this paper will select whether the listed company actually defaults as the prediction label, and classify 1021 listed companies into defaulted companies and non-defaulted companies according to whether they default for the first time in 2021. The 1,021 listed companies are divided into two categories: defaulted companies and non-defaulted companies, of which there are six defaulted companies and 1015 non-defaulted companies.

2.2 Indicator Selection

Concerning previous studies, this paper reflects the creditworthiness of listed companies in China by fully considering their profitability, cash flow, capital structure, solvency, operating capacity, and growth capacity. Table 1 shows the credit rating indicators selected for this paper.

Table 1 Indicators selected for credit rating of Chinese listed companies

Primary indicators	Secondary indicators	Primary indicators	Secondary indicators
Profitability	X1: Gross sales margin	Solvency	X11: Current ratio
	X2: Net sales margin		X12: Quick ratio
	X3: Net operating margin		X13: Total net cash flow from operating activities/total liabilities
	X4: Total net asset margin ROA		X14: Total EBITDA/liabilities
	X5: Return on total assets ROA	Operating capacity	X15: Inventory turnover rate
Cash flow	X6: Sales cash ratio		X16: Accounts payable turnover rate (including notes payable)
	X7: Net cash flow from operating activities/operating income		X17: Accounts receivable turnover rate (including notes receivable)
Capital structure	X8: Gearing ratio		X18: Fixed asset turnover rate
	X9: Current assets ratio		X19: Current asset turnover ratio
	X10: Non-current assets ratio		X20: Total assets turnover ratio
Growth capacity	X21: Net assets growth rate year-over-year	Growth capacity	X23: Net profit growth rate year-on-year
	X22: Year-on-year growth rate of total assets		X24: Operating profit growth rate year-on-year

2.3 Data Pre-processing

The steps of data pre-processing are as follows:

Step1: Descriptive statistics were first performed for each variable, companies with abnormalities in each indicator were removed according to the three-standard deviation method.

Step2: Missing value finding is performed, companies with serious missing values of each index are removed, and those that are not serious are interpolated with mean values. After processing the missing values and abnormal value processing, a total of 862 companies remain, among which there are 6 defaulting companies and 856 non-defaulting companies.

Step3: The maximum-minimum method is adopted to normalize the sample to avoid the influence of the magnitude.

Step4: Unbalanced data set processing. As can be seen from Fig. 1, the amount of data for Y (whether the company is in default) $= 0$ (not in default) is much larger than the amount of data for $Y = 1$ (in default). In order to train the model better, this paper adopts the smote method to synthesize the data for the positive sample ($Y = 1$), thus generating a data volume comparable to that of the negative sample. The processed dataset is shown in Fig. 2, at which time the data volume of both positive and negative samples is the same, which is 856.
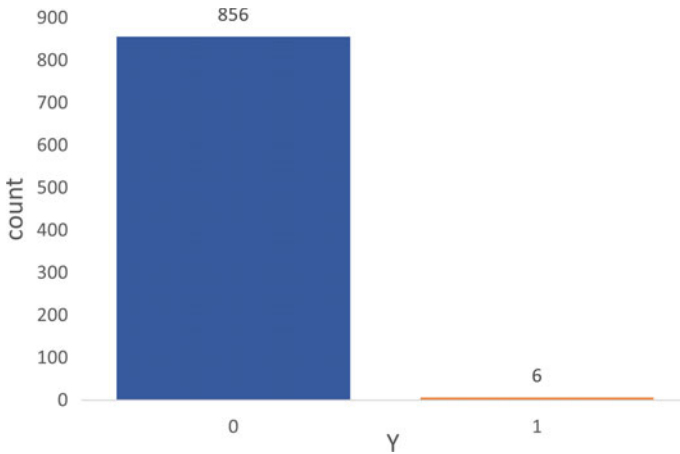
Fig. 1 Distribution of data volume of positive and negative indicators in the original data set
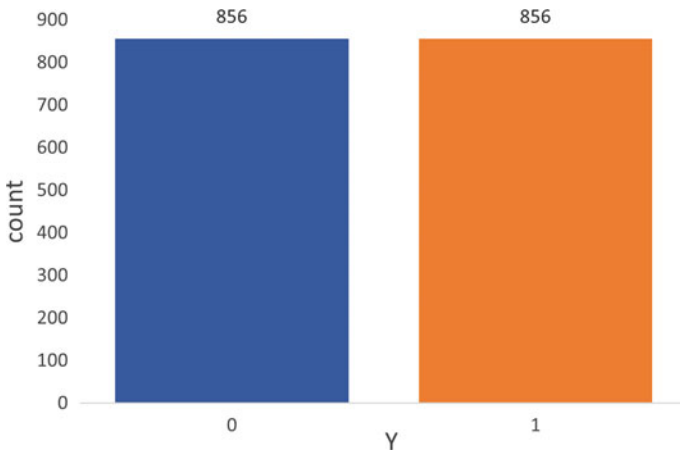
Fig. 2 Data volume distribution of positive and negative indicators for the processed dataset

3 Methodology

3.1 XGBoost Algorithm

XGBoost (extreme gradient boosting), often known as extreme gradient boosting, is an integrated learning algorithm proposed by Tianqi Chen in 2016 [13]. Integrated learning is a learning method that learns by multiple learners together and integrates the learning results of each learner to achieve better learning results than a single learner. The XGBoost algorithm is widely used due to its advantages such as high accuracy, high flexibility, and support for custom loss functions.

3.2 Principle of XGBoost Algorithm

The XGBoost algorithm is based on a modification of the GBDT algorithm, which commonly uses a CART regression tree as a learner. A CART regression tree is a type of decision tree that typically assumes that the trees are all binary trees and can be continually split based on features. The samples are mapped from the root node to the leaf nodes and form a score. Its structure is shown in Fig. 3.

The XGBoot algorithm corresponds to a model containing multiple CART trees, whose prediction function can be expressed as:

$$\hat{y} = \sum_{k=1}^{K} f_k(x_k) \tag{1}$$

$$F = \left\{ f(x) = \omega_{q(x)} \right\} \left(q : R^m \to T, \omega \in R^T \right) \tag{2}$$

where $\hat{y}$ is the predicted value, f_k is the model of the kth tree, ω is the fraction of leaf nodes, $q(x)$ is the leaf node corresponding to sample x, and T denotes the number of leaf nodes of the tree.

Fig. 3 Schematic diagram of CART structure
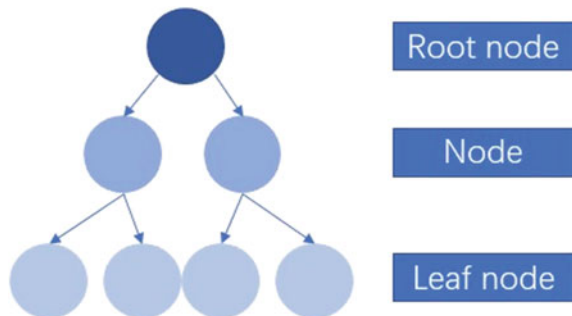
The complexity of each tree can be expressed as:

$$\Omega(f_k) = \gamma T + \frac{1}{2}\gamma w^2 \tag{3}$$

where T denotes the number of leaf nodes of the tree, γ and λ are the penalty term coefficients, and w denotes the mode of the leaf vector, i.e., the weights of the leaf nodes.

Setting the regularization term of the model can optimize the model, prevent overfitting, and improve the accuracy of the prediction set.

After setting the prediction function and regularization term of the model, the objective function can be defined as:

$$L(\varphi) = \sum_i l(y_i, \hat{y}_i) + \sum_k \Omega(f_k) \tag{4}$$

$$l(y_i, \hat{y}_i) = \frac{1}{2}(\hat{y}_i - y_i)^2 \tag{5}$$

where $\sum_i l(y_i, \hat{y}_i)$ is the loss function and the squared error term is chosen as its loss function, $\sum_k \Omega(f_k)$ is the regularization term, y_i is the true value, $\hat{y}_i$ is the predicted value, and i denotes the number of samples.

After defining the objective function, it needs to be optimized. The main purpose of the XGBoost algorithm is to optimize the score of each leaf node, i.e., $f(x)$. It is based on the idea that the newly generated tree needs to be fitted to the error term generated by the previous tree so that the loss of the model is continuously reduced. When t trees are generated, the predicted scores can be expressed as:

$$\hat{y}_t^{(t)} = \sum_{k=1}^{t} f_k(x_i) = \hat{y}_t^{(t-1)} + f_t(x_i) \tag{6}$$

where $\hat{y}_t^{(t)}$ denotes the prediction score when the model contains t trees.

At this point, the objective function can be rewritten as:

$$L^{(t)} = \sum_{i=1} l\left(y_i, (\hat{y}_t^{(t-1)} + f_t(x_i))\right) + \Omega(f_t) \tag{7}$$

At this point, we need to find a $f_t(x_i)$ to minimize the objective function. The idea of XGBoost is to approximate it by Taylor expansion when $f_t(x_i) = 0$. The objective function can be obtained as:

$$L^{(t)} = \sum_{i=1} \left[l\left(y_i, \hat{y}_t^{(t-1)}\right) + g_i f_t(x_i) + \frac{1}{2}h_i f_t^2(x_i)\right] + \Omega(f_t) \tag{8}$$

where g_i is the first-order partial derivative of the loss function L and h_i is the second-order partial derivative tree of the loss function L.

At this point, the regularization term $\Omega(f_t)$ is expanded to solve and substituted into the objective function, and the objective function is obtained as:

$$L^{(t)} = -\frac{1}{2} \sum_j^T \frac{\left(\sum_{i \in I_j} g_i\right)^2}{\sum_{i \in I_j} h_i + \lambda} + \gamma T \tag{9}$$

where $I_j = \{i | q(x_i) = j\}$ is the set of samples in the j_{th} leaf.

At this point, we obtain the scoring function $L^{(t)}$ of the XGBoost algorithm, and the lower the $L^{(t)}$ score, the better the effect of the model.

3.3 Credit Scoring of Listed Manufacturing Companies by XGBoost Algorithm

Following the establishment of the positive score model described above, the XGBoost algorithm is used to predict whether a listed company defaults or not. First, this paper divides the original data into a test set and a training set according to the ratio of 2:8. The XGBoost algorithm is then utilized to make predictions, and when using this model, its parameters need to be tuned. In this paper, Grid-SearchCV is used for tuning, which can help automatically tune the parameters, and it will output the prediction accuracy of the model and the optimal parameter values when the initial parameter values are given to the model. The model is adjusted step by step in the order of n_estimators, max_depth, min_child_weight, gamma, colsample_bytree, subsample, and reg_alpha. The results of the tuning parameters and the meanings of the parameters are shown in Table 2.

4   Results and Discussion

4.1   Model Rating Results

Table 3 shows the accuracy of logistic and XGBoost models on the training and test sets, and it can be seen that logistic regression achieves 100% accuracy on the training set and 98.54% on the test set, and XGBoost model achieves 99.63% accuracy on the training set and 99.41% on the test set, in comparison accuracy in the test set improved by about 1% compared to the logistic regression model.

In order to evaluate the predictive ability of the model, in addition to the accuracy index, we also need to evaluate the combined ability of the model. In this paper, we choose the ROC curve and AUC index to evaluate the comprehensive ability of the

Table 2 Parameters of XGBoost algorithm

Parameter name	Parameter meaning	Parameter setting value
learning_rate	The weight of the model generated by each iteration, i.e. the learning rate	0.01
n_estimators	Number of learners	79
max_depth	Maximum depth of the tree	5
min_child_weight	Sum of weights of the smallest samples in the child nodes	1
gamma	Descent value of the loss function required for further partitioning at the leaf nodes	0.0
colsample_bytree	Proportion of feature sampling to the entire feature set when building the tree	0.6
subsample	Proportion of subsamples used to train the model to the entire sample set	0.8
reg_alpha	Penalty factor for regularization term	0.1

Table 3 Accuracy of the model in the training and test sets

	Logistic model (%)	XGBoost model
Training data	100	99.63
Test data	98.54	99.41

model. The full name of the ROC curve is subject working characteristic curve, which is derived from the confusion matrix, with the horizontal coordinate representing the false positive rate and the vertical coordinate representing the true positive rate. The area enclosed by the horizontal axis under the ROC curve gets the value of AUC, the higher the value of AUC, the better the classification ability of the model. The maximum value of AUC is 1.

Figure 4 depicts the ROC curves of the logistic regression model, and its AUC value reaches 0.98, indicating that the model has a good prediction effect. Figure 5 shows the ROC curve of the XGBoost model, whose AUC value reaches 1.0, which is higher than that of the logistic model, suggesting that the predictive ability of the XGBoost model is better than that of the logistic model.

4.2 Feature Importance Analysis

The XGBoost model can obtain the importance scores of variables, and Fig. 6 shows the ranking of the importance scores of each financial indicator of listed companies, and Table 4 reflects the top 10 indicators in terms of importance. With the importance scores of secondary indicators, we can further obtain the importance scores of primary indicators. Table 5 and Fig. 7 reflect two dimensions of the importance scores of primary indicators: First, the importance scores of primary indicators are obtained
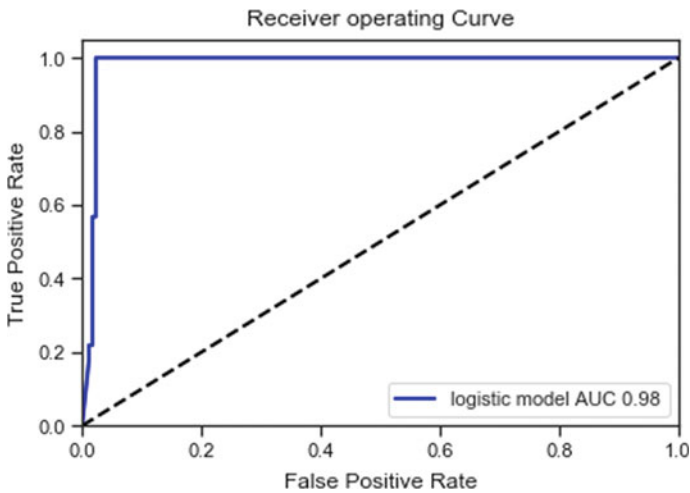
Fig. 4 ROC curves of the logistic regression model
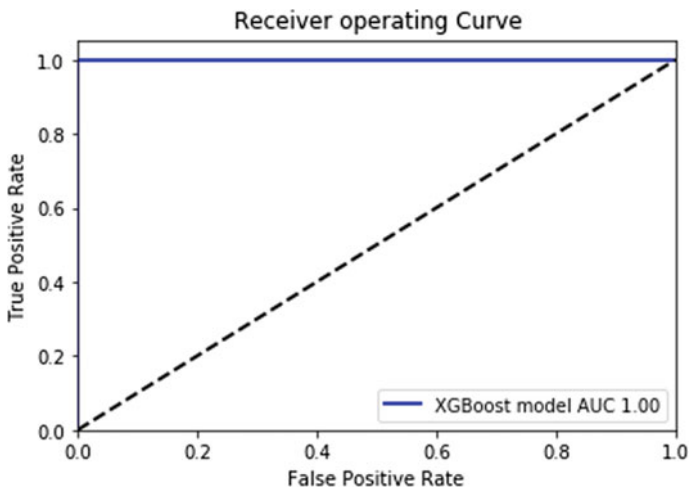
Fig. 5 ROC curve of the XGBoost model

by summing up all the importance scores of secondary indicators under primary indicators. Second, the importance scores of the top ten secondary indicators under the primary indicators are summed to obtain the importance scores of the primary indicators.

It can be found that the importance scores of solvency are the largest in both dimensions, while the importance scores of growth capacity, and cash flow are the smallest. The importance scores of profitability, operating capacity, and capital structure are not very different and are relatively large. In terms of the importance scores of the
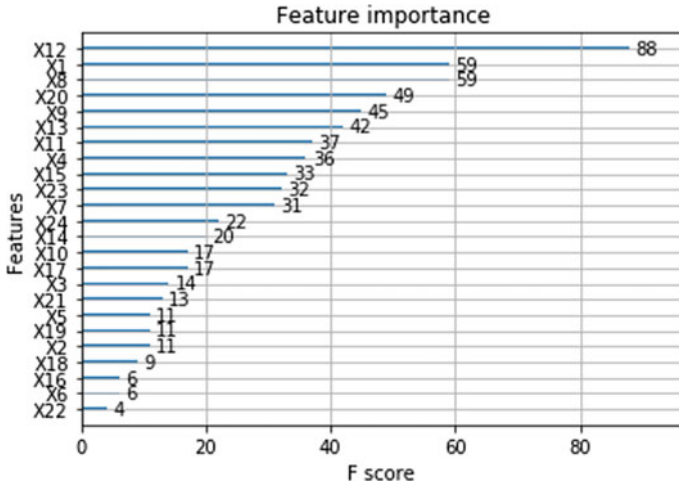
Fig. 6 Ranking the importance of secondary indicators

Table 4 Importance scores of the top 10 importance ranked secondary indicators

Indicators	Importance Score	Indicators	Importance Score
X12: Quick ratio	88	X13: Total net cash flow from operating activities/total liabilities	42
X1: Gross sales margin	59	X11: Current ratio	37
X8: Gearing ratio	59	X4: Total net asset margin ROA	36
X20: Total assets turnover ratio	49	X15: Inventory turnover rate	33
X9: Current assets ratio	45	X23: Net profit growth rate year-on-year	32

Table 5 Importance scores of primary indicators and their ranking

Indicators	Score sum (all indicators)	Ranking	Score sum (top ten ranked indicators)	Ranking
Solvency	187	1	167	1
Profitability	131	2	95	3
Capital structure	121	4	104	2
Operating capacity	125	3	82	4
Growth capacity	71	5	32	5
Cash flow	37	6	0	6
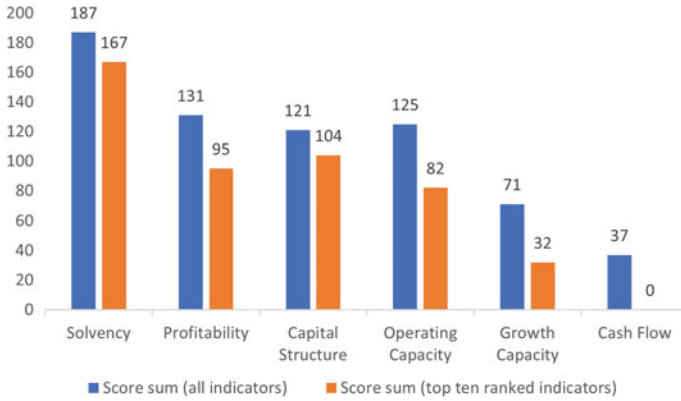
Fig. 7 Ranking the importance of primary indicators

primary indicators, solvency is the most important, profitability, operating capacity, and capital structure is the second most important, growth capacity is the second most important, and cash flow is the least important. In terms of the dimensions of the secondary indicators, the quick ratio is the most important, and the gross sales margin and gearing ratio are the second most important. Sales-cash ratio accounts payable turnover, and total assets year-over-year growth rate are the least important.

5 Conclusion

Credit rating has long been the focus of scholars and investors, and with the outbreak of the COVID-19, the pressure on credit rating agencies has further increased, and how to better improve credit rating methods is a significant issue in modern society. This paper constructs an XGBoost model based on the financial indicators of 1021 listed companies in 2020 and the label of whether the company is in default or not in 2021, replacing the label of "whether the company is in default or not" with the label of "whether the company is marked as ST", which can reflect the credit situation of the company more realistically. When compared to the logistic regression model, the XGBoost model is proven to be more effective in predicting company creditworthiness. This model can be used by investors and rating agencies for credit rating of listed companies. In addition, this paper uses the XGBoost model to rank the importance of model features and finds that the solvency index has the greatest impact on a company's credit rating, followed by profitability, operating capacity, and capital structure. Among them, solvency should focus on current ratio, quick ratio, and net cash flow from operating activities/total liabilities. Profitability should focus on gross sales margin and net asset margin ROA, and capital structure should focus on gearing ratio and current asset ratio. Operating capacity should focus on the inventory turnover ratio and total assets turnover ratio. Companies can focus on

managing their credit ratings based on the importance of indicators. It is suggested that future studies focus on the credit rating methodology for a specific industry.

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Trends in the Use of Validation Tools in the Tourism Sector: A Bibliometric Analysis

David García-Arango, Jefferson Quiroz-Fabra, Alejandro Valencia-Arias, Lina-Marcela Cifuentes-Correa, Wilmer Londoño-Celis, and Vanesa García-Pineda

Abstract Tourism as an economic sector plays a very important role in regions and economies around the world, being the object of study for the development of advances in different areas. One of these areas refers to developing tools that allow the measurement and subsequent validation of the variables and constructs to be measured. This study focuses on identifying trends in the scientific field by using validation tools within the context of tourism through a bibliometric analysis. There has been a growth in the use of these tools in recent years, showing a varied application of these tools in areas such as food service, lodging, and air transport, as a unit for measuring aspects related to service quality and user perception. On the other hand, there are advances related to sustainable development and tourism, integrating tools and results in the progress of sustainable practices in tourism programs. Similarly, analyses are made on the relationships of authors, countries, and journals through the quantity, quality, and structure indicators presented, helping to identify trends in the subject.

Keywords Validation · Scale development · Tourism · Bibliometric analysis

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1   Introduction

The development of the tourism sector worldwide is strongly affected by various factors and variables that both internally and externally correspond to multidimensional scenarios in the economic, social, political, cultural, technological, and in general, various aspects involving human activity [1, 2]. With the rise of new technologies and new ways of knowing, how tourists access different spaces has diversified, which should no longer only offer a look at different contexts or cultures but should also be oriented toward the recognition of sustainability as the main focus [3]. The above attends to the healthy balance between spaces of virtual interaction and spaces of in situ interaction that create an immersive experience much more holistic and closer to the expectations and demands of the client. In this sense, the manager's challenge is doubly complex: on the one hand, he/she must consider the growing demand for more and better experiences at the tourist level with a technological approach and highly active in social networks, and on the other hand, he/she must consider the importance of the sustainability of the proposals with a systemic and reticular approach.

In this study, a bibliometric analysis of the approaches that have been carried out in the components mentioned above is carried out, presenting those that have developed instruments with their respective validation. Efforts in this sense allow considering the importance of methodological rigor in studies related to the tourism sector as a way to contribute to the administrative field and generate knowledge bases that, in their essence, support the implementation of new forms of management with a holistic approach and adapted to current trends in cross-cultural contexts [4, 5]. The article first presents the methodology of the bibliometric review. Then the results are presented considering annual productivity, indicators associated with the journals, indicators associated with the countries, and indicators associated with the authors. Next, the discussion of the results is presented, and finally, the most outstanding components of the study are identified.

2   Methodology

This study seeks to identify the different trends around the use of different validation tools within the tourism sector, for which a bibliometric analysis was developed with a quantitative approach recognized by the use of analytical methods for the determination of the characteristic factors of the subject of interest under analysis [6]. Bibliometric analysis is used to understand the research field's behavior in a given area of knowledge. The study starts from the search for information, which is done with the Scopus database, selected for being a multidisciplinary and quality reference in publications in indexed journals [7], using the following designed search equation:

(TITLE(validity OR validation)AND TITLE - ABS - KEY(tourism)

AND TITLE - ABS - KEY(education OR development))

This search resulted in 102 documents that were subjected to an analysis to determine the thematic relevance around aspects such as productivity, authors, journals, relationships, and keywords, using a series of quantity, quality, and structure indicators. The different analyses were made using the Excel office tool and the specialized software for this type of analysis, VOSviewer [8].

3   Results

A series of indicators were obtained through the data obtained and subsequently analyzed. Those indicators made it possible to know the behavior of research activity in the topic of interest through aspects of the number of publications and citations related to authors, journals, and countries, as well as the associations of keywords as a basis for the analysis of trends.

In this way, quantity indicators refer to those focused on the number of developed publications, thus integrating aspects of scientific productivity concerning the topic of interest. Quality indicators relate to the number of citations that the different publications have in the field of knowledge, thus integrating aspects of the impact that such advances have on the development of this area of knowledge. Finally, the structure indicators refer to the woven relationships between terms and clusters formed between publications and authors.

3.1   Annual Productivity

This indicator relates to the number of publications that have been developed over time, with 1994 being the first year to record publications associated with the use of validation tools in tourism. As shown in Fig. 1, during the first years, there were very few publications in this regard until 2013, when a first production peak was observed. In general, different peaks of academic productivity on the subject can be observed, followed by decreases in the number of publications, with the year 2021 being the highest number of publications with 22 documents. There is a trend of growth in the subject, marked in recent years.
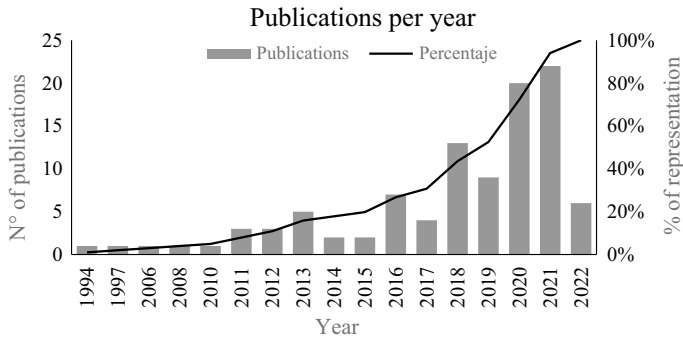
Fig. 1 Publications per year. *Source* Own elaboration

3.2 Indicators Associated with the Journals

First, the quantity indicator relates to the number of publications per journal. Scientific journals are relevant in the academic context since they are the means of disseminating the different advances in the areas of knowledge, thus being units for the communication of scientific knowledge. Figure 2 shows the journals with the highest productivity among those consulted. The journal Tourism Management (H-Index 199) stands out with 16 publications associated with the subject. This journal from the UK is characterized by bringing together articles related to management and planning in the travel and tourism sector. It has an interdisciplinary approach to the scope of tourism as a sector of the regional and global economy [9].

The Journal of Travel Research (H-Index 132), with nine associated publications, is the second journal with the highest number of associated publications. This journal focuses on publications associated with travel and development, management, marketing, economics, and behavior in the tourism sector [10]. Close behind, with a total of 7 publications, is the journal Current Issues in Tourism (H-Index 74), which has different articles associated with new developments in the tourism and hospitality sector, as well as methods and practices that are developed from different areas of knowledge [11]. The rest of the journals in the list have less than five associated publications, highlighting that, although most are directly related to tourism and its analysis, others are associated with marketing and sustainability, showing the versatility of the subject and its interdisciplinarity.

The indicator related to the impact of the different articles on the subject is directly linked to the number of citations that the journals have through these articles. Thus, Fig. 3 lists the journals with the most associated citations. The journal with the highest associated impact is Tourism Management, with 941 associated citations in the field for the articles published by this journal. This journal is also the one with the highest number of publications, so there is a direct relationship between these indicators, making it a point of reference in this subject due to its productivity and impact in the research field.

Publications per journal
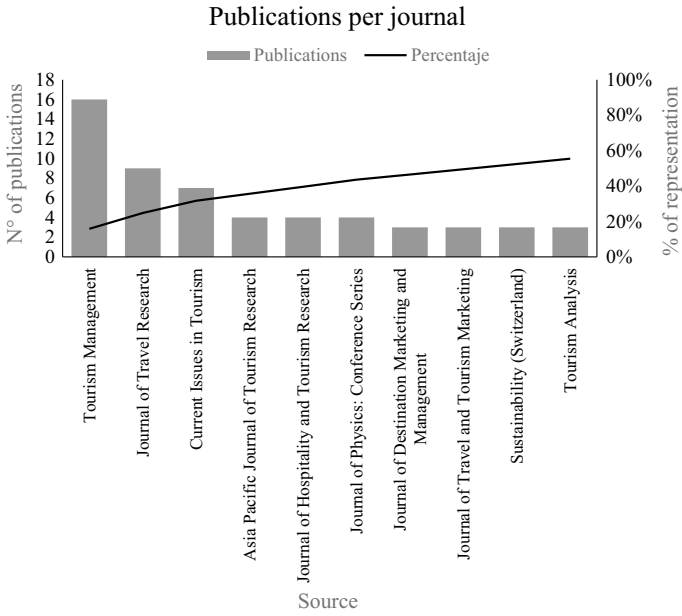
Fig. 2 Journals with the highest productivity. *Source* Own elaboration

Citations per journal
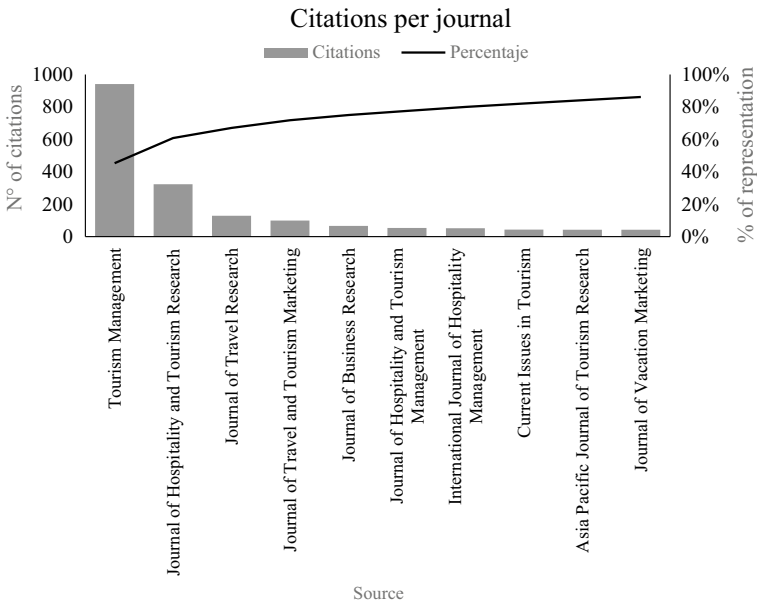
Fig. 3 Citations by journal. *Source* Own elaboration

The Journal of Hospitality and Tourism Research, with 323 citations associated with its academic products, is the journal with the second-highest number of citations. This American journal (H-Index 70) focuses on aspects directly related to tourism and management and aspects related to education, promoting advances in qualitative and quantitative methods and practices in the areas of interest [12].

The rest of the journals in the figure, with less than 130 associated citations, joint diverse topics directly related to tourism, the travel business, the hotel sector, and marketing efforts for the development of the advances that this sector needs from various points of view and sciences, required for the progress of this area of knowledge.

3.3 Indicators Associated with the Countries

Figure 4 shows the list of countries with the highest productivity contributions to the topic. This quantity indicator shows the USA as the leading country with 18 associated publications, followed by Spain and Taiwan with 12 and 11 publications, respectively. The participation of several Asian countries such as Indonesia, China, and Malaysia stands out for their tourist attractions and their approach to development, validating as an important component in improving their tourism experiences and knowledge on the subject.

Concerning the quality indicator, the USA also leads the list of countries with the highest number of citations associated with the publications made, with 861, followed by the UK with 389 citations, which is also the country with the highest number of publications (Fig. 4). In general, the countries with the highest production also have the highest number of citations, highlighting Slovenia and Turkey, which, although they are not among the countries with the highest production, have had
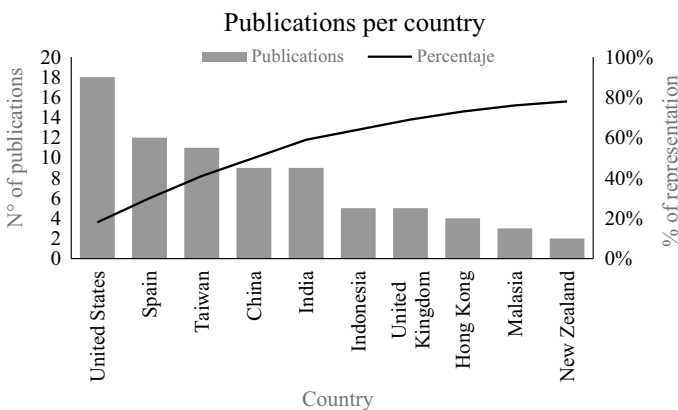
Fig. 4 Number of publications by country. *Source* Own elaboration

articles that have been well received in the academic field, making them stand out, whether from aspects of validation tools or tourism.

3.4 Indicators Associated with Authors

In terms of the distribution of publications according to authors, although there is one author who stands out as a reference in the subject, the topic is not dominated by only one group of academics. Rather, there is a distribution of publications among different authors. Figure 5 shows this phenomenon, where most authors have less than three publications associated with the topic of interest. The one who leads this list with six associated publications is the author Sheng-Hshiung Tsaur, a professor in the Department of Tourism Marketing and Management at the National Chiayi University in Taiwan who has great experience in tourism, hospitality, and recreation management. In his most recent article on the topic of validation in the tourism sector, he proposes the development of a scale for the validation of cultural competencies of tour leaders as a tool for travel and tourism agencies [13].

Among the authors with three publications, the collaborations between authors Ganghua Chen and Songshan Huang are based on the recognition of the characteristics of the identity of Chinese backpackers through the development of a validation scale, given the boom that this segment of travelers has had in recent years [14]. For their part, the authors Tianyu Ying and Jun Wen cover aspects related to the development of validation scales around Chinese tourists' motivations for consuming drugs and commercial sex in their international travels [15].

Regarding the quality indicator, Fig. 6 shows the authors with the greatest impact in the academic field about the number of citations of their articles developed in validation tools in the tourism sector.
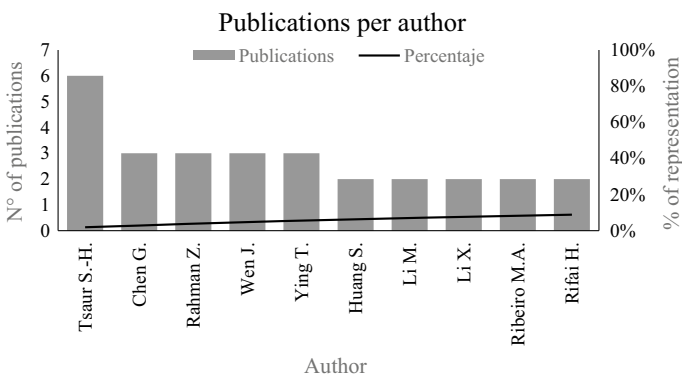
Fig. 5 Authors with the highest number of publications. *Source* Own elaboration

Citations per author
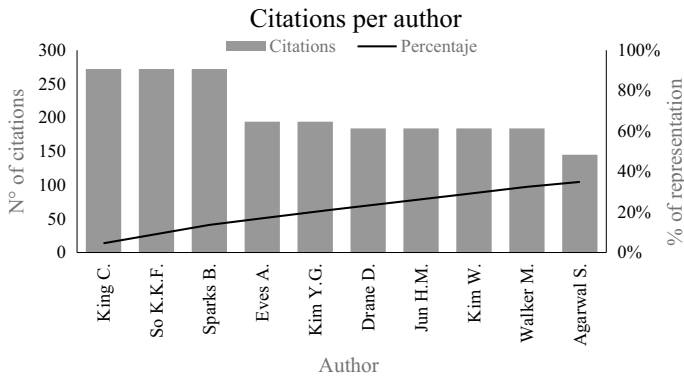
Fig. 6 Authors with the highest number of citations. *Source* Own elaboration

The authors with the highest number of citations are Kevin Kam Fung So and Beverley Sparks from Griffith University in Australia and author Ceridwyn King from Temple University in the USA. Their joint article has a total of 272 associated citations. It focuses on the concept of customer engagement as a trend in different industries, emphasizing the importance of its study in the area of tourism. These authors propose a validation scale for a sample of users of an airline and a hotel service, showing that customer engagement significantly influences the behavior, intention, and loyalty of users [16].

With 194 citations, authors Yeong Gug Kim and Anita Eves focus their attention on developing a validation scale regarding motivations and influences around food and beverage consumption in tourist destinations as a very important part of travel [17]. Authors Wonyoung Kim, Ho Mun Jun, Matthew Walker, and Dan Drane share authorship of a study with 184 citations, which discusses the perception of residents of a region in South Korea regarding the development of major sporting events that promote tourism in that region. The study proposes the design of a validation scale to evaluate the perceived social impacts of the development of this type of sporting event and which serves as a basis for its application in other similar scenarios.

3.5 *Keyword Analysis*

For the development of this analysis, two time periods were taken into account: one from 1994 to 2019, and the second from 2019 to 2022, to make a comparison and know the current state of the different topics. As can be seen in Fig. 7, there has been a considerable increase in the last period with several new emerging topics, such as Structural Equation Modeling, which refers to statistical techniques used to test and estimate causal relationships between data and assumptions, which have been integrated as a fundamental part in the development of validation tools [18].
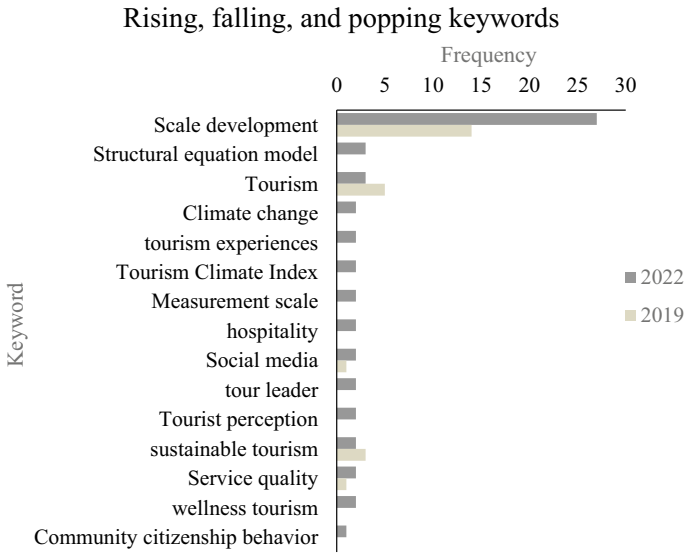
Fig. 7 Keywords analysis. *Source* Own elaboration

Other emerging themes are climate change, tourism experiences, tourist perception, and hospitality, among others, which are associated with the travel experience and the improvements that can be achieved in these aspects by using validation tools. Thus, the terms, measurement scale, become relevant within the advances in the development of this type of tool, as it provides validity within this type of exercise to measure, for example, the engagement of users of an airline or the well-being of a hotel service [16].

The theme with the greatest growth in both periods evaluated is Scale Development, which refers to the development of instruments that allow understanding of the phenomenon being measured to create new knowledge based on its causal relationships with the variables needed. This development allows both researchers and managers in the context of tourism to examine and put into operation different phenomena of importance in the field of interest by measuring sources and effects in various contexts [1].

Now, analyzing the different clusters that are formed and their relationships, it is noteworthy that there is a varied range of contexts in which to apply this knowledge on validation tools since the areas within tourism become targets for the development of measurement and validation scales. Tourism within its wide scope allows approaches in various areas, such as the hotel sector, a fairly close area in the travel business, so we have this cluster in green, as seen in Fig. 8. As mentioned above, the development of a scale to measure the level of well-being in a hotel [19] is the kind of study in which this type of tool is seen applied, as well as to measure the perception of users regarding the technological advancement that exists in the hotel sector [20].
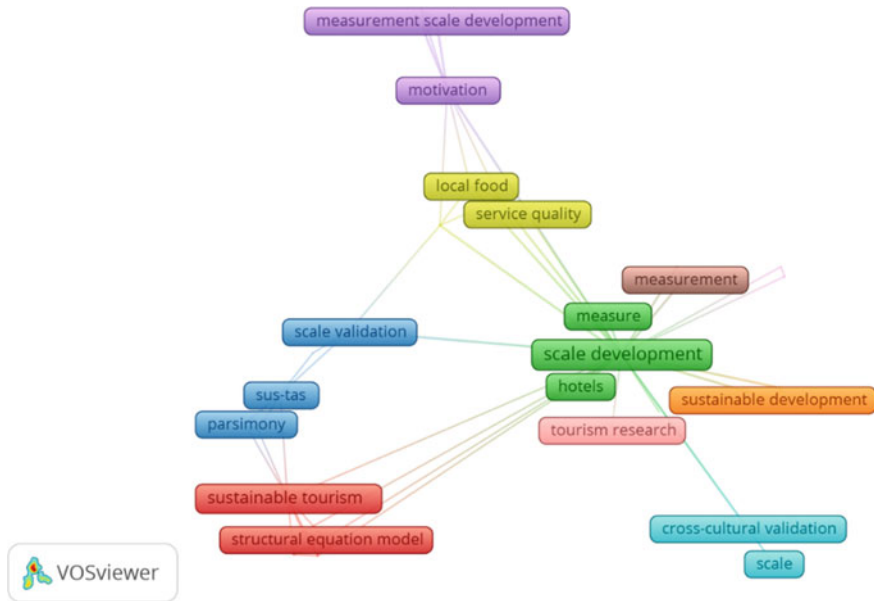
Fig. 8 Clusters analysis. *Source* Own elaboration with VOSviewer

Another study proposes the development of a scale for measuring the service quality of websites in the hotel industry [21].

The yellow cluster relates the issue of service quality and local food, which are factors of great importance within tourism experiences, as users have expectations and needs that demand to be taken into account. For service providers, it is important to understand the behavior of their customers. User preferences against local food trends were studied by [22], where a measurement scale is developed to validate behaviors against gastronomic trends. Another study measures the value of local food consumption from the tourist's perspective, demonstrating not only the validity of the instrument but also its applicability to other regions, where values may change due to regional differences [2].

The red cluster identifies another relevant topic given the boom in sustainable development, with much attention being paid to sustainable tourism as one of the trends in this area. In this aspect, there is the development of tools for measuring tourists' preferences regarding tourism experiences and accommodation options to the extent that they consider sustainable characteristics [3]. This helps to understand both preferences and demands in the current market for sustainability in tourism. There are also studies, such as the one developed by [23], which seek to validate the relationship between the capabilities of SMEs and the actions needed to integrate into nature tourism, integrating the perspective of tourism stakeholders in the region to learn about possible actions that integrate sustainability through innovation.

Another cluster of great interest is that of cross-cultural validation, illustrated in Fig. 8 in light blue. This cluster represents those studies whose aim is to determine whether the measures of the different constructs measured and validated in one region and/or culture are applicable and significant in another. In this regard, the study developed by [4], in which the personal development of backpackers is validated, starting from the results obtained in Chinese backpackers and then applied to Western backpackers, has very similar results on the constructs evaluated. Aspects related to gender and its relationship with the travel destination are measured in China and then tested in Western destinations. This study shows marked differences in some constructs, such as masculinity and femininity, that should be considered for marketing options and differential tourism program designs [24].

Regarding the inclusion of new technologies in the tourism sector, [25] proposes a validation in terms of content, design for learning, the validity of presentation, and language. In this aspect, the Aiken formula has been used through validation by experts from different areas of knowledge.

A resource that has been used to measure the perception of the inhabitants of a region regarding the development of sustainable tourism is called Sustainable Tourism Attitude Scale (SUS-TAS), which, as shown in Fig. 8, integrates a cluster (blue) with parsimony and validation scales. In a study developed by [5], the use is made of SUS-TAS to validate the scale in the Cape Verde Islands in Africa this being an example of a cross-cultural study in which sustainable development, measurement scales, cultural research, as well as cultural and social aspects specific to the region are integrated. This example illustrates in a general way how the scales of measurement and the validation process are applied as a tool of great interest to the tourism sector.

It can be seen how measurement scales and validation tools are used in different contexts, helping to model and better understand tourism's various dynamics. Sustainability plays an important role in the new trends in tourism, as it integrates new variables to be taken into account when choosing destinations and the type of experiences. This is why it is necessary to pay more attention to the development of measurement scales that allow us to know the habits of users in the context of sustainable tourism and ecotourism [26], as well as aspects related to the forms of transportation and lodging options that have less impact on the regions [27].

Another aspect to consider in the future studies is the impact of the pandemic caused by COVID-19, especially on the user's perception of risk [28]. It is, therefore, necessary for studies focused on developing measurement scales that allow knowing the perception of risk, the user's behavior in these contexts, as well as the motivation towards the trip, making comparisons of before and after, as well as studies that allow finding aspects to replicate in other similar situations.

The development of different models and scales of measurement allows advancement more and more in the construction of better ways to understand and relate the other variables related to tourism so that the very fact of generating knowledge in this aspect achieves more accurate results. However, something that is necessary is the study and development of cross-cultural validation studies. These studies would help

to extract good research practices from advances made in certain types of environments and to be able to use them in a methodologically acceptable way in different contexts to check if they work or how certain parts of them can be assimilated.

4   Conclusions

Although the topic has had a greater boom in terms of productivity and development of advances in recent years, the growth behavior of the topic in the academic community is recognized.

The international journal Tourism Management is a reference in the use of validation tools within the tourism sector since it is the journal with the largest number of associated publications and the one that registers the greatest impact through the number of citations.

The scope of this type of study extends throughout the world, being the regions with great tourism activity and development, those with greater participation in the various studies in which these measurement tools are applied, as is the case in Asian countries.

In recent years, there has been the emergence of new topics around scale measurements and validation processes, which are understood as the use of more associated resources or the application of the same in different scenarios. Validation tools constitute a versatile resource in their application to understanding phenomena and their relationships in all areas of the tourism sector.

Cross-cultural analysis and validation represent a valuable tool for measurement scales, as they allow affirming the usability of the findings in a region with specific characteristics and verifying their use in other regions or contexts, thus promoting the use of the advances of other researchers and their collaboration in the construction of new knowledge.

The development and subsequent validation of instruments oriented toward understanding the associated aspects related to phenomena and variables of the tourism sector is of great importance when introducing changes in management and administration. That is not only at the level of future improvements but also in terms of the inclusion of new technologies that significantly impact the user experience's improvement.

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Mapping Corruption Forms with Corruption Causes in Infrastructure Procurement of Pakistan

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Abstract The debate on mechanisms of corruption in the infrastructure sector is decades old. Numerous previous studies explored the many faces of corruption in infrastructure projects. Similarly, various studies indicated the causative indicators which instigate corruption in the infrastructure sector. However, very few studies focused on the formation of a conceptual link between corruption forms and their causes; therefore, this study aimed to develop a conceptual map of corruption forms and their causes. To achieve the aim 34 semi-structured interviews were conducted with industry practitioners in the infrastructure sector of Pakistan. The interview instrument was designed based on in-depth literature review findings. The results suggest that corruption causes and corruption forms are interlaced closely. Lack of regulatory mechanisms, weak morals, and harmful political interference breed acts of bribery, acts of discrimination, and acts of political mobilisation as corruption forms. This study is a valuable addition to the literature on corruption in the infrastructure sector. It may be taken as guidance to conduct more studies on mechanisms of corruption causes and corruption forms in other cultural contexts. The results may be helpful in the formation of effective anti-corruption measures.

Keywords Corruption forms · Corruption causes · Conceptual mapping of corruption · Infrastructure sector · Pakistan

1 Introduction

Infrastructure projects are complex and intricate. The technical scope, multiple stakeholder involvement, and project life cycle of a minimum of five to ten years make them vulnerable to corruption risks [1]. American Society of Civil Engineers reports that corruption costs up to 340 billion dollars in world infrastructure projects [2]. Infrastructure development is a backbone of any economy; the projects constitute building roads, hospitals, airports, and dams to water drinking plants [3]. The misuse of the

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allocated budget for infrastructure development projects results in a socio-economic imbalance in the country [4]. As a result, poor quality infrastructure, incomplete projects, cost and time overruns, and misappropriation of resources become a regular occurrence in any society [5]. The workings of corruption can be understood through demand and supply concepts [6]. The literature argues that the loop of corruption keeps running due to the presence of industry practitioners on the demand side and supply side of corrupt acts [7]. However, this model ignores those policy-makers and industry professionals who are genuinely working to eradicate corruption [8].

Moreover, the corruption mechanisms can never be measured on simple demand and supply indicators only. Undoubtedly, the notion of "corrupt induvial" is valid, but it cannot be the only reason for persistent corruption in the infrastructure sector. In support, the drastic improvement in corruption management in China can be taken as an example [9]. There is a lot more to investigate on the multiple faces corruption takes in the infrastructure sector. Therefore, various studies have been conducted to analyse corruption's forms in the infrastructure sector [10].

Corruption in the infrastructure sector takes various forms such as bribery, fraud, bid fixing, sharing of inside information, money laundering, and patronage [11]. These and many other corruption forms are instigated based on causative markers overlooked in the infrastructure sector [12]. Although many studies identify causative indicators of corruption, there is little or no research available in mapping corruption causes with specific corruption forms [13]. Identifying the link between these causative corruption markers and corruption forms can be the first step to developing a logical framework of how corruption works [14].

Multiple studies are focused on the formulation of effective anti-corruption measures for the infrastructure sector [15–18]. However, this paper focuses on developing a conceptual link between corruption forms and corruption causes. The motivation behind this research paper is to generate an understanding of the problem of corruption from its inception point. We argue that without having an in-depth knowledge of the corruption causes and the corruption forms in infrastructure projects, no effective solutions can be developed. The evolvement of literature on corruption led to various authors' identification of corruption forms and corruption causes [3, 5, 10]. Nevertheless, few studies focused on developing a link between corruption causes that instigate specific corruption form/forms. Thus, this paper fulfils this knowledge gap by drawing a conceptual link between corruption causes and corruption forms through literature and 34 semi-structured interviews.

The structure of this paper is as follows:

- First, we presented a brief account of literature on corruption forms and corruption causes in the infrastructure sector. Further, corruption in the infrastructure of Pakistan is discussed according to literature.
- Next, overview of the methodology adopted is given; we reviewed 39 articles on corruption forms and causes to develop a link between the two based on literature. Further, we conducted 34 semi-structured interviews to achieve a conceptual model of corruption forms and corruption causes.

- Then, the results of manual content analysis on data collected through semi-structured interviews are discussed in detail.
- At the end, the conclusion and future recommendations are provided, along with the limitations of this study.

2   Literature Review

The term "corruption" has multiple definitions. It comes from the Latin word "corruptus", which means to rot or broken [19]. In all disciplines, researchers have presented a different definition of corruption suitable contextually to that area [20]. Yet, there is consensus on corruption being referred to as moral weakness or wicked behaviour [21]. In the infrastructure sector, corruption is defined as a misuse of authority to achieve private or personal gains at the expense of a project [22]. The acts of corruption are divided into two broad types, i.e. small corruption and grand corruption [23]. Petty corruption refers to small gains such as bribes given and taken to speed up approval processes [22]. In comparison, grand corruption refers to big financial gains achieved through the misuse of power and resources by corrupt officials [24]. The infrastructure sector deals with both types of corruption. Petty corruption usually goes unnoticed as regulatory bodies are more focused on the management of persisting grand corruption, which is weakening the socio-economic development [24–26]. Consequently, a number of studies identified corruption forms and corruption causes to serve as a tool for the development of effective anti-corruption measures.

2.1   Forms and Causes of Corruption in the Infrastructure Sector

Corruption takes multiple faces in the infrastructure sector. One of the first forms of corruption identified in the literature is bribery [27]. The spread of a said form of corruption is persistent in every activity or infrastructure projects [28–30]. Recently, the OECD has revised recommendations for an anti-bribery framework in collaboration with 44 countries; Number one is to focus on training and awareness and the development of official agencies to detect corruption [30]. Another recent development was by the international organisation for standardisation (ISO) in 2016 to develop a corruption management framework targeting bribery prevention [31].

Along with bribery, the most common corruption forms in the infrastructure sector are fraud, embezzlement, fake companies, bid fixing, coercion, and collusive acts [32–35]. Brown and Lossemore [35] identified 11 forms of corruption, among which bribery, fraud, and collusion are common. In Transparency International's report, 14 forms of corruption have been identified within which lobbying, solicitation, client abuse, and fake companies are some distinctive forms which are yet to be

explored by scholars [32]. Owusu and Chan [27] proposed five corruption forms constructs which are bribery acts, fraudulent acts, extortion acts, discriminatory acts, and collusive acts. These several forms of corruption are associated with infrastructure procurement [5]. Every infrastructure project relies heavily on its procurement activities; time and again, research indicates that this is the process which faces a high volume of corruption [27, 28]. Understanding these corruption forms provide a basis for the formulation of combating measures. In this regard, the measures developed are whistleblowing, rigorous supervision, auditing, strict procurement rules, and a competitive bidding process, to name a few [25].

The corruption forms exist due to some causative markers, eradication of which may result in a corruption-free environment [27]. According to previous studies, presence of three factors in any scenario encourages corruption to prosper, i.e. presence of power, power to use economic resources, and weak regulatory mechanisms [4]. Unfortunately, these three attributes are dully present in the infrastructure sector. The officials enjoy the power of taking decisions with no or less accountability [9]. Another view is that infrastructure project nature plays a significant part in encouraging corruption. The projects have an intrinsic complex nature; within one project, many small projects are running simultaneously, requiring people of specific skill levels [11] and making it challenging to detect corruption at the early stages [13]. Usually, illegal activities are detected through poor quality final deliverables [15]. This realisation led to numerous valuable studies to identify corruption causes in the infrastructure sector. Some worth mentioning research is conducted by Owusu et al. [27], Zhang et al. [36], Le et al. [21, 22], Tabish and Jha [37], and Zou [38]. The study conducted by Owusu et al. [27] identified 44 causes presented in six constructs, i.e. project-specific causes, regulatory specific causes, organisational specific causes, and psychology specific causes. Another study by Zhang et al. [39] identified 24 causes presented in five primary constructs, i.e. project causes, regulatory causes, organisational causes, individual causes, and industrial specific causes. In a study conducted on the Chinese construction industry, Le et al. [21] identified ten causes of corruption presented in two main constructs, i.e. lack of positive industrial climate and flawed regulatory system.

2.2 Corruption in the Infrastructure Sector of Pakistan

The literature takes into account cultural dimensions for the identification of corruption forms and corruption causes. It is argued that the frequency of occurrence of a specific corruption form is stipulated with corruption causes in cultural context [23]. For example, a study conducted by Le et al. [21, 22] in the Chinese construction sector to study the causal links of corruption indicated that corruption is rampant in China due to weak regulatory mechanisms, whereas Bowen et al. [6], in their study of the African construction sector, identified lack of transparency as a number one cause of corruption. The studies conducted by Osei-Tutu et al. [29] and Zambia Sichombo et al. [38] in Ghana stated that barriers to reporting mechanisms are a

major cause of corruption in Ghana's construction industry. In Vietnam, one of the leading corruption causes in the construction industry is a lack of moral standards and personal greed [33].

It should be noted that diverse cultural contexts face unalike causes of corruption that are more frequent than others and encourage specific corruption forms. In the case of Pakistan as a developing country, the weak rule of law and lack of transparency is indicated to be the primary cause of corruption in the infrastructure sector [2]. A report by OECD indicates that infrastructure procurement of infrastructure projects in Pakistan is heavily affected by corruption due to poor or weak procurement laws [5]. The studies conducted in the context of the construction sector of Pakistan highlight that bribery, and bid fixing is a norm in the procurement process of any infrastructure projects [18]. Many recent studies attribute it to the lack of effective regulatory mechanisms in the country [19]. More detailed studies are required on corruption forms and corruption causes in the infrastructure sector of Pakistan to develop a strategic plan of corruption mitigation [18, 19, 40]. Therefore, this paper aims to conduct an in-depth study on developing a conceptual link between corruption forms and corruption causes based on a rigorous literature review and primary data collection through semi-structured interviews.

3 Methodology

The methodology adopted is explained below in two phases.

3.1 Questionnaire Design Through Literature Review

A step taken further in the detailed literature review was to develop a mapping (Table 1) of corruption forms and corruption causes in the infrastructure sector. It is a valuable effort to help industry practitioners and policy-makers. This exercise aimed to establish a link between corruption causes and corruption forms. In lieu, 39 publications were shortlisted from renowned journals *like the Journal of construction management, IJPM, Journal of Management Studies, and PMJ.* The Journal selection was based on Chau's ranking [3]. Moreover, *Journal of public administration and policy research, Journal of management in engineering, &Construction Management and Economics, Engineering, Construction and Architectural Management,* Jordan *Journal of Civil Engineering. The articles reviewed also included conference papers.*

The articles were searched using keywords; corruption causes in infrastructure procurement, corruption forms in infrastructure procurement, a link between corruption forms and corruption causes in infrastructure procurement, and corruption in the infrastructure sector. The search revealed 100 publications related to corruption causes and forms in the infrastructure sector.

Table 1 Mapping of corruption forms with corruption causes

Forms of corruption	Causes of corruption	Publications
Acts of bribery Acts of fraud Acts of discrimination Acts of political mobilisation	Social and individual causes Organisational causes Regulatory causes	[1, 2]
Acts of bribery Acts of fraud Acts of coercion Acts of misconduct	Project causes Organisational causes Regulatory causes Social and individual causes	[3–5]
Acts of bribery Acts of fraud	Social and individual causes Organisational causes Regulatory causes	[4, 5]
Acts of bribery	Regulatory causes Social and individual causes Organisational causes	[6–15]
Acts of bribery Acts of political mobilisation	Social and individual causes Political causes Regulatory causes Organisational causes	[12, 16]
Acts of bribery Acts of coercion Acts of political mobilisation	Social and individual causes Political causes Regulatory causes	[13, 17–23]
Acts of bribery Acts of discrimination	Organisational causes Social and individual causes Project causes	[16, 20, 23]
Acts of bribery Acts of fraud Acts of misconduct Acts of discrimination	Social and individual causes Regulatory causes Organisational causes	[18, 23–26]
Acts of fraud Acts of bribery Acts of political mobilisation	Regulatory causes Political causes Organisational causes	[22, 26–28]
Acts of misconduct Acts of discrimination	Political causes Organisational causes Social and individual causes	[24, 28–32]
Acts of bribery Acts of misconduct Acts of coercion	Social and individual causes Political causes Regulatory causes Project causes Organisational causes	[29–39]

1 = Brown and Loosemore [7]; 2 = Le et al. (2014a, b); 3 = Tabish and Jha (2011); 4 = Sohail and Cavill [35], 5 = Ling and Tran (2012); 6 = Bowen et al. [6]; 7 = Stanbury (2009a, b); 8 = Ning (2014); 9 = ling et al. (2014); 10 = Chan et al. (2003); 11 = Zhang et al. [40], 12 = Tanzi (1998); 13 = Liu et al. (2004); 14 = Moodley et al. (2008); 15 = Zarkada-Fraser and Skitmore (2000); 16 = Alutu (2007); 17 = Porter (1993); 18 = Shan et al. (2016a); 19 = Damit (1983); 20 = King et al. (2008); 21 = Fan and Fox (2009); 22 = Shan et al. (2015b); 23 = Boyd and Padilla (2009); 24 = Hartley (2009); 25 = De Jhong et al. (2009); 26 = Khrishnan (2009); 27 = Locatelli et al. (2016); 28 = Shan et al. (2015b); 29 = Shan et al. (2016b); 30 = Gunduz and Onder (2013); 31 = Sumah (2018); 32 = Rahman [31], 33 = Campos et al. (2019); 34 = Owusu et al. [27], 35 = Ebekozien (2019); 36 = Zulu and Muleya (2019); 37 = Ibrahim et al. (2019); 38 = Ebekozien (2020); and 39 = Yap et al. (2020)

A thorough review of these 39 articles helped us develop Table 1, which provides clear pictures of which corruption causes are linked with which corruption forms. These 39 publications were shortlisted based on identifying forms and causes of corruption in infrastructure project procurement.

Table 1 indicates that most of the studies consider bribery is taken and given due to a lack of ethical training and the influence of social networks [6, 8–10, 14, 15, 25, 27–29]. It is further explored that acts of political mobilisation are linked with the influence of government, political interference, and the appointment of representatives [40]. A study conducted by Le et al. [21] identified that bribery occurs due to low ethical standards; fraud occurs due to no organisational checks; discrimination occurs due to a lack of regulatory mechanism; and political influence occurs due to project complexity.

In Table 1, we have consolidated corruption forms in constructs of acts of bribery, acts of misconduct, acts of fraud, acts of political mobilisation, and acts of coercion. Similarly, the corruption causes are consolidated in constructs of project causes, regulatory causes, social and individual causes, organisational causes, and political causes. This consolidation of corruption forms and corruption causes was based on the relevancy of acts and a better understanding of the reader.

A brief explanation of the constructs is given below.

Constructs of Corruption Forms

The constructs of corruption forms are acts of bribery, acts of misconduct, acts of fraud, acts of political mobilisation, and acts of coercion. In Fig. 1, each construct's corruption forms is grouped on their proximity of relevance. For example, bribery, kickbacks, bid fixing, coalition, lobbying, solicitation, and unfair restriction of competition are all included in acts of bribery [6, 8–10, 14, 15, 18, 19]. Similarly, threats, blackmailing, intimidation, client abuse, extortion, and renegotiations are all acts of coercion [33]. Numerous publications identify kickbacks as a form of bribery [32]. Further, studies conducted by Le et al. [21, 22], Brown and Loosemore [7], and Tabish and Jha [37] take influence peddling, image building, and distorted spending patterns as acts of political mobilisation.

Lack of regulatory mechanism leads to a perpetual increase of acts of misconduct [16]. Acts of misconduct include inside information sharing, professional negligence, conflict of interest, unlawful possessions, and greasing the palms [13]. A recent study conducted by Yap et al. [39] acknowledges project complexity as a cause to encourage acts of misconduct along with weak regulatory systems.

Ebekozien [11], in his research on the construction sector of Nigeria, advocates that blackmailing, threats, intimidation, and renegotiations (acts of coercion) are associated with competitive tendering, performance-based salaries, job insecurity, and bad economic conditions.

Constructs of Corruption Causes

The corruption causes constructs are presented in Fig. 2. The corruption causes constructs to include project causes, regulatory causes, political causes, organisational causes, and social and individual causes. The causes in the constructs have
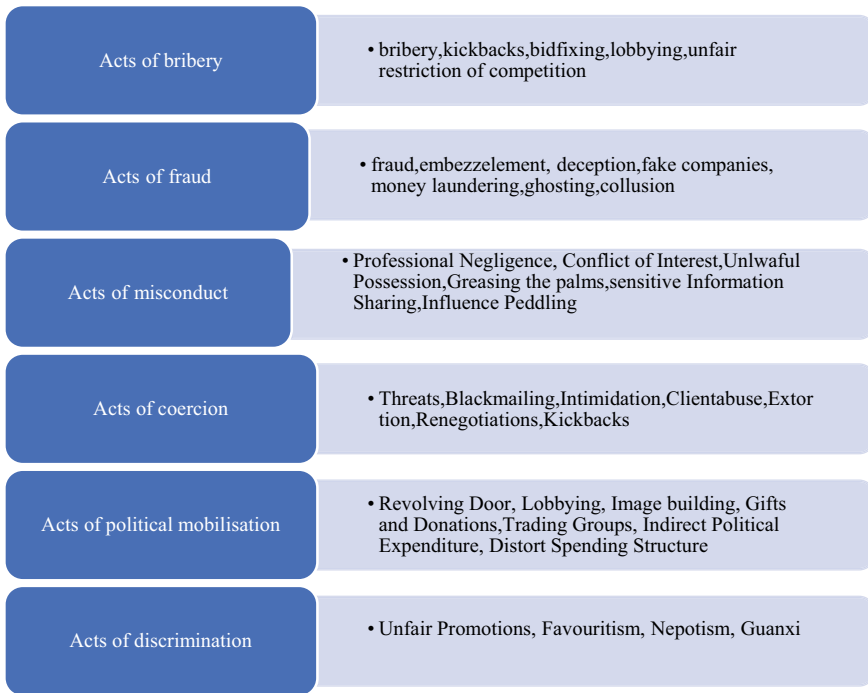
Fig. 1 Constructs of corruption forms (developed by authors)

been consolidated based on their relevancy to each other in literature. For instance, low ethical standards, close relationships, corrupt role models, and greed are grouped as social and individual causes as all these traits are individual and social attributes [14, 17, 27, 28, 33]. Shan et al. [33] conducted a study on the Chinese construction sector and discovered that social networks and low ethical standards are primary causes of bid fixing, bribe culture, lobbying, and kickbacks. In a recent study by Fazeka and Toth [12], it was found that renegotiations and unfair restrictions of competitions are associated with the presence of strong social networks.

Likewise, lack of supervision, weak procurement structure, and feeble governance mechanisms, to name a few, are a part of regulatory causes. The corruption forms of ghosting, fake companies, and fraudulent acts are rampant when regulatory frameworks are weak [35].

An interesting finding during the literature review is political causes. The political causes include government influence, monopoly, the transition of governments, appointment of representatives, and concealment of corruption [4, 5, 10]. Although many studies identify political interference as a corruption cause, more in-depth research is required to draw meaningful conclusions. For now, most studies on indirect political expenditure distort spending patterns, unfair contract awarding to harmful political interference [40].

Social and indivual causes	• Low ethical standards,Close relationships/close knitted networks,.Corrupt role models, Greed,Negative encouragement, Gnauxi
Project nature causes	• Complex nature,.Numerous permits and license,Complex contracts,Lack of standardized project practices, Multi certificates requirement
Regulatory causes	• Lack of supervision, Inadequate legal rules,Poor regulation system,Lack of efficient administration,Lack of punishment and penalties,Lack of control mechanism, Lack of anti-corruption mechanism, Deregulation in Public construction, Weak procurement structures, No transparency
Organisational causes	• Bad economic conditions, Competitive tendering, Low salaries, Poor working conditions, Delayed salaries,Lack of legal awareness, Lack of communication within departments, Job insecurity, Competition within organization
Political causes	• Influence of Government,Political changes/transition of economy, Concealment of corruption, Appointment of representative, Negative political interference and influence,Monoply, Not focused on public interest

Fig. 2 Constructs of corruption causes (developed by authors)

Another critical dimension of the construction sector is its project nature, which causes corruption [3]. Infrastructure projects have a technical scope with specific requirements, making it easier for corrupt players to manipulate them [35]. The multiple licence requirement, approvals, involvement of several skilled professionals and various quality checks encourage bribery to speed up the process.

There are some other causes which encourage the manifestation of corruption. These corruption causes are related to the organisational environment and hence grouped as organisational causes. Organisational causes include low salaries, cut-throat competition, poor working conditions, limited promotions, and competitive tendering process [27]. Monteiro et al. [25] argue that bad economic conditions and perpetual increase in inflation with no or less increase in salaries drive individuals to involve in bribery, sharing inside information, threats, and blackmailing.

The in-depth literature review helped us formulate Table 1, which provides the layout of mapping corruption forms with corruption causes. This consolidation provided us with the basis to design our interview questions.

3.2 Semi-structured Interviews

Thirty-four semi structured interviews were conducted with industry experts in infrastructure sector of Pakistan. The sample was selected based on an expert sampling approach by selecting individuals of specific skills and experience working in Pakistan's infrastructure sector for more than 5 years. The interviewees included project managers, project consultants, procurement officers, quality assurance officers, etc. The details of respondents are given in Table 2.

As topic of corruption in infrastructure sector is a sensitive issue, we assured respondents that all personal details were kept confidential. The study has ethics clearance from ethics committee at Teesside University and is a part of final thesis of DBA program.

The interviews were conducted for four months, from November 2021 till February 2022. The interviews' questions were designed to extract meaningful experiences and understandings of respondents towards corruption causes and corruption forms prevailing in infrastructure sector [4, 8, 17].

Table 1 was presented to respondents as a guideline of mapping of corruption forms with corruption causes along with explanation of how it is formulated based on literature review of previous studies. The current study aimed to establish the mapping of corruption forms with corruption causes in the context of the infrastructure sector of Pakistan.

Table 2 Respondent profile

Respondents job roles	Number of respondents	Years of experience (years)	Work location
Assistant project managers	5	5–10	Islamabad
Senior project managers	4	10–15	Islamabad
Procurement officers	3	5–10	Islamabad
Contract managers	2	10–15	Islamabad
Quality assurance head	1	10–15	Rawalpindi
Quality assurance team	8	5–10	Islamabad
Project consultants	3	15–20	Rawalpindi
Procurement team	8	5–10	Rawalpindi

4 Results and Discussions

The collected data was analysed following Braun and Clarke's [5] thematic analysis approach to extract meaningful interpretations of standard responses. The data were subjected to open coding initially by following a line-by-line assessment to generate codes. Once codes were established, the number of instances each code mentioned was recorded using Microsoft Excel. Also, colour coding was followed throughout all transcripts using Microsoft Word. Both approaches were followed to discard any possibility of biasedness in results. Further, the data was analysed, categorised, and organised concerning mapping corruption forms with corruption causes (Sect. 3.1).

The emerging themes found in the data are corruption forms in infrastructure procurement, corruption causes in infrastructure procurement, and the conceptual mapping of corruption forms and corruption causes.

4.1 Theme 1: Corruption Forms in the Infrastructure Procurement

Infrastructure procurement is vulnerable to corrupt practices in Pakistan [1]. The first case reported corruption in the infrastructure sector was bribery [6]. Bribery is most commonly found in procurement activities; favouritism, bid fixing, and sharing of inside information are a few others [2]. When asked about corruption in procurement, respondents numerous times mentioned the presence of bribe culture, collusion between bidders, pre-decided contract winners, and the presence of fake front companies as corruption forms. In response to a question about corruption forms in procurement activities, IR11 said,

> Unfortunately, in Pakistan, giving and taking bribes has become a norm and is not considered bad at all. Rather, it is expected to do an exchange of money for any work that is a legal duty of the individual in power.

> IR16 shared his experience,

> We all are well aware of bid fixing, collusion and fraudulent acts prevalent in the procurement of construction contracts, many times contract is awarded to a favored group by twisting the technical project requirements.

The corruption forms acknowledged by respondents were somewhat similar to literature verdicts. Based on the data collected, we have formulated Fig. 3 to provide a better understanding of corruption forms in the procurement sector of Pakistan to the reader. A pre-designed list developed by authors (Fig. 1) of corruption forms based on a thorough literature review was shared with respondents to rank the corruption forms on a scale of very common to not common (Fig. 3).

The results in Fig. 3 show that 80% of respondents considered acts of bribery and acts of fraud as very common. Surprisingly, 60% of respondents considered political forms of corruption fairly common. The corruption forms related to professional
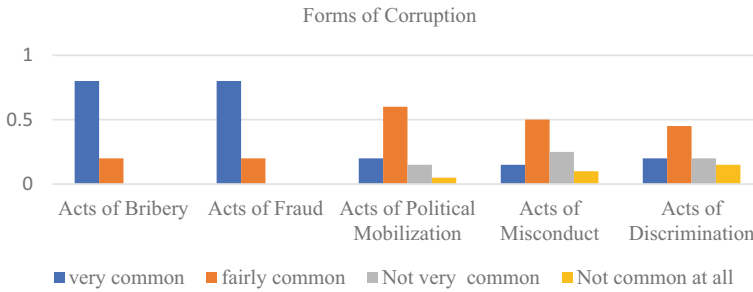
Fig. 3 Forms of corruption in the infrastructure procurement

negligence (acts of misconduct), sharing inside information (acts of misconduct), and favouritism (acts of discrimination) were considered fairly common by 50% and 45% of respondents, respectively.

The results below indicate that almost all corruption forms indicated by literature are prevalent in Pakistan's infrastructure procurement. As indicated by Khattak and Mustafa [18], bribery, misuse of power, ghost companies, and harmful political interference are embedded in the infrastructure sector of Pakistan.

4.2   Theme 2: Causes of Corruption in the Infrastructure Procurement

Causative indicators of corruption in the infrastructure sector are diverse and dispersed. According to Blackburn and Sarmah [4], project complexity and weak regulation mechanisms can primarily cause uncountable corruption practices. In the case of Pakistan, the lack of transparency, the weak rule of law, and feeble governance structures are adding fuel to the fire of corruption [1]. The interview data findings are in line with literature conclusions. IR 2 shared his experience,

> We have PPRA (Public Procurement Regulatory Authority) to provide us guidelines of procurement processes and activities. Unfortunately, there are many loopholes in the rules of PPRA, which makes political interference easy. For decades in Pakistan, the weak rule of law and absence of regulatory frameworks have affected the execution of fair and transparent procurement activities. In addition, few contractors in the market can fulfil technical project requirements; hence lobbying and solicitation is a common practice.

It is clear from the above response that corrupt individuals take advantage of project complexity, lack of competition, and the weak rule of law [7]. To further validate our findings, we shared a pre-designed list of corruption causes (given in Fig. 2) developed by authors after a thorough literature review to rank the causes on a scale of very common to not common at all.

Figure 4 depicts rankings of corruption causes; the primary corruption cause identified by 70.50% of respondents was project complexity and multiple approval
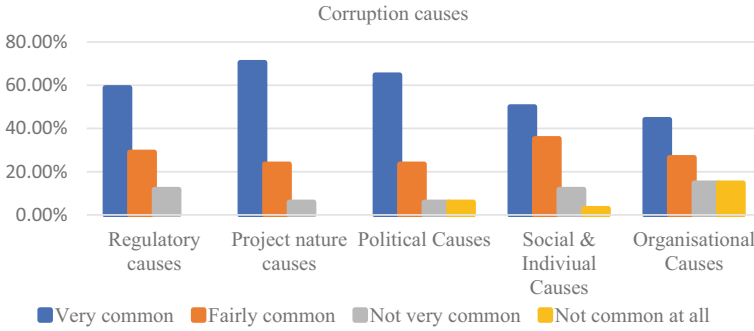
Fig. 4 Causes of corruption in the infrastructure procurement

processes. 64.70% ranked harmful political interference as a very common corruption cause, whereas 58.80% of respondents ranked weak regulatory framework as a very common corruption cause.

These results provide a clear warning for industry practitioners and the government of Pakistan to strengthen their regulatory frameworks so that no illegal interference can hamper the procurement process of the infrastructure sector.

4.3 Theme 3: Conceptual Mapping of Corruption Forms with Corruption Causes

Numerous previous studies indicate a relationship between corruption forms and causative markers of corruption [6, 27, 28, 30, 31]. To better understand how corruption forms are related to corruption causes, we have developed a conceptual mapping of both based on literature review and interview data (Fig. 5). The interview findings suggest that one or more corruption forms can be caused due to one or more causative markers. For example, IR 12 said,

> Bribery is deep-rooted in our procurement activities due to economic conditions, political influence and no fear of getting caught.

The above and various other responses on causative indicators of corruption forms validated that corruption mechanisms are complex. There is no linear relationship between corruption forms and causes; however, curbing one type of cause may be effective in curbing various corruption forms, as depicted in Fig. 5.

Figure 5 depicts that almost every corruption cause encourages acts of bribery in procurement processes. A study conducted by Le et al. [21, 22] argues that the primary face of corruption is bribery in all sorts of infrastructure environments. Political instability, bad economic conditions, and the weak rule of law allow corrupt politicians to
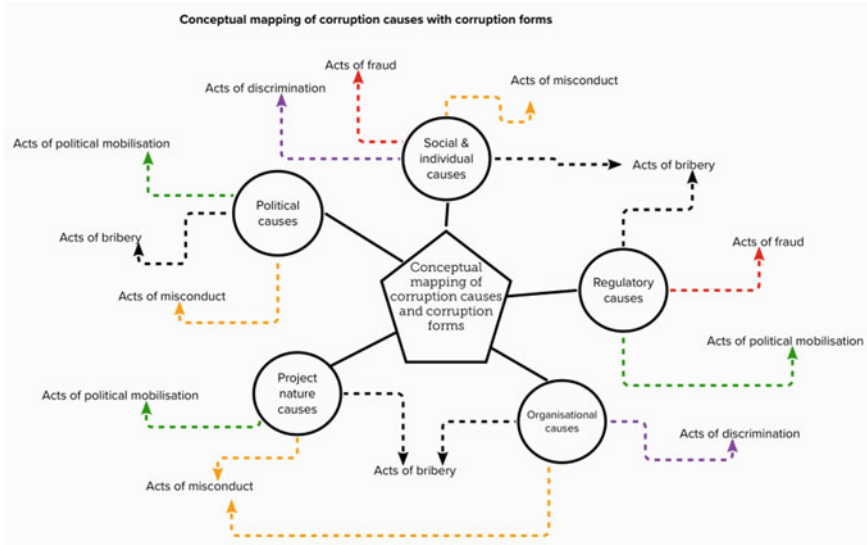
Fig. 5 Conceptual mapping of corruption forms with corruption causes (developed by authors)

extract millions of dollars through infrastructure projects [20]. The interview findings suggest that in the case of Pakistan, open political interference takes the form of making fake front companies entice millions of worth of infrastructure projects.

In comparison, fraudulent activities are frequent due to regulatory causes, including lack of supervision, no accountability, and zero penalties and punishments in Pakistan. The conceptual mapping given above is a helpful snapshot of how corruption forms are interlaced with one or various corruption causes.

The anti-corruption measures designed to eradicate the corruption causes (Fig. 5) may effectively manage indicated corruption forms. The interview findings suggest that corruption is a norm in the infrastructure sector of Pakistan. Policy-makers and researchers need immediate attention to work towards effective regulatory frameworks to eradicate corruption from the country. Hong Kong can be an example to follow; literature suggests that Hong Kong revolutionary corruption management frameworks have successfully brought the country back on track with economic development [33]. Other prosperous developing countries in curbing corruption are Turkey and Malaysia [39]. Their drastic policy measures resulted in profitable economic growth for the said countries. Therefore, it is pertinent to give the issue of infrastructure corruption urgent attention by redesigning rules and regulations of procurement on values of transparency and robust governance mechanisms.

5 Conclusion

The study aimed to develop a conceptual mapping model of corruption forms with causes. After an in-depth literature review of 39 articles, a table was formulated to map the corruption forms with corruption causes to achieve this aim. Further, 34 semi-structured interviews were conducted consisting of open-ended and closed-ended questions to collect rich data on corruption forms and corruption causes in the infrastructure sector of Pakistan.

The findings suggest that the most common corruption forms are acts of bribery and acts of fraud, whereas the most common corruption causes are project nature causes and regulatory causes. In addition, the authors developed a conceptual model of corruption forms with corruption causes to provide a snapshot of corruption mechanisms in Pakistan. The study results can be valuable to project managers, policymakers, and fellow researchers for designing effective anti-corruption frameworks.

The study is limited, and results cannot be generalized in other geographical settings. The current study is conducted within the infrastructure sector of Pakistan; therefore, results indicate the corruption causes and corruption forms rampant in the construction sector of Pakistan. Future studies can be conducted in other cultural backgrounds to explore new corruption forms and causes relevant to their infrastructure industry.

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Digital Economy and Artificial Intelligence in Business

Assessment of Trust Level in Digital Economy

Viktorija Skvarciany and **Daiva Jurevičienė**

Abstract In the current study, a unique dataset is used that represents the trust of households and individuals in the digital economy, so-called e-trust. On the basis of that, the level of e-trust of the selected countries is calculated. The study covers almost all EU countries and Iceland. France and Romania are excluded from the research due to missing data. A multi-criteria approach was employed to assess trust in the digital economy in a two-step procedure combining CRITIC and COPRAS techniques used for weighting and aggregation. The sample consists of 26 countries; the study is built on six indicators provided in the Eurostat ICT Trust, Security, and Privacy database. As a result, countries' prioritisation regarding trust in the digital economy is presented. The outcomes revealed that the highest level of e-trust is in Ireland and Belgium, while in Iceland, the Netherlands, Cyprus, Germany, Luxembourg, Sweden, and Estonia, this level could be considered average.

Keywords Trust · E-Trust · Digital economy · Multi-criteria approach

1 Introduction

The digital economy has become the core of the modern economic system [1], especially in the COVID-19 era. The EU member states are willing to increase penetration of the digital economy to all spheres of life, for instance, enhancing the online business sector, e-governance portals, e-health services, and others. The increase of the importance of the digital economy has been discussed on the EU level, and the significance of the digital economy has been indicated by the EU priority A Europe fit for the digital age [2]. Moreover, European Commission [3] launched three activities for realising this priority, one of which is Shaping Europe's digital future, which is being achieved through three pillars, one being a fair and competitive digital economy. However, all the mentioned actions have been taken on the governmental level, and people's readiness to the global changes (such as continuous usage of ICT, digital

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skills development) are usually omitted. As a rule, people shun changes; therefore, the most challenging thing is encouraging people to accept them. One of the essential aspects that could help to do that is trust, which in terms of the digital economy could be handled as e-trust. Hence, the current study aims at assessing the level of e-trust in selected European countries, as knowing where the countries are now would help to set a benchmark, which should be reached in order to increase the level of e-trust as the higher level of it means the higher level of e-loyalty to the digital economy [4].

2 Theoretical Background

Trust is a feeling when a person expresses his confidence, faith, reliability in something (or someone). Trust is important in everyday life, relations between people and attitude to any business or a company. Trust is associated with the relationship. In general, trust is the belief that the counterparty will fulfil its obligations. The importance of trust arises (excluding people's relationships) in recent decades during the extraordinary development of electronic services, sometimes called the expansion of the digital economy. It covers the fast progress of telecommunication and data technologies [5]. Digitalisation covers all spheres of the economy, including financial intermediation, healthcare, public governance, industrial manufacturing, consumer markets, services, utilities, mining, technology, media, telecommunications, leisure, etc. Therefore, trust is essential to companies, businesses, service providers and consumers, individuals or households. Trust usually relates to the data in the digital economy. In all types of services or contracts, either one or both parties deliver digital information, typically personal or financial, anyway data that are important to its provider. This type of trust has already an established title—e-trust [6]. E-trust usually relates to digital data that one somehow provides or gets on various websites or similar places. Lee et al. [7] state that the higher an individual perceives one's information literacy, the more they trust the website, and this referred to one's perceived information overload (negatively) and perceived usefulness (positively).

The study of Anser et al. [4] used e-trust as a mediator between e-service quality and e-loyalty. Seçkin et al. [8] measure e-trust using four items: customer considers that the information provided online was reliable; that the information provided online was balanced and accurate; that the information provided online was the same or better than that offered by most service provides-professionals and trust the Internet to get adequate, accurate information.

Usually, scholars investigate e-trust (or digital trust) from the perspective of service providers. The number of articles focuses on e-commerce [6, 9–11]. Others stress on e-governance (public) [5, 7, 8]. Many articles are dedicated to investigating e-tourism, especially considering the sharing economy [12–14]. And of course, financial intermediation is a subject for e-trust [15, 16].

To sum up, the above-mentioned fields of e-trust, the following interrelationship of e-trust building characteristics could be defined (see Fig. 1).
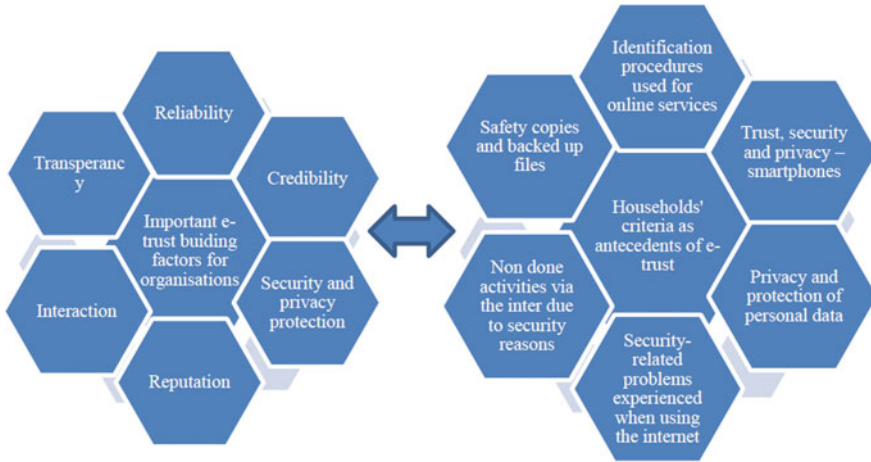
Fig. 1 Interrelationship of e-trust building characteristics. *Source* prepared by authors based on [17]

Despite the variety of different e-trust factors, the following are considered as antecedents in the current research:

- Identification procedures used for online services (individuals used at least four identification procedures for accessing online services) (C1)
- Trust, security and privacy—smartphones (individuals at least once restricted or refused access to personal data when using or installing an app on a smartphone) (C2)
- Privacy and protection of personal data (C3)
- Security-related problems experienced when using the internet (C4)
- Activities via the internet are not done because of security concerns (C5)
- Safety copies and backup files (C6).

The selected criteria represent ICT trust, security, and privacy, which could be determined as indicators of overall e-trust, as ICT could be treated as the backbone of the digital economy.

3 Materials and Methods

For e-trust level evaluation, the two-step approach was employed. First, the CRITIC method was used in order to assign the weights to the e-trust criteria, which were selected from Digital Economy and Society data provided by [18]. Second, the COPRAS method was chosen for evaluating the level of e-trust in the EU countries.

The CRITIC method approach is described in the following steps [19]:

Step 1: The normalisation of the decision matrix:

$$r_{ij} = \frac{x_{ij} - x_j^{\min}}{x_j^{\max} - x_j^{\min}}, i \in \{1, 2, \ldots, m\}, j \in \{1, 2, \ldots, n\} \tag{1}$$

where m represents the number of alternatives, n—number of criteria.

Step 2: Calculation of the standard deviation σ_j of each r_j.

Step 3: Calculation of correlation of every pair of normalised criteria and construction of the symmetric matrix with elements R_{ij}.

Step 4: Determination of conflict measure between criteria:

$$\sum_{j=1}^{n} (1 - R_{ij}) \tag{2}$$

Step 5: Determination of information amount C_j released by the j-th criterion:

$$C_j = \sigma_j \sum_{j=1}^{n} (1 - R_{ij}) \tag{3}$$

Step 6: Determination of the weights of criteria:

$$w_j = \frac{C_j}{\sum_{j=1}^{n} C_j} \tag{4}$$

After the weights are assigned, the COPRAS method is used for the development of the prioritisation line. The steps are as follows [20]:

Step 1: Normalisation of the decision matrix:

$$\overline{x}_{ij} = x_{ij} \Big/ \sum_{i=1}^{m} x_{ij} \tag{5}$$

Step 2: Construction of weighted decision matrix:

$$\tilde{x}_{ij} = \overline{x}_{ij} \cdot w_j \tag{6}$$

Step 3: Calculation of maximising and minimising index for each alternative:

$$S_{+i} = \sum_{j=1}^{n} \tilde{x}_{+ij} \tag{7}$$

$$S_{-i} = \sum_{j=1}^{n} \tilde{x}_{-ij} \tag{8}$$

Step 4: Calculation of the relative weight of each alternative.

$$Q_i = S_{+i} + \frac{S_{-\min} \sum_{i=1}^{m} S_{-i}}{S_{-1} \cdot \sum_{i=1}^{m} \frac{S_{-\min}}{S_i}} \tag{9}$$

Step 5: Determination of the priority line of alternatives.

4 Results and Discussion

After applying the CRITIC method, the investigated criteria have been assigned with the following weights: C1—0.1698; C2—0.1513; C3—0.1693; C4—0.1862; C5—0.1742; C6—0.1492. The weights received with the CRITIC method are assumed to be objective [21, 22]. Based on the obtained results, it could be stated that C4 (Security-related problems experienced when using the internet) has the highest relative importance. Actually, it supports the existing research results that proved there is a relationship between security and trust in different fields of human lives, not only in the context of the digital economy. Hence, it could be noted that the assigned weights are adequate and, consequently, are used in the second step of the research, which is an assessment of the e-trust level in the EU-selected countries. The outcomes achieved (priority line) are presented in Table 1.

The results indicate that Ireland and Belgium have the highest level of trust in the digital economy ($Q_i > 0.5$), while Iceland, the Netherlands, Germany, Luxembourg, Sweden, and Estonia ($Q_i > 0.4$) are ranked to the average position. The research results show a linkage between the level of e-trust and the overall level of the digital economy of a country, measured by various indexes. For instance, a parallel could

Table 1 Country ranking according to the level of trust in digital economy

Country	Q_i	Rank	Country	Q_i	Rank
Ireland	0.054180	1	Austria	0.035540	14
Belgium	0.051568	2	Spain	0.035402	15
Iceland	0.045941	3	Greece	0.035219	16
Netherlands	0.044763	4	Finland	0.034991	17
Cyprus	0.043831	5	Lithuania	0.034665	18
Germany	0.043708	6	Poland	0.034173	19
Luxembourg	0.043577	7	Slovakia	0.033901	20
Sweden	0.041672	8	Czech Republic	0.033863	21
Estonia	0.041529	9	Croatia	0.033003	22
Latvia	0.039081	10	Portugal	0.032105	23
Italy	0.038410	11	Malta	0.031655	24
Denmark	0.037520	12	Slovenia	0.031447	25
Bulgaria	0.037257	13	Hungary	0.030996	26

Source authors' calculations

be drawn between e-trust and Network Readiness Index (NRI) [23]. The countries at the top of the e-trust level list are almost similar to those which received the highest ranking (first 30 positions out of 130) in the NRI list. According to NRI, the only exception is Cyprus, which is in the 39th position. Moreover, NRI has four pillars, one of which is the technology pillar, which seeks to evaluate the level of technology of a country, which in turn, is an essential condition to take part in the global economy [23] and especially in the digital one. Looking at the current study results and the Technology pillar's values, the connection between these two aspects is undoubtful. All the countries mentioned above (except Cyprus) are in top-top 30 countries, which shows an evident interface between the level of technology and e-trust.

Another index related to the digital economy is the Digital Economy and Society Index (DESI), which is constructed to monitor the digital progress of the EU member states [24]. The countries' ranging regarding e-trust shows similarity with DESI index as well. All the countries (except Cyprus) are above the EU average according to DESI (there is no information regarding Iceland). From now, it could be concluded that similarities between analysed indexes and e-trust proves the validity of the proposed ranking.

5   Conclusions

Transition to the digital economy is impossible without trust in it, so-called e-trust. Consequently, the current paper focuses on evaluating the level of e-trust in order to observe where countries are at present. In the current study, multi-criteria methods, more precisely—CRITIC and COPRAS—were employed in order to set the objective weights for criteria measuring trust in the digital economy and, later, assess the level of e-trust of the alternatives (countries). The most influential criterion, according to CRITIC, was security-related problems experienced when using the internet. Ireland and Belgium achieved the highest degree of e-trust, followed by Iceland, the Netherlands, Cyprus, Germany, Luxembourg, Sweden, and Estonia, having average scores. Moreover, the results showed the similarity between the calculated level of e-trust and other indexes related to the digital economy, i.e., NRI and DESI. It means that enhancing the level of e-trust could help countries to boost the level of the digital economy, which undoubtedly, is a must for the overall level of economic development.

To sum up, it could be stated that the research outcomes contribute to the existing scientific literature investigating how to measure the level of e-trust. Moreover, the results could be valuable for policy-makers in terms of making strategic decisions regarding the further transmission to the digital economy.

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Marketing Communications in the Sharing Economy: Who Is the Target Segment for Car Sharing?

Pavel Pelech

Abstract In recent times, the notion of a sharing economy has become more prevalent. It is based on the underutilization of resources which could otherwise be distributed to those who do not have them but need them. One of the target segments is car sharing. It is not clear from academic articles and publications what generation of respondents is the target customer of car-sharing platforms. We based the primary research on the assumption that not every generation of customers wants to use car sharing. The research focused on three generations of respondents (X, Y, and Z) to identify which generations of customers are prospective for this segment. The research showed that Generation Y and Generation Z would be more likely to use car sharing compared to Generation X. We found that Generation X and Y have the most significant differences in willingness to car share between themselves, followed by Generation X and Z. These findings are valuable for platforms that mediate car sharing. It will enable them to target their marketing campaign correctly to the age group that is more likely to become the platform's customers and attract those customers with the right marketing communication strategy. At the same time, this knowledge will enhance the theoretical anchoring of the sharing economy with factual information that links the sharing economy to marketing. The Kruskal–Wallis test and descriptive statistics were used to evaluate the research. The research was conducted from December 2021 to March 2022 and involved 741 respondents.

Keywords Car sharing · Marketing communications · Sharing economy · Generation X · Generation Y · Generation Z

1 Introduction

The sharing economy is an alternative to the traditional view of economics in which ownership is transferred [1]. *"The sharing economy model represents an alternative to the traditional modes of commodity ownership, i.e., the method of acquisition*

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by purchasing or leasing. This alternative is made possible by the development of information and communication technologies based on the development of new platforms. Furthermore, development is dependent on the innovative approaches of a new generation of users who no longer cling to ownership but whose lifestyle, respectful of their relationship with the environment, favors this operational approach to products and services" [2, p. 113].

Through the existence of the sharing economy, more people have access to products they cannot afford or do not want to buy. However, for a fee, they can use these products under predefined conditions [3]. The owners of these products, in turn, are relieved of the full financial burden of product ownership through the fee received [4].

Between the owner of the product and the one who needs the product is a so-called platform. A platform can be imagined as an intermediary between the supply side and the demand side. Wirtz et al. [5] distinguish two types of platform: platforms whose product capacity is limited (e.g., car sharing) and platforms whose product capacity is not limited (e.g., information sharing). There is no transfer of ownership of the product to the platform; the product is still owned by its original owner. Likewise, the owner still bears the costs of maintaining and repairing the product. The platform only enables product sharing by establishing the process and conditions for sharing. It creates value by finding product providers and customers who need the product for a limited period [6].

To gain customers, platforms must use marketing communications and target their advertisements effectively [6]. Communication in the sharing economy environment will most often take place online. This is because the platform operates on a web interface or an app. Communication, therefore, has no reason to take any other form. The online format allows information to get to where it needs to go quickly. Online communications are two way, i.e., the platform will communicate with its customers, and its customers or potential customers will communicate with it [7].

Marketing communications and proper targeting are critical to the platform. This is also described by Aljukhadar et al. [8], who considered it critical to properly define the customer segment the platform wants to target. This is important for the reason that every marketing communication will cost some money. With proper targeting, a platform can manage its marketing expenditure effectively.

Platforms can use the results of this research to effectively target their marketing communications in the car-sharing segment. It will allow them to properly target their marketing campaign to the age group of the population more likely to be interested in car sharing.

2 Literature Review

The literature review focuses on the sharing economy and marketing communications.

2.1 Sharing Economy

The sharing economy is a new phenomenon based on sharing the spare capacity of products owned by one person with others who need those products. Academic articles define the sharing economy differently, and often no uniform definition is applied. Some authors use the term *sharing economy* [9], others use *collaborative consumption* [10, 11], or *collaboration economy* [12]. An overview of selected definitions is given in Table 1.

It might seem that the meaning of these definitions is the same or similar, i.e., they describe the same reality. However, this is contradicted by Schneider [13, p. 26], who provides Botsman's definitions of the various terms associated with the sharing economy:

- Collaborative Economy: *"An economic system of decentralized networks and marketplaces that unlocks the value of underused assets by matching needs and haves, in ways bypass traditional middlemen. Good examples: Etsy, Kickstarter, Vandebron, LendingClub, Quirky, Transferwise, Taskrabbit."*
- Sharing Economy: *"An economic system based on sharing underused assets or services, for free or for a fee, directly from individuals. Good examples: Airbnb, Cohealo, BlaBlaCar, JustPark, Skillshare, RelayRides, Landshare."*
- Collaborative Consumption: *"The reinvention of traditional market behaviors—renting, lending, swapping, sharing, bartering, gifting—through technology, taking place in ways and on a scale not possible before the Internet. Good examples: Zopa, Zipcar, Yerdle, Getable, ThredUp, Freecycle, eBay."*

Görög [14] also agrees with the difference between these terms, seeing the sharing economy as a part of collaborative consumption. However, some authors disagree with this distinction and confuse the terms (see Table 1).

Table 1 Overview of selected definitions of the sharing economy

Definition	Source
Collaborative consumption is the peer-to-peer-based activity of obtaining, giving, or sharing the access to goods and services, coordinated through community-based online services	Hamari et al. [10, p. 2047]
Collaborative consumption can be tracked back to the well-established form of resource exchanges in our socioeconomic system	Tussyadiah et al. [11, p. 156]
Sharing economy are online platforms specialized in matching demand and supply in specific markets, enabling peer-to-peer (P2P) sales and rentals	OECD [9, p. 53]
Collaboration economy is an economic system in which smart growth, fueled by collaborative initiatives, serves as a vehicle to accelerate the journey toward sustainable development	Lowitt [12, p. 14]

Source Author

Sustainability is often discussed in the context of the sharing economy [15]. Sustainable development in the context of the collaborative economy is mentioned by Lowitt [12]. The sharing economy is seen as a means to save resources, which has a positive impact on the environment people live in [15]. This view is contradicted by Klein et al. [16], who see the sharing economy as a means to increase consumption in contrast. He argues that those who own a product and want to share it can use the funds to acquire other assets, which again will be accessed by consumers for a fee. Eckhardt et al. refer to this type of consumer, i.e., those who own the product use it for their own use, share its spare capacity with others, and simultaneously act as consumer and prosumer (producer + consumer) [17].

It is reasonable to assume that the sharing economy will lead to partial solutions to current problems facing society, such as over-consumption, depletion of natural resources, pollution, and poverty, but it will not solve the problem completely [10].

2.2 Marketing Communications

Marketing communications are a part of the marketing mix. In addition to marketing communications, the marketing mix consists of product, price and distribution, including the individual policies of these components. However, some experts consider marketing communications to be the most important, as without them, no one would know about the product. Marketing communications therefore include activities which *"communicate the product or service features and benefits to key customers and persuade them to buy"* [18, p. 71]. Persuasion is based on influencing the emotions of customers in a manner to create positive attitudes and preferences and subsequently lead to the purchase of the advertised product [18].

In 2017, an official definition of marketing was accepted by the American Marketing Association. This definition has been consequently accepted by a number of authors, for example, Malhotra [19, p. 4] and Saura [20, p. 37]. According to this definition, *"marketing is the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large."*

The American Marketing Association also has an official definition of marketing communications. This definition was accepted, for example, by Kreft et al. [21]. It is not the only definition used in the context of marketing communications. Table 2 provides an overview of selected definitions of marketing communications.

Czech authors offer similar definitions. Srpova [27, p. 83] states that "*marketing communications are a set of processes and tools used by a company to attract customers by conveying a properly selected message to a specific target group (otherwise known as a market segment)."* Karlicek et al. [28, p. 10] views marketing communications as *"the controlled informing and persuasion of target audiences used by companies and other institutions to meet their marketing objectives."*

However, marketing communications can also be defined more broadly. For example, Foret [29] also sees marketing communications as actively seeking

Table 2 Overview of selected definitions of marketing communications

Definition	Source
Marketing communications are coordinated promotional messages and related media used to communicate with a market. Marketing communications messages are delivered through one or more channels, such as digital media, print, radio, television, direct mail, and personal selling	American Marketing Association [22]
Communication can be described as the glue that holds together a channel of distribution	Mohr [23, p. 36]
Marketing is the collection of all elements in an organization´s marketing mix that facilitate exchange by establishing shared meaning with its customers	Shimp et al. [24, p. 704]
Marketing communication is a management process through which an organisation engages with its various audiences	Fill [25, p. 17]
The means by which a supplier of goods, services, values and/or ideas represents itself to its target audience with the goal of stimulating dialogue, leading to a better commercial or other relationship	Egan [26, p. 4]

Source Author

customers and mapping their needs. Based on this, marketing communications can be seen as the sum of all basic marketing activities, starting with the creation of a product, setting its price, and distribution. When a business does this, it communicates to the customer that it is aware of what the customer wants and needs, or at least has an inkling of what the customer might want and need. This is confirmed by Gustafsson et al. [30], who consider understanding customer needs as an important part of marketing communications. Adapting the content of marketing communications to customer needs is also described by Rakic et al. [31].

Marketing campaigns will have to adapt to the sharing economy. Platforms will have to create different methods of setting up marketing communications and acquiring customers, for example, by connecting with other applications [32].

Marketing communications in the sharing economy environment will mainly be done online. Internet or online marketing is already a standard marketing communication method. Some companies have even abandoned standard offline marketing communication tools, which Janouch [33] considers a mistake. He specifies that the online marketing tools of marketing communications must be based on the overall marketing strategy and should be complemented by classic offline marketing.

The development of online marketing is probably the most dynamically developing area in terms of marketing, which affects mainly marketing communications. This is reflected in consumer behavior, setting up marketing strategies, and so on [34]. Consumer behavior in the online environment was addressed, for example, by Aljukhadar et al. [8, p. 421]. He was the first to analyze segmentation in the online

consumer market according to Internet usage patterns. He revealed interesting find-
ings. His analysis distinguished three groups of consumers in the online environment:
(1) *the basic communicators*—the basic group of consumers (the reason why they use
the Internet in the first place is the possibility to communicate, most often via e-mail);
(2) *the lurking shoppers*—the lurking consumers (the Internet is a tool for them to
make purchases); (3) *the social thrivers*—socially thriving consumers (consumers
who take advantage of the more socially interactable possibilities of the Internet).

The online format allows fast interaction between stakeholders. The communica-
tion between these entities is two way, i.e., this is how online communication differs
from offline communication, where communication is only from the company to
the consumer [7]. The functioning of online marketing communications can be well
explained by the model devised by Klepek et al. [7, p. 514]. Klepek et al. [7] devel-
oped this model to show how companies conduct marketing on social networks. On
the left side of the model is a company which creates messages for its customers,
using a technical environment. The content of the message is then disseminated
to the company's individual customers, who communicate with each other. These
customers also give feedback to the company through a technical environment, i.e.,
the communication is two way between the company and its customers or potential
customers.

These communications and normal interactions occur in the B2C market (business
to customer). In the sharing economy, it is not the company which is on the supply
side but the owner of a product who is willing to share it with others. On the demand
side, it is a consumer who needs the product from someone. Between these two is a
platform which mediates this sharing.

In addition to ensuring supply and demand are brought together, platforms should
be a guarantee of sustainability. Smaller and less well-known platforms tend to be
more sustainable than larger and more well-known platforms. They tend to operate
under a traditional business model [35].

2.3 Knowledge Gap Specification

Demand in the sharing economy is created by people who need the unused asset
of its owner for a limited time. Many studies have looked at car sharing from the
perspective of these customers. Tian et al. [36] look at the demand for car sharing
in terms of the preferred time of use of these services. Although Carrese et al. [37]
focus on the generation of students (we assume Generation Z) in car sharing, they
examine their pro-environmental attitudes toward car sharing, not their willingness to
demand these cars. Giordano et al. [38] discuss car sharing extensively but lacks any
marketing link, focusing on fleet size, reservation characteristics, or time patterns.

Huang et al. [39] address the willingness to share cars, but they focus on the
supply side. He observed motivational factors concerning car sharing regardless of
the generation of respondents. Car sharing was also addressed by Svennevik [40],
but again he examined the supply side in terms of different approaches to car sharing.

The sharing economy in the context of generations of respondents was described, for example, by Pham et al. [41], but they looked at generation Z and its relationship to fashion. All three generations were studied by Özek [42]. His study demonstrates that differences in knowledge sharing can be found between generations X, Y, and Z. From the perspective of this paper, this is a different area of research as it focuses on intangible assets.

Based on these findings, we identified a knowledge gap that lies in the fact that expert publications do not describe the willingness of different generations to demand shared cars. The willingness of different generations to demand shared cars are relevant variables that have not been jointly studied before.

3 Data and Methodology

The research was carried out in the Czech Republic from December 2021 to March 2022 and involved 247 people of Generation X, 247 people of Generation Y, and 247 people of Generation Z. A total of 741 questionnaires were answered. Fifteen questionnaires were discarded for being incomplete.

The information was collected online through a questionnaire. The questionnaire comprised of several parts, and for the purpose of the article, information about the willingness of people of Generations X, Y, and Z to car sharing was essential. At the beginning of the research, the respondents were explained what is meant by the sharing economy, i.e., that the sharing economy is a system whereby the owner of a product which is not fully used can offer the product for sharing to someone who needs it.

On the result of the literature search, we established the following hypotheses:

- H0: No significant relationship exists between willingness to car sharing and the generation of the respondents.
- H1: A significant relationship exists between willingness to car sharing and the generation of the respondents.

Cronbach's alpha coefficient verified the reliability of the processed data. The coefficient took the value of 0.9357, i.e., the reliability of the data is excellent.

The obtained answers were processed in Microsoft Office Excel. Verification of the research hypothesis was performed using the nonparametric Kruskal–Wallis test. We evaluated the data using descriptive statistics. *"The Kruskal–Wallis* test *is sometimes referred to as a one-way ANOVA for ranks. It is used to compare two or more independent samples when our data violate the assumption of normality and our sample size is not large, or when we have ordinal data"* [43, p. 144]. The results of testing the research hypotheses are presented in the next section of this article.

4   Results and Discussion

After excluding 15 respondents due to incomplete data, we analyzed the willingness
of 241 Generation X respondents, 239 Generation Y respondents, and 246 Generation
Z respondents. These respondents were asked how willing they would be to use
sharing car, i.e., to "borrow" a car from someone for a fee in a sharing economy. The
respondents were given the following ordinal [44] options: (1) no, (2) more likely no,
(3) more likely yes, and (4) yes. In Table 3, we evaluated the data using descriptive
statistics.

The Kruskal–Wallis H test indicated that there is a significant difference in the
dependent variable between the different groups, $\chi^2(2) = 14.04$, $p < 0.001$. This
means that at the 5% significance level we reject the H0 hypothesis and accept the
H0 hypothesis, i.e., some of the groups' mean ranks consider to be not equal.

In other words, the difference between the mean ranks of some groups is big
enough to be statistically significant. The p-value equals 0.0008925, ($P(x \leq 14.043)$
$= 0.9991$). It means that the chance of type I error (rejecting a correct H0) is small:
0.0008925 (0.089%). The smaller the p-value the more it supports H1.

Next, we evaluated whether differences exist between all generations of respon-
dents. We used multiple comparisons to compare any pair of groups using the
Kruskal–Wallis test. The results are elaborated in Table 4.

The Post-Hoc Dunn's test using a Bonferroni corrected alpha of 0.017 indicated
that the mean ranks of the following pairs are significantly different: Generation X
and Y; Generation X and Z. The p-value is below the 5% significance level in these
two cases.

Table 3 Descriptive statistics for car sharing

Generation	Index	Value
X	Median	2
	Mean	2.93361
	SD	1.382838
	N	241
Y	Median	4
	Mean	3.364017
	SD	1.416189
	N	239
Z	Median	4
	Mean	3.313008
	SD	1.341486
	N	246
P-value of Kruskal–Wallis test		0.0008925
Significance		S

Source Author

Table 4 Multiple comparison

Generations	Mean rank difference	Standard error	P-value
X and Y	−63.2291	18.2689	0.0005381
X and Z	−54.0289	18.1379	0.002894
Y and Z	9.2002	18.1762	0.6127

Source Author

Fig. 1 Distribution of responses
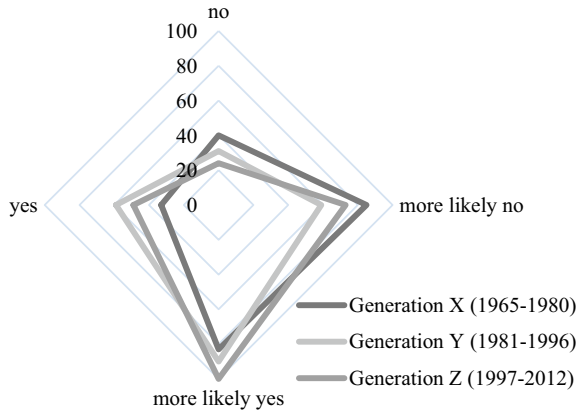
The distribution of responses by generation can be seen in Fig. 1.

Figure 1 is just a confirmation that Generation Y will be more inclined to become a customer of car-sharing platforms. Mean is 2.93361 for Generation X, 3.364017 for Generation Y, and 3.313008 for Generation Z.

5 Conclusion

This paper aimed to determine which generations of customers are prospective for sharing economy products, specifically sharing cars. The research was based on the general rule that an average customer does not exist [45]. There are academic articles where individual authors try to find the average demographic characteristics of sharing economy participants. However, no article addressed the relationship between the generation of respondents and the products that customers are willing to demand in the sharing economy. Angelovska [46] examined demographic characteristics and motives among sharing economy providers. She found that the average sharing economy provider tends to be male and under 35. According to Lutz, segmentation of customers in the sharing economy environment will also be crucial, both on the supply side and the demand side [47].

Secondary research revealed a knowledge gap. It was not clear from the available academic publications and articles how to define the target customer segment for car sharing in terms of generally accepted generations of people. The aim was not to define the average customer but to select a generation that is a promising segment for car-sharing customers. Each generation has its characteristics, and therefore, segmenting customers by generation is more appropriate from a marketing perspective. Primary research has shown a significant relationship between the generation of the respondents and their willingness to demand car sharing. Generation Z and Generation Y will be more willing to use car sharing than Generation X. These findings will help car-sharing platforms target their marketing campaign correctly to the age group that is more likely to become customers of the platform and attract these customers through the right marketing communication strategy. This research has provided the professional community with further information on the sharing economy and its marketing link.

Further research can be done to deepen the understanding of customers in the sharing economy and see if there are products for which the demanding customer segment will be different from car sharing. Based on further research, a generation of customers can be defined that is willing to participate in the sharing economy in general, regardless of the type of products they demand to share.

Conflict of Interest The author has no conflicts of interest to declare that are relevant to the content of this article.

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Treat-Before-Collapse: Forecasting Change of National Pension Assets in G7 and Republic of Korea by Demographic-Based Machine Learning Approach

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Abstract Future demographic projections have indicated that the low fertility rate problem will put significant pressures on the long-term sustainability of public finance. Nevertheless, among the concerned sustainability of public finance, the depletion of future national pension assets has received little attention. This paper provides numerical projection data by forecasting change of national pension assets in some of OECD countries. Among OECD countries, G7 countries which are leading society of OECD countries and Republic of Korea that has the lowest total fertility rate in OECD countries are analyzed. By adopting demographic-based machine learning (ML) approach, the forecasted results have been demonstrated, and possible future scenarios have been analyzed as variables (future total fertility rate, age when people begin pension receiving) are to be changed in the future. In doing so, possible solutions regarding demographic approach and political approach are suggested to each country.

1 Introduction

Along with the recent spread of the Fourth Industrial Revolution (4IR), various social changes have taken place in Organization for Economic Co-operation and Development (OECD) countries. Among them, the low fertility rate and population aging have been considered as a very serious social and demographic issue [1–4]. In particular, it is projected that the working-age population will decrease as the most of

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total fertility rate becomes below 2.0 [4]. What is worse, the number of people to be supported by the working-age people is gradually increasing due to the population aging problem [5–7].

These social phenomena also make a significant impact on the national pension system. As the number of national pension payer decreases due to low total fertility rate and the number of national pension recipients increases due to population aging, there are many concerns that national pension assets will be depleted in the future [8–10]. Accordingly, various studies on depletion of national pension assets have been conducted, but all previous studies have only presented abstract prediction or are based on just statistical method [11]. Therefore, the forecasted depletion time is different for each published research, and the forecasted depletion time is even accelerated every year [12]. In order to address these issues and make more precise forecasting, this study aims to forecast how the national pension reserves will change year by year through numerical analysis rather than simple abstract prediction and seek a viable solution for the depletion of national pension assets.

In this study, we intend to make more accurate forecasting by machine learning (ML) methods. As artificial intelligence (AI) technology has been developed [13–19], various socio-economic phenomena including financial crisis and housing price have been predicted using machine learning (ML) methods [20–26]. In this framework, the aim of this paper is to forecast the depletion time of national pension assets more accurately with abundant numerical data by using a ML algorithm.

2   Forecasting Models

The change in national pension assets is forecasted for about 30 years herein. Among OECD countries, total eight countries including Group 7 (G7: USA, UK, France, Germany, Italy, Canada, and Japan) countries and Republic of Korea (= South Korea) are selected for the forecast because G7 countries are the leading society in OECD countries, and Republic of Korea has the lowest total fertility rate recently [4].

2.1   Research Hypothesis

In creating a forecasting model based on previous demographic data, three hypotheses are established and applied to the forecasting model.

- Hypothesis (1): The number of national pension payers and national pension recipients affects the change of national pension assets.
- Hypothesis (2): The number of people aged from 23 to 64 (except: 66 for Germany, 67 for UK) affects the national pension assets.
- Hypothesis (3): The number of people aged more than or equal to 65 (except: 67 for Germany, 68 for UK) affects the national pension assets.

In the case of hypothesis 1, it is established by considering two correlations: a positive correlation between the number of national pension payers and the change in national pension assets and a negative correlation between the number of national pension recipients and the change in national pension assets [27]. Namely, hypothesis 1 is established given that the increase of the number of national payers will increase national pension assets and the increase of national pension recipients will decrease national pension assets.

Regarding hypotheses 2 and 3, it is considered that 80% of 23–54-year-old people in G7 countries are already employed and 75% of 23–52-year-old people in Korea are already employed [28, 29].

2.2 Equations and Parameters Used in Modeling

In modeling the change of national pension assets, four socio-economic factors are considered: number of births, life expectancy growth rate (R_{le}), age at which people begin pension receiving in each country (Age_{pr}), and expected GDP growth rate (R_{GDP}). The input parameter, output parameter, and cost functions used in this research are explained as follows.

$$x_{1,i} = \sum_{k=i-Age_{pr}-1}^{i-23} (\text{number of birth in year } k) \tag{1}$$

$$x_{2,i} = \sum_{k=i-80}^{i-Age_{pr}} (\text{number of birth in year } k) \tag{2}$$

$$H_i = W_{1,i} \cdot R_{GDP}^{i-2019} \cdot x_{1,i} + W_{2,i} \cdot R_{le}^{i-2019} \cdot x_{2,i} + b_i \tag{3}$$

$$\text{Cost} = \frac{\sum_{i=2009}^{2018} (y_i - H_i)^2}{10} \tag{4}$$

Input parameter $x_{1,i}$ in Eq. (1) means the number of people aged from 23 to Age_{pr} in year i, and $x_{2,i}$ in Eq. (2) means the number of people aged from Age_{pr} to 80 in year i. The specific value of Age_{pr} is described in Table 1 [30].

Table 1 Age at which people begin pension receiving in eight countries

	Age_{pr}		Age_{pr}
USA	65	Germany	67
Japan	65	Italy	65
UK	68	Canada	65
France	65	Korea	65

Table 2 Expected GDP growth rate in eight countries

	$R_{GDP}(\%)$		$R_{GDP}(\%)$
USA	2.0	Germany	0.9
Japan	0.7	Italy	0.5
UK	1.2	Canada	1.7
France	1.2	Korea	2.3

Output parameter H_i means the forecasted change in national pension assets in year i and is calculated through Eq. (3). Specifically, R_{GDP} in Eq. (3) is determined by previous research data as given in Table 2 [31]. R_{le} in Eq. (3) is also calculated by OECD statistics data [32].

y_i in Eq. (4) is the actual change in national pension assets in year i. That is to say, the year when y_i was positive is the year when the national pension assets actually increased, and the year when y_i was negative is the year when the national pension assets actually decreased.

The cost function (Cost) in Eq. (4) is the function that represents error of the suggested model [33–36]. In specific, Cost is calculated by averaging the sum of the squared difference between the forecasted value (H_i) and the actual value (y_i). Therefore, it is really important to reduce Cost for more accurate forecasting [37, 38].

2.3 Forecasting Process

The learning is conducted using existing statistical data from OECD statistics [39], and the utilized data are the number of births by year and national pension assets by year in G7 countries and Republic of Korea. Figure 1a, b illustrates the number of births by year, and Fig. 1c, d describes the change of national pension assets in G7 countries and Republic of Korea.

The input data of Eqs. (1) and (2) are made by utilizing the number of births data. Figure 1c, d illustrates the change of national pension assets in G7 countries and Republic of Korea. It can be seen that the national pension assets are still generally increasing every year until 2018. From this socio-economic statistical data, the learning has been done by comparing the output data of Eq. (3) to past change of national pension assets (namely the model has been optimized by making the output data of Eq. (3) similar to the past change of national pension assets through learning).
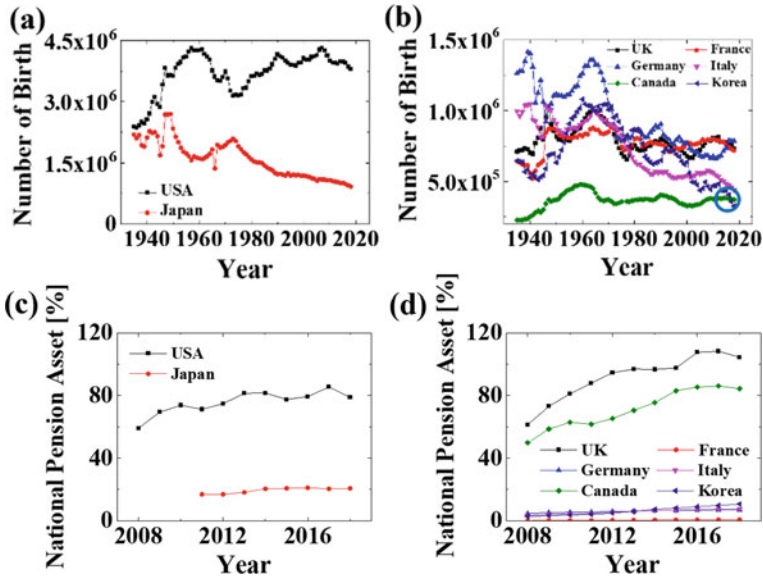
Fig. 1 **a** Number of births by year in USA and Japan, **b** number of births by year in UK, France, Germany, Italy, Canada, and Korea, **c** change in national pension assets in Japan and USA, and **d** change in national pension assets in UK, France, Germany, Italy, Canada, and Korea. The unit of national pension assets is the share of GDP in each country

3 Forecasting Change of National Pension Assets

3.1 Type 1: Canada and USA (Promising Countries)

As given in Table 3, Type 1 countries are promising countries regarding future national pension assets. Canada and USA are Type 1 countries and have good prospects. In both Type 1 countries, it has been forecasted that the national pension assets will decrease and then rebound at some point and increase again. Interestingly, even in the two most promising countries (Type 1), the national pension assets are predicted to increase after decreasing rather than continuing to increase. Specific analysis by each country is as follows.

As for Canada, the situation for the national pension assets will be getting worse and worse in section 1 (orange curved arrow 1 in Fig. 2a) and then gradually improve as shown in section 2 (orange curved arrow 2 in Fig. 6a).

In the case of section 1, the number of pension recipients increased (red arrow 1 in Fig. 2b), while the number of pension payers decreased (yellow arrow 2 in Fig. 2b). Therefore, the national pension assets will deteriorate in section 1 (Fig. 2a).

In case of section 2, even though pension recipients and pension payers decreased at the same time, the decrease of pension recipients (yellow arrow 2 in Fig. 2b) is much greater than the decrease of pension payers (green arrow 3 in Fig. 2b). Therefore,

Table 3 Classification of forecasting results based on their prospect

	Shape of future national pension assets	Shape of past number of births	Prospect	Country
Type 1 (Promising)	U (decrease and then increase)	Almost steady increase	Good	Canada and USA
Type 2 (Intermediate)	A (increase and then decrease)	Almost steady decrease	Bad (but not collapse)	Japan, UK, and Italy
Type 3 (Unpromising)	A	A	Bad (collapse)	France, Germany, and Korea
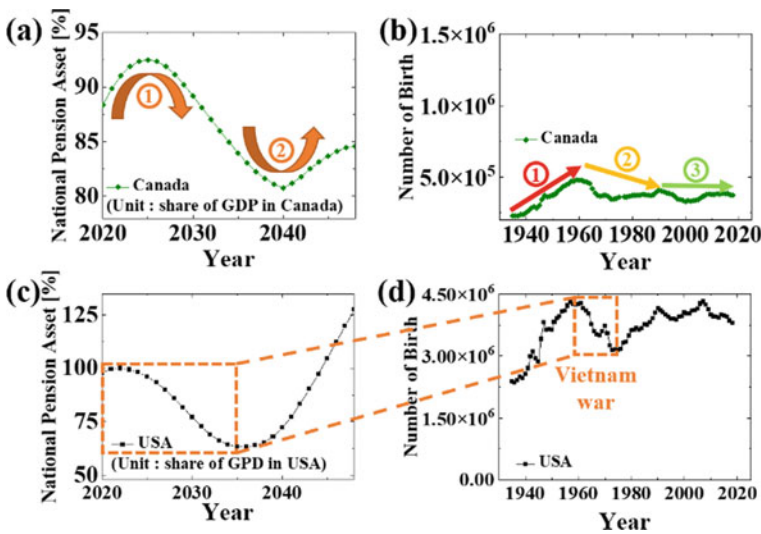
Fig. 2 **a** Change of future national pension assets in Canada, **b** past number of births in Canada, **c** change of future national pension assets in USA, and **d** past number of births in USA. The unit of national pension assets is the share of GDP in each country

the situation of national pension assets will be gradually improved as demonstrated in section 2 of Fig. 2a.

As for USA, the result can be interpreted in a similar context, but a historical interpretation is informatively added as follows. As demonstrated in Fig. 2c, the national pension assets in USA will deteriorate from 2020 to 2035 because of the Vietnam War between 1955 and 1975. Specifically, the Vietnam War broke out between 1955 and 1975, and the USA also dispatched a large number of soldiers [40]. This results in numerous casualties at that time, and as a result, the number of pension payers will dramatically decrease between 2020 and 2035 (Fig. 2c, d). Therefore, it is forecasted that the national pension assets will decrease from 2020 to 2035 (Fig. 2c).

However, fortunately, the situation of national pension assets in USA will remarkably rebound after 2035. This is because the number of births has increased exponentially again after the Vietnam War, which is called 'Baby boom' [41]. As a result, it is forecasted that the number of pension payers after 2035 increases again, and hence, the national pension assets will improve again (Fig. 2c).

3.2 Type 2: Japan, UK, and Italy (Intermediate Countries)

In all Type 2 countries, it is commonly projected that the situation of national pension assets will be gradually getting worse (Fig. 3a, c, e). Fortunately, the national pension assets of Type 2 countries will not be depleted within 30 years. This is because the past number of births in Japan, UK, and Italy steadily decreases (Fig. 3b, d, e). Importantly, the steady decrease in the number of births means that the number of pension payers and pension recipients decrease at the same time.

Especially in Japan, it has been forecasted that the national pension asset steadily improves from 2020 to 2037 (Fig. 3a), because the number of births from 1950 to 1967 decreases sharply (Fig. 3b) in the aftermath of World War II [42, 43]. In other words, numerous Japanese men died during World War II, and as a result, the number of births between 1950 and 1967 in Japan decreased sharply after World War II. As a result, the number of pension recipients in Japan decreases from 2020 to 2037 and the situation of national pension assets in Japan will improve from 2020 to 2037 (Fig. 3a).

3.3 Type 3: France, Germany, and Korea (Unpromising Countries)

In all Type 3 countries, it has been forecasted that the situation of national pension assets will deteriorate and deplete within 30 years (Fig. 4a, c, e). The reason is that the graph of the past number of births in Type 3 countries has an 'A' shape (increase and then decrease). Strictly speaking, all four countries have almost concave-down function in the number of births (Fig. 4b, d, f).

As for France and Republic of Korea, the number of births increased and then decreased in the past (Fig. 4b, f), which leads to a sharp increase in the number of pension recipients and a sharp decrease in the number of pension payers. Therefore, the national pension assets in France and Republic of Korea are expected to worsen after 2020 and will be depleted within 30 years (Fig. 4a, e). In the case of Germany, the number of births fluctuated significantly before 1967, and then began to decline sharply after 1967 (Fig. 4d). This leads to a rapid decrease in the number of pension payers, while the number of pension recipients will not change significantly since
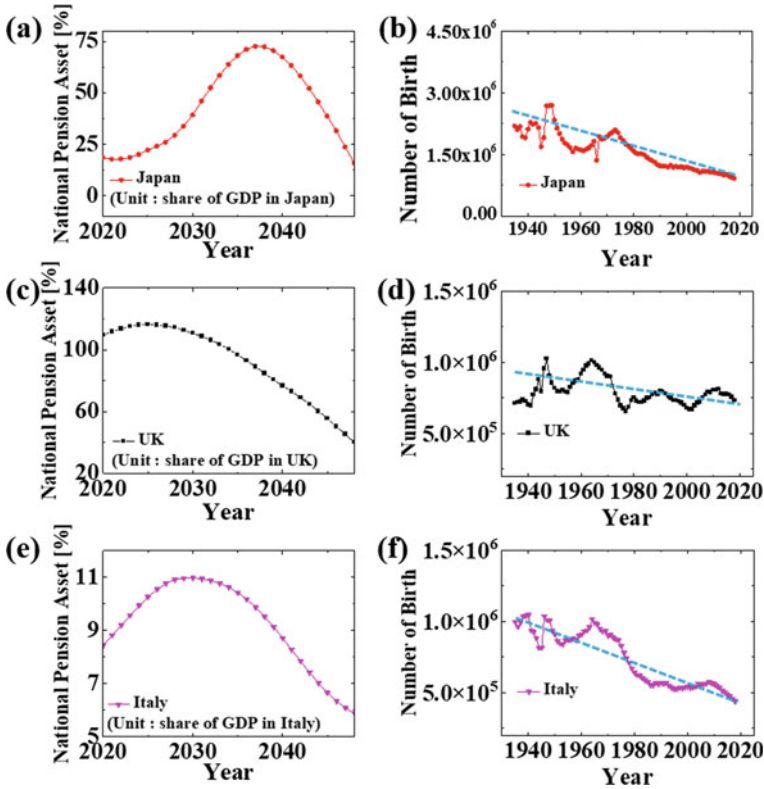
Fig. 3 **a** Change of future national pension assets in Japan, **b** past number of births in Japan, **c** change of future national pension assets in UK, **d** past number of births in UK, **e** change of future national pension assets in Italy, **f** past number of births in Italy. The unit of national pension assets is the share of GDP in each country

2020. As a result, it is forecasted that pension depletion will occur within 30 years (Fig. 4c).

4 Discussion and Conclusion: Treat-Before-Collapse—Where to Go?

4.1 Demographic Approach

Figure 5 predicts how the national pension assets will change when Type 3 countries succeed in increasing total fertility rate in the future. Importantly, no matter how successful the total fertility rate increases, the national pension assets will improve after 2050 (namely not just after increasing birth rates). This is because even if an
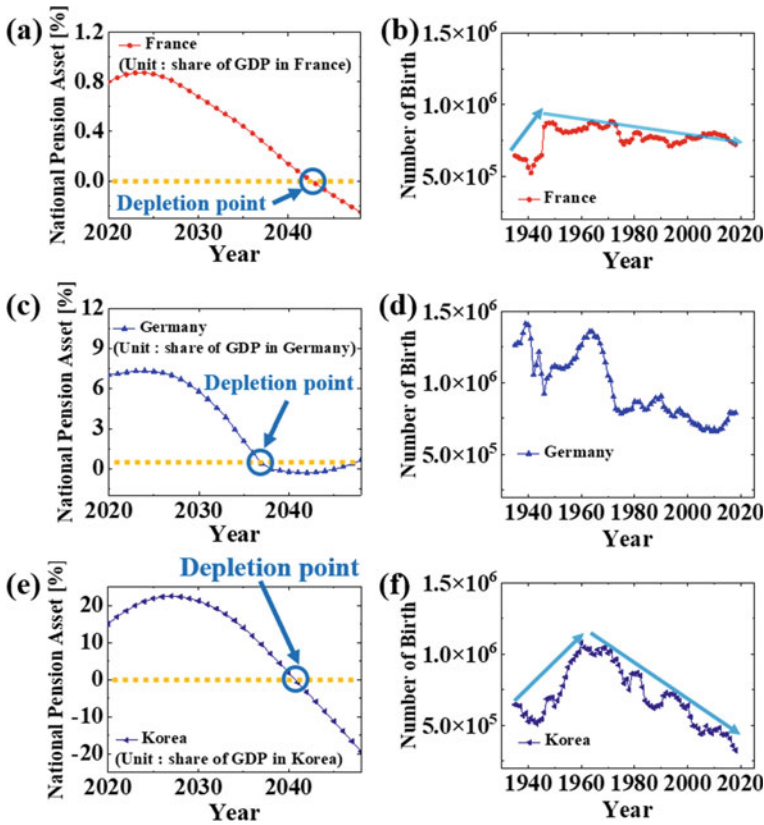
Fig. 4 **a** Change of future national pension assets in France, **b** past number of births in France, **c** Change of future national pension assets in Germany, **d** past number of births in Germany, **e** change of future national pension assets in Korea, and **f** past number of births in Korea. The unit of national pension assets is the share of GDP in each country

increase in the number of births succeeds in the future, it may take time until that births become adults and become a workable population.

France shows very interesting and remarkable results. France is the country that sees the greatest effect of the population policy. In other words, if the demographic approach is not successful, the national pension asset will turn into a deficit after 2060, however, if it succeeds in raising the number of births by more than 10%, it will turn from the deficit to the surplus.

In the case of Germany, it is projected that the national pension assets will be significantly improved again after 2040 even if the number of births in Germany slightly rebound. This is because Germany has already contributed to the rebound in total fertility rate since 2010. If Germany further increases the number of births after 2018, the national pension assets is expected to be improved even more.
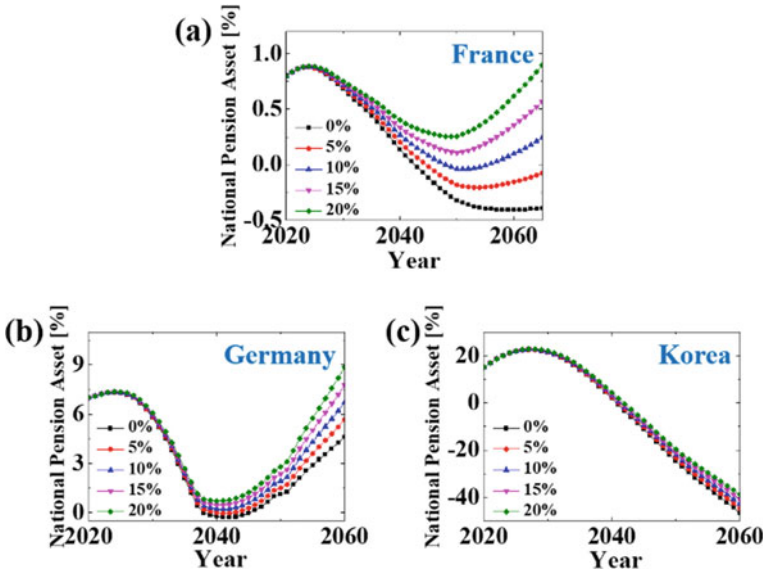
Fig. 5 **a** Change of future national pension assets in France as total fertility rate increases (0% is the case of forecasting when total fertility rate isn't change after 2018), **b** change of future national pension assets in Germany as total fertility rate increases, and **c** change of future national pension assets in Korea as total fertility rate increases

Fig. 6 Change of future national pension assets in Korea as Age_{pr} changes (65 year is control group)
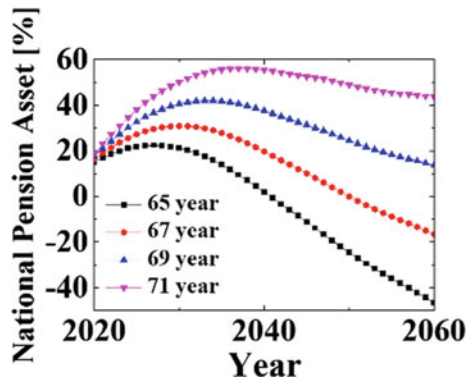
Unfortunately, in Republic of Korea, the increase in the number of births may not improve the national pension assets significantly. This is because the number of births in Republic of Korea has already fallen too much until 2018. Specifically, Republic of Korea is the only one country among OECD countries whose total fertility rate fell below 1.0. In addition to this, the number of elderly people in Republic of Korea has been increasing rapidly in recent years due to the baby boom after World War II

[42]. Therefore, it is projected that the national pension assets will not be improved significantly no matter how much the number of births will be increased.

4.2 Political Approach for Solving the Demographic Problem

According to data (Fig. 4), Germany is the only country in which the national pension asset graph is rebounded, which indicates income is higher than national pension expenditure around 2070 among Type 3 countries.

Germany has reformed the pension system and enabled private pensions through the 'Riester Pension' system in order to overcome the situation that the working-age population and national capital production is declining, and elderly support costs are rising [43]. The 'Riester Pension' system activates private pensions through subsidies and tax deductions. Subsidies are divided into basic subsidies and children's subsidies. In addition, Germany's 'Riester Pension' is a policy that provides stable support for retirement income, while taking into account total fertility rate and giving low-income families and multi-child families relatively more benefits [43]. Moreover, unlike Republic of Korea, private pensions are subject to strict government regulations from design to advertising management which would usually be found within the public pension.

The 'Riester Pension' system can lead to immediate losses of tax revenue by increased tax benefits and government subsidies. However, in the long term, it can provide opportunities for self-sufficiency to low-income families, and it is possible to disperse the burden of a rapid increase in welfare finance. In addition, it can have a positive effect on the development of the financial industry by increasing the number of private pensions, the 'Riester Pension.'

Germany was fundamentally out of the population structure (demographic) and pension system of Type 3 countries by modifying the age criteria for pension entitlement and reforming private pensions to the 'Riester Pension.' Therefore, Germany was predicted to be the only Type 3 country with a low likelihood (probability) of depletion in its pension system in the long term.

In Germany's case, Germany took a demographic solution that improved childbirth encouragement policies and an influx of immigrants, and a political solution that institutionally modified the age criteria for pension entitlement and the private pension system.

Therefore, Germany's political solution with pension system improvement for avoiding depletion has significant implications for Republic of Korea where the possibility of depletion is the highest among Type 3 countries. Fortunately, as demonstrated in Fig. 6, it has been demonstrated that changing the age criteria for pension entitlement can be a viable solution to Republic of Korea, in which the depletion possibility is the highest in Type 3 countries. Interestingly, our result shows remarkable results that raise the age criteria for pension entitlement by just 2 years (from 65 to 67 as in the past Germany case) can significantly mitigate the unpromising prospect of future national pension assets in Republic of Korea (Fig. 6).

5   Conclusion

In this research, numerical projection data have been shown for forecasting change of national pension assets in G7 countries and Republic of Korea by machine learning (ML) approaches. Especially, by adopting demographic-based ML approach, the forecasted results have been demonstrated and possible future scenarios have been analyzed as variables (future total fertility rate, age when people begin pension receiving) are to be changed in the future. In doing so, possible solutions regarding demographic approach and political approach are suggested to each country. As a results, Type 1 countries (Canada, USA) are expected to have positive results in projection of pension assets, while Type 2 countries (Japan, UK, Italy) have intermediate results. However, Type 3 countries (France, Germany, and Republic of Korea) need to apply demographic approaches. Especially, Republic of Korea needs another incentive-based political solution as well by changing retirement age more than 67.

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Development of an Expert System to Support the Decision-Making Process on the Shop Floor

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Abstract This paper discusses a new multidimensional approach to create a smart, digitally supported workplace. The approach is based on the development and use of an expert system to support the decision-making process of managers when designing smart workplaces on the shop floor. To derive the rules of the expert system, comprehensive literature research was done, resulting in the allocation of organizational, personnel, data, technology, and acceptance dimensions. These dimensions were used for the formulation of the corresponding problem–solution pairs of the decision tree. Implementation of the expert system was done in the KnowWE software tool with further validation in a research and learning factory, the Smart Production Lab at FH Joanneum University of Applied Sciences, Austria, within the research project Smart Workplaces. Being implemented, the proposed approach will help industrial companies to increase the awareness and effectiveness of decision-making on the shop floor.

Keywords Smart workspace · Digital shop floor · Expert system · Decision-making

1   Introduction

Knowledge-based expert systems (ES) are computer programs that mimic the intelligent behaviour of humans. These systems collect and store knowledge about a specific domain and allow to draw conclusions to offer specific solutions to problems.

An ES consists of a dialogue module, an explanation module and an inference engine, a knowledge acquisition module, and a knowledge base (KB). Figure 1 presents the schematic structure of an expert system.

Communication with an ES takes place via a dialogue module—a system interface for a knowledge engineer and a user. The heart of an expert system is the knowledge base, which structures and formalizes expert knowledge to enable machine

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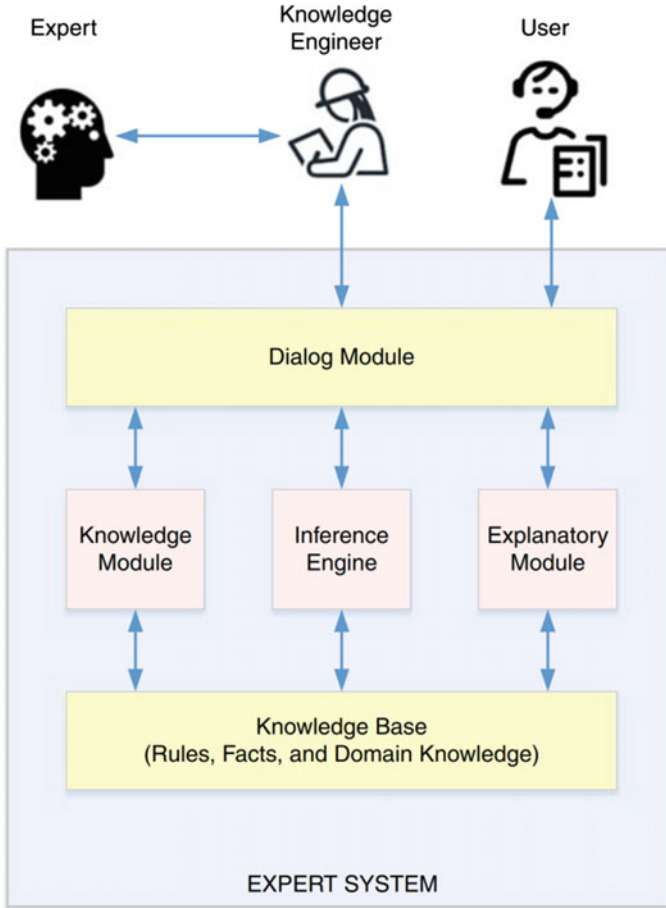
Fig. 1 Schematic structure of the expert system [1]

processing. A formal representation of the knowledge allows its usage for new knowledge deduction by the inference engine. An example of such new knowledge is a recommendation, derived by the inference engine from the KB and user input. The generated knowledge is available to the user via the explanation module.

After some period of neglect, expert systems are increasingly being used in industry nowadays. ESs are used to support decision-making and to improve operations and process control, e.g. Sokchoo et al. developed a novel multi-expert system (SFlex-WMS) for flexible logistics and warehouse operation [2]. Ramezani and Jassbi presented a hybrid expert decision support system based on ANN in the process control of plaster production [3]. Cobos-Guzman et al. proposed a fuzzy logic ES for selecting robotic hands using kinematic parameters [4].

Another growing domain of ES application in the context of I4.0 is the quality control of products and failure prediction of equipment. In this context, Moura,

Franqueira, and Pessin developed an expert system for anomaly detection [5]. Alvares and Gudwin proposed an ES for predictive maintenance of products [6]. Buccieri et al. considered ES for knowledge management of failure prediction for onshore pipelines [7]. Mewada et al. developed diagnostic ES for detecting defects in the forging process by using machine learning [8].

Mihigo, Zennaro, and Uwitonze used a fuzzy expert system for enhancing the priority of maintenance activities for hospitals' mechanical equipment [9]. Spatti et al. developed an ES for optimized asset management in electric power transmission systems [10]. Schmidt et al. presented an expert system to support the design of agricultural machinery [11].

Together with the support of a user in solving specific tasks of the industry, there is research devoted to the design of ES in the more broad and abstract problem domains. An example of such is the paper of Lak and Rezaeenour, who used a fuzzy logic expert system for the maturity assessment of social customer knowledge management [12].

There are also comprehensive literature review papers on the use of ES in industry [13]. Leo Kumar gave a review of a knowledge-based expert system in manufacturing planning [14]. A review of knowledge-based expert system applications in metal forming processes was done by Dixit and Hingole [15].

To summarize, considered papers show applications of ES to increase the effectiveness of organizational processes, raise personal awareness, and improve the quality of the products. At the same time, the reasons for the use of ES in the industry may not only be organization-, personnel-, and product-related, but they are also concerning other dimensions, such as availability of data or use of proper technology.

This paper concentrates on the development of an ES, which supports a shop floor manager in recognizing a problem situation at the workplace and providing a corresponding recommendation to solve the problem. To support a broad range of industries, it was decided to keep the ES generic, without specification of details of industrial processes, but rather a definition of the main dimensions, where the problem may occur.

To the best of our knowledge, there are no existing works covering the development of such an ES. Consequently, this paper concentrates on the following research questions:

- What form of knowledge representation and a corresponding software tool can be used for the effective support of decisions on the shop floor?
- How does the ES need to be designed to support the decision-making of the managers in the abstraction of specific details of industrial processes?

This paper is organized as follows. The first chapter provides a short introduction to the research topic and formulates a problem statement and the research questions (RQs). The following chapters give answers to the specified RQs. Chapter "Improving on the Markov-Switching Regression Model by the Use of an Adaptive Moving Average" introduces the forms of knowledge representation and selected tools. Chapter "Elephant and Ant: Do Equity Investors Care About Firm's Carbon Emission?" discusses the specific design of ES to give decision-making support to

managers. Chapter "A Review of the Applicability of Value Investing in China's Capital Markets" discusses the implementation of ES in the KnowWE tool [16]. Chapter "Web Presence and Multilingual Management in the Tourism Sector: An Analysis of Active Tourism and Ecotourism Corporate Websites from Southern Spain" is the validation section, flowing by the conclusion, which summarizes the main findings of the study and gives direction for future work. The references list finalizes the study.

2   Tool and Form of Knowledge Representation

The literature describes different forms of knowledge representation in ES. According to Kumar [14], these are classified into Rule-Based Systems (RBS), Frame-Based Systems (FBS), Object-Oriented Systems (OOS), and Case-Based Reasoning (CBR). Weidenhaupt describes the following forms: semantic networks, object-attribute-value triples, frames, rules, and logical expressions [17].

The RBS are based on the "if–then" condition and perform specific tasks once a condition is met. The FBS use the advantage of both declarative and procedural knowledge representation. In the OOS, the knowledge is presented as a hierarchy of classes, subclasses, and behaviour of objects. CBR is based on the observation that similar problems usually have similar solutions. Here, knowledge is formulated in the form of cases [14].

Weidenhaupt describes the semantic networks, which represent the oldest and most general form of knowledge representation in artificial intelligence. Finally, the knowledge can be described with the use of Boolean values, linked by logical functions such as AND, OR [17].

Thus, for the formalization of knowledge, different tools and techniques can be applied. The KnowWE software tool [16] provides markups for the formalization of the problem-solving knowledge in form of Flowcharts (DiaFlux models [18]). The advantage of the DiaFlux language is its simple application for the development of decision support systems, since it provides a limited number of intuitive language elements [18]. Its simplicity allows for intuitive usage, even for people without specific IT knowledge and skills (as managers on a shop floor) and hence eases the knowledge acquisition process.

Thus, the KnowWE tool with its DiaFlux graphical workflow notation was selected for the representation of the managerial knowledge. The knowledge was derived from expert interviews, observation of the processes on the shop floors, and comprehensive literature research.

3 Structure of ES to Support the Decision-Making on the Shop Floor

3.1 Knowledge Base Dimensions

To support a broad range of industrial processes, it was decided to develop a generic decision tree, without specification of details of industrial processes, but rather a definition of the main dimensions where the problem may occur. The proposed KB consists of five dimensions, which include technology, organization, data and personnel. The acceptance, which interfaces with and influences the main dimensions, can be found across the four main dimensions.

The technology dimension deals with the technical implementation of the industrial processes and corresponding framework conditions, especially the technological interfaces between humans and machines. Questions and answers about shop floor management, problems in the supply chain or capacity bottlenecks are dealt with in the organization dimension. The data dimension describes the nature of the data flows as well as the availability of the information to make a decision. The last dimension is defined at the personnel level, which deals with the roles, skills, and influence of people. This includes the experience of managers as well as blue-collar workers, training of the employees, transfer of knowledge, the feasibility of tasks, etc. Acceptance is described as the overriding dimension, which intersects with the other dimensions and corresponds to the information system acceptance model [19].

These five dimensions form the basis for the development of the question/solution pairs for the KB of the proposed ES.

3.2 The Question–Solution Recommendation Pairs

The content of the reviewed literature, the knowledge, derived from expert interviews, and observation of the processes on the shop floor in the Smart Production Lab of FH Joanneum served as an input to the workshops of the project team, where the content and structure of decision trees were created.

Corresponding to the main dimensions, four decision trees were defined, giving the structure to question–solution recommendation pairs. In total, 140 questions, intended to clarify the source of the problem, were formulated. The starting point to run the ES is the question, in which dimension the source of the problem is supposed. A user's answer defines the selection of a specific decision tree. The dimension of acceptance is not implemented as an independent tree, as it is distributed at the technology, data, organizational, and personnel levels.

Table 1 shows the samples of questions and recommendations. In the implementation of the dialogue module of ES, the questions were used to organize communication with a user. Based on the structure of the decision tree and the rules of the inference engine, a corresponding recommendation was produced.

Table 1 Terminology of the knowledge base

Sample of the questions	Sample of the recommendations
Organizational level	
• Does your company apply digitalization?	• Invest in the digital infrastructure
• Is your company ready for innovations?	• Implement workshops for the managers and employers
• Do you have digitalization experts?	• Attract IT experts
• Do you have the resources needed for digitalization?	• Buy specific software tools
Technology level	
• Are machines equipped with sensors to get transparency?	• Install sensors on the industrial machines
• Is there a digital infrastructure to support the workplace?	• Design and develop intranet solutions
• Do you use manual resource planning?	• Use ERP tools • Use SAP tools
Data level	
• Are the paper forms still in use?	• Give a digital structure to your data
• Do you use Excel tables to store interconnected data?	• Consider the use of RDBMS and Data warehouses
• Are data relevant for the decision-making available at the workplace?	• Apply normalization rules • Enrich the quality of data
• Are data available to monitor the process?	• Use MES tools
Personnel level	
• Do you have a needed level of IT skills?	• Implement workshops for forming IT skills
• Are you familiar with decision-making techniques?	• Implement workshops for forming problem-solving skills
• Can you take an action, based on the made decision?	• Implement workshops for the use of specific software tools
No solution	• Address the smart workspaces team for the consultations

4 Implementation

After the definition of the question–solution pairs, the decision trees were implemented in the KnowWE tool with the use of the DiaFlux editor. Separate KB pages, corresponding to the individual dimensions, were created. DiaFlux editor allows users to visually define the links between the questions, answers, and recommendations within the dimension.

Figure 2 represents the sample of the decision tree, created with the DiaFlux editor.

Figure 3 shows the interface part of the KnowWE tool—the ES running in a dialogue for the end-user.
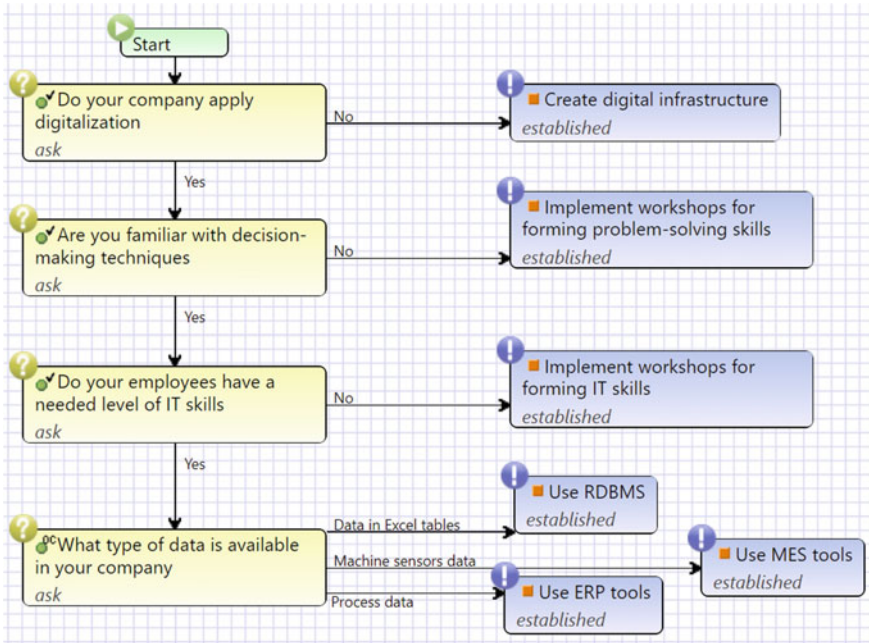
Fig. 2 Sample of the decision tree

5 Validation

After the development of the ES, it was validated twice with regard to qualitative criteria. The first validation was done by a cross-check procedure. Researchers from the development team analysed and simulated decision trees developed by other team members. The focus here was put on the understandability of the formulation of question–solutions pairs and their logical sequence. In addition to the internal feasibility within one dimension, the cross-dimensional links were also checked. The second validation was an empirical one, done for a particular process in a specific workplace (lens cleaning of a laser cutter), in the Smart Production Lab at FH Joanneum University of Applied Sciences, Austria. The focus here was put on the feasibility of the proposed approach in an industrial environment. Thus, a practice near infrastructure, as well as a proband simulating a manager, was necessary. As for the manager, this role was taken by a senior researcher that is familiar with the workstation but not with the outlined KB. The cross-check process resulted in a reformulation of the questions and recommendations pairs and the development of a clear procedure for going through the trees.

Fig. 3 Interview based on the decision tree

6 Conclusion

Considering the increasing complexity and dynamics of business, it may be optimized through decentralization of responsibility and decisions, which, at the same time, can be supported with the help of expert systems.

In the proposed solution, a KB to support managerial decisions was defined in the form of a decision tree, linking the question–solution recommendation pairs. To provide the generality and to abstract from the specifics of the individual industrial processes, conceptual dimensions (organizational, personnel, data, and technology) were defined.

The proposed approach has a big potential for implementation in industrial companies to increase the awareness and effectiveness of decision-making. Since the recommendations are at the abstract level, specific workshops are planned for further development of action plans.

Our future works will concentrate on the development of methodology for capturing domain-specific knowledge in the industry. Specifically, the method for validating the knowledge base will be elaborated.

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Fintech Solutions' Adoption: A Systematic Literature Review

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Abstract Discovering and understanding the marketing side of fintech is becoming a necessity, as it is the future of the world's finance. In the context of analyzing and understanding Mikadof's costumers (fintech start-up that offers services to facilitate decision-making in the stock and cryptocurrency markets), a systematic literature review was conducted to get a clearer picture of existing research that has been around the segmentation of fintech customers. The results showed a gap in the research that deals with the segmentation of these types of consumers. Nevertheless, several researches were about the stimuli that drive consumers to adopt a fintech solution. Understanding and analyzing these stimuli is an important step in segmenting these fintech consumers. According to the review, the Technology Adoption Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) were among the most mentioned theories explaining the reasons for adopting new technologies. Security, perceived ease of use, and perceived usefulness were among the variables most used by the authors to explain the intention to use new technologies.

Keywords Segmentation · Fintech consumer · Adoption of fintech

1 Introduction

Fintech, or finance developed through technology, has started to attract more attention, but the continuation of its use remains doubtful [1]. It is defined as a "service that provide increased personalization, flexibility, and ease of delivery of financial services, which in turn leads to higher productivity, profitability, and reach of financial services" [2] Also, fintech refers to "the technology-enabled or digitalization process of finance solutions" [3]. In our context, we define fintech as the technical

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process resulting from developing and establishing new financial software which might affect the entire traditional system and precisely, this new financial software will help the investors to make better investment decision.

In this article, a systematic literature review will be used to understand the existing research that deals with the segmentation of fintech services' users and analyze their behaviors and attitudes. The segmentation step is considered essential since it allows the company to group its potential customers into homogeneous subgroups in terms of needs and behavior.

The methodology followed to build the systematic literature review will be detailed in the first part. In the second part, a deeper analysis of the articles will be done based on axes of analysis. First axis will be about the most used theories to understand the attitudes and behaviors of new technologies and fintech' users. The second axis will be about the most adopted variables to understand the motives and attitudes of users to adopt a new technology or a fintech solution. The last axis of analysis will be about the articles that have studied the behaviors and attitudes of fintech users while categorizing them into different types, groups, or categories.

2   Research Method: Systematic Literature Review

Within the framework of identifying a marketing strategy to manage Mikadof properly, deeper research on the consumers of the proposed service by Mikadof was needed to understand their nature and behaviors.

Mikadof is a platform created as a research program application on artificial intelligence and sentiment analysis and their importance in predicting the price of stocks and cryptocurrencies on the stock market. Within the same research framework, there was a need to study the marketing aspect of this fintech solution to understand the users of this kind of service and adopt an effective marketing strategy for the platform that will help segment and target the users effectively.

Segmentation of fintech consumers especially in the stock and crypto markets area is not that rich in term of researches. We tried to study this problematic based on a systematic literature review in order to build a general idea of the articles that have mentioned this issue among their contributions. As this area is not studied, as it must be yet, we tried to fix general keywords to have a clear idea about all the methodologies used for segmentation in the fintech field (Table 1).

At first level, we searched the most relevant journal database portals. "ScienceDirect, IEEE explorer, Emerald insight, springer link" were the databases used in this study. There are other sources for articles, but we consider these four journals to be the best known and the richest in terms of results. We fixed nine combinations (Table 1) to find the most relevant articles. At the level of each Journal database, we searched on all these selected combinations. In the second phase of this process, the inclusion criteria were necessary to find only the articles included in our research field. Table 2 summarizes all the inclusion criteria chosen.

Table 1 Keywords and combinations used in the study

Code	Keyword	Number of combination	Combination	Details
FIN	Fintech	1	FIN + MS	Fintech, marketing segmentation
MS	Marketing segmentation	2	MS + FIN + CONS	Marketing segmentation, fintech, consumers
B2B	B to B	3	B2B + FIN + MS	B to B, fintech, marketing segmentation
B2C	B to C	4	B2C + FIN + MS	B to C, fintech, marketing segmentation
PR	Profiling	5	PR + FIN + B2B + B2C	Profiling, fintech, B to B, B to C
TR	Trading	6	TR + CONS + PR	Trading, consumers, profiling
STM	Stock market	7	STM + CONS + PR	Stock market, consumers, profiling
CRPT	Cryptocurrency	8	CRPT + CONS + PR	Cryptocurrency, consumers, profiling
ADOP	Adoption	9	ADOP + FIN	Adoption, fintech
CONS	Consumers	–	–	–

Table 2 Details of the inclusion criteria selected for the study

Inclusion criteria	Details
Date	2012–2022
Subject area	Decision sciences, social sciences
	Business, management and accounting
	Economics, econometrics, and finance
Language	English
Article type	Review articles
	Research articles
Source type	Journals
Document type	Articles

After this stage, we opted to select articles based on their titles. The title needed to include words related to our problematic in order to choose the article. In some combinations, such as the sixth and seventh combinations, it was important to fix a keyword in these combinations in the titles of the articles to reduce the number of articles obtained and simplify the task of selecting an article based on its title. After

Table 3 Results of the last step of the research based on the title and number of citation

Combinations	Springer link	Science direct	IEEE xplore	Emerald insight
1	3	2	–	1
2	1	–	–	–
3	1	–	–	–
4	–	1	–	–
5	5	1	–	–
6	4	1	2	6
7	2	2	1	3
8	4	2	1	–
9	4	5	3	5
Total	24	15	7	15

this step, we checked the number of citations of each article. Articles with less than five citations were excluded from the final list. At the end, we obtained 61 articles (Table 3).

These articles selected will be analyzed based on their hypothesis, frameworks, data collection, results, and interpretations.

3 Results and Discussion

After reading the articles, we eliminated 19 articles, as they were unrelated to our research objective. The keywords cryptocurrency, stock markets, and trading are very consumed on the researches, which explains this amount of results. Even the titles of articles contain these keyword, their contents were not related to the subject of research. On the other hand, we analyzed 42 research and review articles.

After reading and analyzing the articles, we found a lack of research on the segmentation area of fintech users. Most of the analyzed articles dealt with the different incentives that drive users to use new technologies, especially fintech services. The analysis of the articles will then be based mainly on the different theories used by the authors to identify the variables that affect the decision and behavior of a user to adopt and use a fintech solution. Then a detailed analysis will be about the variables most used and the articles that have studied the behaviors and attitudes of fintech users while categorizing them into different types, groups, or categories.

3.1 Theories and Models

The articles treated were mainly based on new frameworks developed based on previous research, theories, and models to select the most significant variables that influence the intention to use the new technologies according to the different contexts of the articles. The authors of the articles more often used some models and theories. The evolution of the latter started in the twentieth century, and it is still evolving [4]. Regarding the theories used in the articles, most of their authors were based on the Technology Acceptance Model (TAM) to explain the adoption of new technologies.

As technology evolves, the theories and models that explain consumer behavior and adoption of these evolutions also improve. In 2003, Venkatesh and his research group studied eight theories that explain the acceptance of new technologies. They came up with a new theory: Unified Theory of Acceptance and Use of Technology (UTAUT). This theory is the second most usable theory in the articles treated. There were also other models and theories from which the authors took the variables for their researches.

Table 4 will present the different theories used, their explanations, their main variables, and the articles that have been based on these models and theories.

3.2 Variables Used to Explain the Adoption and the Intention to Use New Technologies

Based on the different theories and models explained in the previous section, the authors selected several variables to shed light on the stimuli that drive consumers to adopt and use a fintech solution. The main TAM variables, perceived usefulness, and perceived ease of use were among the most usable variables in several articles [2, 5–12]. The first variable can be defined as a variable that measures the degree to which a user sees that the new technology can make his or her activities and tasks more efficient and profitable [5]. The second can be defined as a variable that measures the degree to which a consumer sees that new technology can make tasks easier to perform with minimal effort [7]. Trust was also among the variables that greatly affected the adoption of new technologies. According to the articles, trust expresses the level of confidence, comfort, and security that a user feels when using new technologies [7]. Social norms, experience, and regulatory support can be sub-variables that help explain trust [7]. Other variables have been used to explain the adoption of new technologies. Table 5 presents the most mentioned variables in the articles, their number of mentions, and their definitions.

Perceived ease of use, perceived risk, and social influence were positively and negatively correlated considering their contexts on the articles. A variable that has a positive and sometimes negative correlation with the main variable "intention of use" should be studied with caution. Sometimes some variables are dependent on other sub-variables, and the correlation between them is usually positive at the level of

research [1, 2, 7, 11, 13–15]. Here, we take the example of the variable trust with the sub-variables: experience, regulatory support, and social influence; their correlation was positive according to article [7].

3.3 Types of Fintech Users

Based on our analysis, there were no article that dealt with the segmentation of fintech consumers. Still, on the other hand, some articles [1, 16–18] analyzed the behavior of investors in the financial market or fintech users while making a differentiation between different type of profiles. This is what marks a difference between these five articles and the other articles. The latter is based only on a general sampling without differentiating between types of investors or users of fintech services.

The study elaborated by Ryu [1] aims to understand why a user will use or hesitate to use a fintech solution and see if the perceived benefits or risks affect continuance intention for two types of users: early adopters and late adopters. Early adopters are defined as users who use an innovation even if there is uncertainty about its potential and if its benefits are recognized and visible [1]. Late adopters are users who are resistant to change. They wait for innovations to be adopted by most people to avoid its dysfunction [1]. There is not a big difference between these two types of users in terms of age and level of education. The perceived risk and benefit of the fintech continuance intention significantly affect the early adopters' group, as they are open and ready to deal with innovations. Financial risk is considered the low-risk factor to adopt and use fintech by the early adopters' group. In general, the latter preferred using fintech as they believed that its benefits are more important than its risks. On the opposite, the late adopters saw that fintech's risks were more important and strong than its benefits, and security risk was among the first type of risks and the most critical reason not to use and adopt fintech.

The study elaborated by Metawa et al. [16] aims to study the relationship between the socio-demographic criteria of investors and their investment decision by taking the behavior factor (investor sentiment, overconfidence, overreaction and under-reaction, and herd behavior) as an explanatory tool in the Egyptian financial market. It classifies investors on individual, institutional, national, and foreign investor. These types of investors affect the behavioral factors, and the latter impacts the investment decision. The purpose of defining these types of investors was to confirm that the behavioral factor impact the investment decision the same way on the different type of investors. This was confirmed at the level of results. The latter indicates that a majority (72.2%) of investors, whatever their types, are driven by overconfidence while making investment decisions. Also, the majority (71.6%) of investors had an overreaction or under-reaction toward new information in the market. The demographic characteristics such as age, gender, and level of education positively affect the investment decision made by all types of investors in the Egyptian stock market. However, experience has no significant impact on behavioral factors and investment decisions.

The study elaborated by Wins and Zwergel [17] aims to study the difference between three types of investors according to their attitudes and motives: Sustainable fund investors (SR) and conventional investors that are generally interested (INT) or those that are not interested at all (CONV) to invest in SR funds. The results showed no significant differences between the three-investor types for the educational degree, the income level, the place of residence, and the age distribution. On the other hand, SR fund investors are similar to those interested in investing sustainably (INT) and very different from those who only consider investing conventionally (CONV). When comparing them to INT and CONV investors, SR fund investors are more likely to be female, married, and a parent. INT investors see their lack of knowledge as a barrier to investing in SR funds, compared to CONV investors, even though they have the same level of objective knowledge. In addition, CONV as well as INT investors are only concerned about financial issues, while SR funds investors were concerned about the financial and non-financial issues.

The study elaborated by Phansatan et al. [18] aims to study the difference between four types of investors: foreign, individual, and institutional investors, as well as proprietary traders, based on their trading behavior and performance. Proprietary traders are generally assumed to have a potential informational advantage over other types of investors. The authors tried to analyze the differences between these types of investors based on two variables: trading patterns and trading performance. The results confirmed that foreign investors made their investment decision based on positive feedback and adopted momentum trading strategies. Still, these strategies only lead to superior short-term market timing performance, with a poor selection performance, thus canceling the trading gains. The trading strategies adopted by proprietary traders lead to good short-term but poor long-term market timing performance—this type of investor profits from its liquidity provision role to the markets via short-term market trading gains. The trading strategies adopted by institutions and proprietary traders are the reason for the inferior security selection and thus poor overall trading gains and performance.

4   Conclusion

Segmentation is a necessary step that precedes targeting. Good segmentation means good targeting, which will attract more potential customers who are ready to adopt a fintech solution and continue using it. The systematic literature review presented in this article facilitated the understanding of the stimuli that drive a user to adopt a fintech solution based on the research and studies that have contributed to this area. TAM and UTAUT were among the most usable theories by the authors of the articles. In addition, perceived ease of use, perceived usefulness, and security were among the most used variables to explain the stimuli that affect the behavior and attitude of consumers to adopt fintech solutions.

The absence of articles dealing with fintech user segmentation is considered one of the main limitations of this research, as Mikadof needs to identify existing fintech

user segments. This lack of research around fintech user segmentation can be a starting point for future research. The authors can develop deeper research on fintech users, identifying their segments, and characteristics to facilitate profiling and the implementation of marketing strategies in the fintech field after that.

Appendix

See (Tables 4 and 5).

Table 4 Most used theories in the articles with their definition and variables

Theory	Definition	Variables	Mentions
Technology acceptance model (TAM)	For TAM, the perceived usefulness and ease of use by an individual are the main variables that determine the attitude toward the adoption of a new technology (Davis, 1989) [2]	Use behavior- behavioral intention- perceived usefulness- perceived ease of use	[2, 5, 7–12, 19]
Unified theory of acceptance and use of technology (UTAUT)	UTAUT model was developed to examine what drive a user to accept technology and what affects their intention to adopt new technologies [19]	Performance expectancy—effort expectancy-social influence and facilitating conditions—age—gender—experience—use behavior—behavioral intention—Voluntariness of use	[2, 9, 19]

(continued)

Table 4 (continued)

Theory	Definition	Variables	Mentions
Information System Success Model (ISSM)	The success of ISSM is conditioned by the intention to use, the use and satisfaction of its users [6]	Information quality—system quality—service quality—intention to use—use—user satisfaction -net benefits	[6, 19]
Theory of planned behavior (TPB)	The TPB was developed to predict, understand, and change human behavior [20]	Behavioral intention—attitude toward behavior—perceived behavioral control—subjective norm	[20, 21]
Technology acceptance model 2 (TAM 2)	This model was developed based on TAM. Two crucial processes, the social influence processes and the cognitive instrumental processes were integrated into this model [2]	Use behavior—behavioral intention—perceived usefulness—perceived ease of use—experience—subjective norm—image—job relevance—output quality-result demonstrability	[2]
Unified theory of acceptance and use of technology 2 (UTAUT2)	This model was developed to understand the effects of performance and effort expectancy, social influence, facilitating conditions, and hedonic motivation on behavioral intention [15]	Performance expectancy—effort expectancy—social influence and facilitating conditions—behavioral intention—voluntariness of use—hedonic motivation- price value…	[15]

Table 5 Most used variables with their definition, sub-variables, number of mention, and their correlation

Variables repeated	Articles in which they were mentioned	Definition	Sub-variables	Correlation
Trust	[3, 7, 8, 11–13, 22–24]	Trust refers to the level of comfort, confidence, and security that consumers have when using technologies [7]	Cognition-based signals of trustworthiness, affect-based signals of trustworthiness, experience, social influence, regulatory support	Positive correlation at the level of 9 articles: [3, 7, 8, 11–13, 22–24]
Perceived usefulness	[2, 5–8, 10–12]	Perceived usefulness is the degree to which a person believes that adopting a particular system will increase his effectiveness and job performance [5]	–	Positive correlation at the level of 7 articles: [2, 5–8, 10–12]
Attitude	[5, 7, 8, 10, 11, 20, 25]	Attitude refers to the users positive or negative feelings toward the new technology [7]	–	Positive correlation at the level of 7 articles: [5, 7, 8, 10, 11, 20, 25]
Perceived ease of use	[2, 5, 7–9, 11, 12]	Perceived ease of use refers to the degree of users' belief that using the new technology will be free of effort [7]	–	Positive correlation at the level of 5 articles: [2, 5, 7, 11, 12] Negative correlation at the level of 2 articles: [8, 9]
Perceived benefit	[1, 11, 13, 15]	A users' perception of the potential that fintech use will result in a positive outcome [1]	Convenience, smooth transaction-economic benefits	Positive correlation at the level of 4 articles: [1, 11, 13, 15]
Perceived risk	[1, 11, 13, 15]	A user' perception of the uncertainty and the possible negative consequences regarding the fintech use. [1]	Financial, legal, security, operational, time, performance, social, psychological	Positive correlation at the level of articles: [1, 11, 13] Negative correlation at the level of one article: [15]

(continued)

Table 5 (continued)

Variables repeated	Articles in which they were mentioned	Definition	Sub-variables	Correlation
Service quality	[3, 6, 19, 26]	Service quality represents the match between what users expect and what they receive [6]	–	Positive correlation at the level of 4 articles: [3, 6, 19, 26]
Herding behavior	[3, 14, 16]	When people face an uncertain situation, they are likely to mimic other people's actions [3]	Cognitive capability (the mental ability)—social factor—emotional factor	Positive correlation at the level of 3 articles: [3, 14, 16]
Subjective norm	[3, 5, 20]	It refers to the belief about whether one's social group think a person can perform the behavior [20]	–	Positive correlation at the level of 3 articles: [3, 5, 20]
Satisfaction	[8, 19, 25]	State of being satisfied: contentment [8]	–	Positive correlation at the level of 3 article: [8, 19, 25]
Social influence	[2, 7, 15]	Social influence is the influence of others to use a specific technology [2]	Subjective norm, social factors, image	Positive correlation at the level of 2 articles: [7, 15] Negative correlation at the level of one articles: [2]

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Industrial Economy and Development

EU Energy Policy: Implications for Renewable Energy Investments

Dubravka Pekanov, Ivana Fosic, and Irena Jadresic

Abstract Europe is currently facing a number of issues related to energy: climate change and decarbonisation; slow improvements in energy efficiency and the challenges posed by a higher share of renewable energy. The European Union is trying to address these challenges through various policies aimed at achieving full EU decarbonisation by 2050. Renewable energy contributes to the reduction of greenhouse gas emissions; and therefore, investments in renewable energy generation are seen as a tool to decarbonise the EU. However, this puts strong pressure on countries that rely on fossil fuels to switch to cleaner energy sources. This paper examines the business characteristics of three EU energy companies from the former Eastern Bloc: their production mix, their past efforts and their future plans in terms of investment in renewable energy sources. The question is how they can achieve the EU energy policy targets. The results show that the production mix of energy companies plays an important role in their adaptation to EU requirements. Not all energy companies will succeed in meeting decarbonisation targets within the deadlines set by the EU, as national economic interests could be a limiting factor. Finally, renewable energy sources alone are not sufficient to ensure a secure energy supply, but must be combined with each other or with nuclear power or gas.

Keywords EU energy policy · Climate neutrality · Energy companies · Renewable energy investments · Business models

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1 Introduction

EU legislation has been intensively addressing the issue of renewable energy sources and their promotion for the last 15 years. In 2009, the EU set a target of 20% share of gross final energy consumption from renewable sources by 2020 [12]. It also defined various mechanisms that should help Member States achieve their goals, such as joint projects, support programmes, cooperation between EU members and non-EU countries.

The next target was set in 2018 when the Renewable Energy Directive [10] stated that 32% of final energy consumption in the EU should come from renewable sources by 2030. It was part of the Clean Energy for All Europeans package [5], and the main objective was for the EU to remain a world leader in renewable energy sources. The directive also aimed to help EU Member States meet their commitments to reduce greenhouse gas emissions under the Paris Agreement [31][1]. Member States were required to transpose the revised directive into national law by June 2021, and from 1 July 2021 the directive has become legally binding.

In December 2019, the European Commission published a Communication on the European Green Deal [6], detailing the vision for a climate-neutral Europe by 2050. This is to be achieved by ensuring a secure, clean and affordable energy. The European Green Deal sets out guidelines and actions needed for Europe's green transformation. To achieve this goal, Member States have committed to reduce emissions by at least 55% by 2030 compared to 1990 emission levels.

In July 2021, a new legislative package to achieve renewable energy targets in line with new climate challenges was published, entitled "Fit for 55: delivering the EU's 2030 climate target on the way to climate neutrality" [4]. A new revision of the Renewable Energy Directive proposes to increase the share of renewable energy in the EU energy mix to 40% by 2030.

The requirements imposed by the European Union to reduce greenhouse gas emissions by expanding renewable energy capacities are becoming increasingly stringent. Companies that generate electricity from fossil fuel power plants are among the biggest polluters. This is because 75% of all greenhouse gas emissions in all sectors in the EU are caused by energy production and use [6]. Against this background, this paper examines how three EU energy companies from the former Eastern Bloc are preparing to respond to EU requirements to reduce greenhouse gas emissions and increase the share of renewable energy sources. Their production capacities are compared, and projects and planned investments are presented. Special attention is given to activities related to the reduction of greenhouse gas emissions and how

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[1] The main goal of the agreement is to limit global warming to temperatures "significantly below 2 °C", strengthen the capacity of countries to combat the effects of climate change and ensure food security. The goals also include developing "green" technologies and helping less developed members implement individual national emission reduction plans. The goal is to completely eliminate pollution from greenhouse gas emissions by the end of the twenty-first century. The Paris Agreement was adopted on 12 December 2015 and has been in force since 4 October 2016, when it was ratified by the EU.

companies are preparing for the challenges posed by the requirements of the European energy policy. The rest of the paper is structured as follows. The introductory section is followed by an overview of renewable energy (investments) in the context of EU energy policy, followed by the methodology used. The research results with discussion are presented in the fourth section, while the concluding remarks are presented in the last section.

2   Renewable Energy (Investments) and EU Energy Policy

Primary energy sources include fossil fuels, renewable energy and nuclear energy, which are further converted into electricity as a secondary energy source [29]. The energy transition as a process of shifting from fossil fuels to renewable energy sources is crucial for sustainable development [1, 30]. At the same time, investments in renewable energy production and energy efficiency are crucial for achieving the energy transition [17, 24].

Looking at the EU's primary energy production in 2020, renewable energy accounted for the largest share (40.8%), followed by nuclear energy (30.5%), solid fossil fuels (14.6%), natural gas (7.2%), petroleum and petroleum products (3.7%) and non-renewable waste (2.4%) [14]. According to the same source, primary energy production from renewable sources has developed positively over the period 1990–2020 (excluding 2011) with an increase of 39.2%, while production from natural gas, solid fossil fuels and oil and petroleum products decreased (62.4%, 43.0% and 35.1% respectively). Looking at final energy consumption, solid fossil fuels showed a decrease from 9.6% in 1990 to 2.1% in 2020, renewables an increase from 4.3% in 1990 to 11.8% in 2020, while natural gas remained relatively stable from 18.8% in 1990 to 21.9% in 2020.

In 2020, the share of renewable energy in energy consumption in the EU was 22.1% [15]. This means that the EU reached its 2020 target. This was achieved through the growth of electricity generation from renewable energy sources. According to Statista [28], investments in renewable energy sources are crucial for the development of new capacities and further expansion of the sector. EU investments in renewable energy in the period 2010–2019 are presented in Fig. 1.

Renewable energy investments in the EU were highest in 2011 and fluctuated in the following period until they reached USD 58.4 billion in 2019. In addition, investments in energy infrastructure, which are important for the energy transition, of around €1 billion are planned at the EU level [7]. The energy transition and decarbonisation are among the most important issues that EU faces.

Decarbonisation itself refers to the reduction and final elimination of carbon emissions in the atmosphere and represents the process of reducing carbon intensity. The carbon intensity of the energy sector in the EU is on a declining trend (Fig. 2).

The carbon intensity of the EU-27 has decreased from 341 g of CO_2 per kilowatt hour in 2010 to 226 g in 2020 [13]. The highest carbon intensities in 2020 were recorded in Estonia, Malta, Greece and Poland (973, 884, 875 and 868 g of
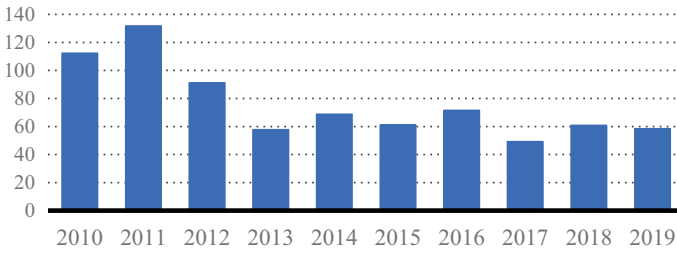
Fig. 1 EU renewable energy investment (2010 to 2019, in billion USD) *Source* Statista [28]
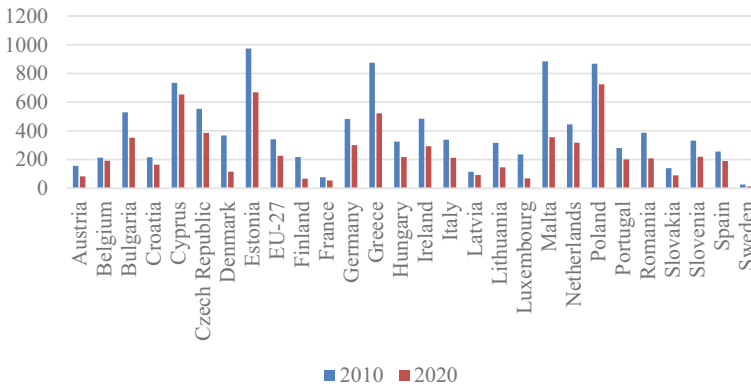
Fig. 2 EU energy sector carbon intensities in 2010 and 2020. *Source* Eurostat and Ember/Agora [13]

CO_2 per kilowatt-hour, respectively). This suggests that further efforts are needed to decarbonise the EU. Some argue that both nuclear and renewables could contribute to national decarbonisation [3, 16, 23]. More specifically, Fell et al. [16] found evidence that nuclear and renewable energy contribute almost equally to lower per capita CO_2 emissions. According to Eurostat [14], 13 EU Member States produced nuclear heat in 2020, with France having the largest share in gross available energy (41%), followed by Sweden (25.2%), Slovakia (24.6%), Bulgaria (24.2%) and Slovenia (23.2%). Some see nuclear capacity as a key tool to achieve the Paris Agreement targets (e.g. [25]). In addition, the EU taxonomy, defined as "a classification system establishing a list of environmentally sustainable economic activities" [8], has included gas and nuclear as transitional fuels for achieving climate neutrality by 2050. According to the Taxonomy Complementary Climate Delegated Act [8], gas and nuclear will accelerate the shift away from more polluting energy sources such as coal and enable the energy transition based primarily on renewable energy sources. The EU taxonomy steers investments towards climate-friendly investments.

It is clear that renewable energy is increasing and at the same time pressure is being put on countries that rely on fossil fuels to switch to cleaner energy sources

and decarbonise their economies. This paper adds to existing literature on renewable energy investments and their contribution to the EU's full decarbonisation targets. It also considers specific factors influencing future investment decisions in renewable energy sources.

3 Methodology

One of the main goals of this paper is to determine how companies from the former Eastern Bloc, which have always relied on conventional power generation capacity, are coping with the requirements of the European Green Deal and EU targets to reduce emissions, generate electricity from renewable sources and achieve carbon neutrality by 2050. The question is whether energy companies will be able to adapt to the new regulatory framework and the associated business challenges. The main challenges include the ageing infrastructure and the European coal phase-out, as this fuel is no longer compatible with energy policy goals.

To examine how the business activities of energy companies can be adapted to the European Union's requirements to reduce greenhouse gas emissions, mainly by investing in renewable energy sources, the paper analyses the business plans of electricity companies to see if they include investments in renewable energy sources and reduced fossil fuel production. It also analyses whether there are plans to abandon fossil fuel production within the deadlines set by the EU.

Hrvatska elektroprivreda Group (HEP Group), the largest energy company in Croatia, was selected as the first company. In selecting the other companies, certain characteristics were considered to ensure comparability between the companies. The main characteristics that the companies had to meet were: full or partial state ownership, being the largest energy companies in their country and having a consolidated turnover of around 2 million euros. Likewise, it was desirable that they come from the former Eastern Bloc, as they have a similar heritage and are easier to compare. Holding Group Slovenske elektrarne (HSE Group) from Slovenia met all the requirements and was selected for analysis. Of the other analysed companies from Europe, Slovenske elektrarne Group (SE Group) from Slovakia was the most suitable for the analysis, so it was chosen as the third company to be analysed in this paper.

The use of annual reports in the study of energy companies' investments in renewable energy sources is common in the existing literature (see [2, 18]. The annual reports for the period 2017–2019 were taken from the websites of the analysed companies. From the annual report for 2020, data on the company's impact on the environment and other non-financial data relevant to the subject of the research were used. All annual reports [19–22, 26, 27] and financial data are in euros (reporting currency of HSE Group and SE Group), while the financial data of HEP Group was converted into euros at the exchange rate of 7.5.

4   Results and Discussion

4.1   *Group Hrvatska Elektroprivreda (HEP Group)*

HEP Group is the largest energy company in Croatia. The core activities of the Group are generation, distribution, transmission, supply and trading of electricity. HEP Group derives the majority of its revenues from the sale of electricity (86% in 2019, 82% in 2018 and 85% of revenues in 2017). The basic production capacities of HEP Group consist of 28 hydropower plants, 7 thermal power plants and 1 nuclear power plant, with a total installed capacity of 4060.25 MW. Within the Group, 52% of installed capacity is accounted for hydropower plants, 31% for thermal power plants and 17% for the Krsko nuclear power plant, while the share of other capacities is negligible. Although HEP Group has a balanced production mix, it purchases about 40% of the electricity needed to meet customer demand on the electricity market.

The Croatian electricity system largely depends on the generation of electricity from hydropower plants. They are the most important source of electricity in the Group. The energy generated in hydropower plants contributes significantly to the achievement of Croatia's national targets regarding the share of energy from renewable sources. In recent years, the Group has made investments in other renewable energy sources such as solar power plants, biomass cogeneration plants and wind farms.

Since 1 January 2013, HEP's thermal and cogeneration plants have been included in the EU Emissions Trading System (hereafter: EU-ETS). According to the revised EU-ETS Greenhouse Gas Emissions Trading Directive [11], the target is to reduce greenhouse gas emissions from production capacities in the EU by 43% by 2030 compared to 2005. By 2020, the production capacities of HEP Group covered by the EU-ETS scheme have reduced CO_2 emissions by 45.37% compared to 2005, i.e. they have exceeded the EU target by 2.37%, ten years ahead of schedule. The reduction in emissions was achieved through the investments in renewable energy facilities and high-efficiency cogeneration plants. In addition, heavy fuel oil was replaced by gas and gasoil in the power plants, units that did not meet the conditions set in the environmental permits were shut down and the operation of the Plomin 2 thermal power plant, which uses coal as fuel, was reduced.

Although HEP Group was one of the largest investors in Croatia in the period 2017–2019, most of the investments were related to revitalisation and reconstruction of existing production facilities and the distribution and transmission network, as well as equipment replacement. The existing production capacities (hydropower plants and thermal power plants) are quite old and continuous investments in renovation and revitalisation are needed. To harmonise its operations with EU requirements related to climate and energy goals, HEP Group plans to reduce greenhouse gas emissions from EU-ETS facilities by 50% by 2030 compared to 2005. Also, by 2030, HEP Group plans to increase the share of electricity produced from renewable sources by 50% compared to 2017.

4.2   Group Holding Slovenske Elektrarne (HSE Group)

HSE Group is the largest producer and trader of electricity in Slovenia and the largest producer of electricity from renewable sources. The main activities of HSE Group are the sale and trading of electricity and heat, CO_2 emission certificates, certificates of origin and other renewable energy certificates, the optimisation of HSE Group's production, the provision of ancillary services necessary for the operation of the electricity system and the management and implementation of energy projects. The total installed capacity in HSE Group amounts 1915.47 MW. Thermal power plants account for 52% of the installed capacity in HSE Group (the most significant is the Sostanj thermal power plant with an installed capacity of 928 MW), while hydropower plants account for the remaining 48%. Other capacities are negligible.

Renewable energy sources in HSE Group are mainly hydropower plants. HSE Group's hydropower plants are located on the Drava River and on the Soca River. In the last two years, activities related to the coordination of the concession contract for the construction of ten hydropower plants on the Sava River have been intensified again. This project would increase the Group's installed capacity by 300 MW, which would generate 1 TWh of electricity per year, currently equivalent to 10% of total electricity generation in Slovenia.

An analysis of HSE Group's operations from 2017 to 2019 shows that the Group relies equally on the generation of electricity from hydropower and thermal power plants. During the observed period, HSE Group was dominated by investments ensuring the safety of the Group's operations, i.e., investments and overhauls related to the reliability of production. Investments in coal technology were completed, i.e., in unit 6 of the Sostanj Thermal Power Plant, which was built according to the international standards of the best available technologies and which will reduce CO_2 emissions per unit of electricity produced by one third compared to unit 5.

HSE Group supports the goal of becoming a carbon neutral Group by 2050. Therefore, developments and investments are focused on renewable energy sources. At the same time, HSE Group is committed to a fair transition of regions whose industries are significantly dependent on coal and to a fair burden sharing in the restructuring of such regions into sustainably oriented circular economies. HSE Group believes that the adoption of legislation and policies should consider that the power generation sector has already made a significant contribution to reducing emissions by almost halving them over the last three decades. This was achieved by replacing the old units in TES with the best available technologies, installing appropriate modern philtres and closing the coal-fired power plant in Trbovlje. Furthermore, HSE Group sees natural gas as an important transitional energy source for achieving climate neutrality. Following the adoption of measures on new climate targets by the European Commission in December 2020 [9], it was emphasised that each Member State has the right to decide on its own energy mix and choose the most appropriate technologies, including transitional technologies and energy sources such as gas, to collectively achieve the 2030 climate targets. HSE Group is therefore making

significant efforts to identify gas-related projects as a key element in the transition to climate neutrality.

4.3   Group Slovenske Elektrarne a.s. (SE Group)

The main activity of SE Group is the generation and sale of electricity. The company is the largest electricity producer in Slovakia. SE Group also generates and sells thermal energy and provides ancillary services for the electricity grid.

SE Group operates 31 hydropower plants, 2 nuclear power plants, 2 thermal power plants and 2 solar power plants with a total installed capacity of 4080.92 MW. The largest share of installed capacity in SE Group is accounted for nuclear power plants (48%), hydropower plants (40%) and thermal power plants (12%), while the share of other capacities is negligible. Thanks to a balanced production mix from various sources, the Group supplied 92.5% of the electricity to the grid in 2019 with no local carbon emissions.

Renewable energy sources within SE Group are hydropower plants and solar power plants. The exploited potential of hydropower in Slovakia is about 57.5%. Hydroelectric power plants use the hydropower potential of Slovak rivers to generate electricity, which is constantly renewed and thus represents an inexhaustible source of energy, unlike fossil fuels. Due to their variable power output and operational flexibility, hydropower plants can meet rapidly changing daily load requirements. Hydropower plants at large reservoirs and pumped storage plants contribute most to meeting the uneven electricity consumption during the day. At the hydropower plants, outdated plants and equipment were systematically replaced and maintained.

Solar power plants occupy an important place in the Group's portfolio, especially because of their contribution to environmental protection. Each plant saves about 1200 to 1300 tonnes of greenhouse gas emissions per year (an amount that would otherwise be released into the air if a similar amount of electricity were generated in coal-fired power plants). The investment in the solar power plants was about 5.9 million euros, and now they produce about 1000 MWh of electricity per year.

SE Group invested in projects in accordance with the approved investment plan for 2019 with the basic objective of increasing safety and reliability as well as production efficiency in nuclear power plants. Once completed, units 3 and 4 of the Mochovce nuclear power plant will supply up to 26% of Slovakia's electricity demand. This is the largest private investment in Slovakia. The production of the units will be 2 × 471 MW after the trial run, and each unit is designed to produce 530 MW of electricity in the future. In 2019, the Novaky Thermal Power Plant prepared a comprehensive plan for the transformation, which will operate in the general economic interest until 2023. At the Vojany thermal power plant, investments focused on starting to test the use of new secondary fuels to replace hard coal.

SE Group produces most of its electricity in nuclear and hydroelectric power plants and therefore has low emission levels in relation to the total amount of electricity produced. The operation of thermal power plants (which are practically the only

plants in the SE Group that emit pollutants) met the air protection requirements of the Industrial Emissions Directive and the corresponding national legislation in 2020.

5 Conclusion

Although the energy transition could be challenging and cause numerous problems for countries, it will ultimately bring more benefits. The EU supports the energy transition through various policies aimed at achieving climate neutrality. Energy companies need to adjust their production mix in line with these policies. Three energy companies monitored plan future investments in renewable energy sources and the reduction or elimination of fossil fuels in electricity generation in line with EU targets and expectations.

As for the HEP Group, the biggest polluter is the Plomin thermal power plant, but the Group is systematically reducing production from the thermal power plant and given that the company relies heavily on electricity production from hydropower plants and the Krsko nuclear power plant, the HEP Group is expected to meet EU decarbonisation targets within the set deadlines. Given the stability of operations and the lack of major projects in recent years, HEP Group is recommended to start the investment cycle in major renewable energy projects to achieve greater energy independence.

HSE Group is the one that will find it most difficult to meet the targets and deadlines set by the EU, as a significant part of its business depends on electricity generation at the Sostanj thermal power plant, which runs on coal. This is complicated by the fact that coal from Slovenian mines is used, which is a national problem overall. HSE Group has clearly highlighted this issue in all annual reports and publications. The Group is very active on this issue and advocates a national regulatory framework and the establishment of a fund at EU level to finance investments in renewable energy sources. It is likely that HSE Group will not achieve the set decarbonisation targets within the deadlines set by the EU.

For SE Group, the focus is on investments in new units of the existing nuclear power plant to ensure the Group's energy independence. Although nuclear power plants are not considered renewable energy sources, they are climate neutral and do not represent capacities that emit greenhouse gas emissions. As SE Group relies mainly on production from nuclear power plants, the discontinuation of production from thermal power plants will not have a significant impact on the Group's operations. Similar to HSE Group, the Novaky thermal power plant uses coal from Slovak mines to generate electricity, and SE Group is obliged in the national economic interest to buy domestic coal and generate electricity from it. It is expected that SE Group will have no difficulty in meeting the fossil fuel phase-out targets and deadlines set by the EU.

The analysis of the business plans and strategies of three observed energy companies may lead to the conclusion that renewable energy sources alone are not sufficient

to ensure a secure energy supply. One possible solution is to combine different renewable energy sources, which will reduce the volatility of electricity generation from renewables. Another possibility is to combine renewables with nuclear power or gas. With regard to the security of gas supply, countries are beginning to consider nuclear energy as a possible solution. Since the main obstacle to choosing nuclear energy as an energy source is the high initial investment and usually strong public opposition, small modular reactors (SMRs) could be a solution. SMRs require lower investment costs, can be built closer to industrial sites, and offer more flexibility compared to larger plants. Moreover, the new EU taxonomy has defined gas and nuclear power as environmentally sustainable. Clearly, this inclusion should attract private investors, who are crucial to achieving climate neutrality and shifting financial flows away from coal.

In summary, the study has shown that the decision to invest in renewable energy sources influences the future transition to a low-carbon economy. It is obvious that national interests have a significant impact on the business models of energy companies. Therefore, governments should make more efforts to guide energy companies' investments in renewable energy sources. Of course, the study has some limitations. The most important one relates to the secondary data used from the published annual reports. Therefore, the data on investment in renewable energy sources is based on the information provided by the energy companies. For future studies, it is suggested to extend the study period to a longer time frame in order to analyse broader impacts of renewable energy investments on EU decarbonisation targets.

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Gambling and Drinking, Do They Go Hand in Hand? The Impact of Drinking on Gambling Behaviors and Game Outcomes in Texas Hold'em Poker Short Game

Tianqing Zheng

Abstract Gambling and drinking often go hand in hand, and there is a close relationship between gamblers drinking alcohol and gambling behaviors. The main purpose of this paper is to study the impact of players' drinking on their gambling behaviors and game outcomes in Texas Hold'em Poker Short Game, and then analyze how drinking leads to gambling behaviors and game outcomes. Few existing studies have investigated the relationship between the alcohol and gamblers' behaviors, and this paper is the first to study the relationship between gamblers' drinking and gambling behaviors and game results in Texas Hold'em Poker Short Game, as well as gambling behaviors affected by the alcohol and other related influencing factors, not only providing the practical significance for analyzing the impact of drinking on gambling behaviors and outcomes in gambling games, but also adding to the limited literature on the effects of the alcohol on players' behaviors in Poker Games (note that, by no means, is this paper arguing that people should drink to improve gambling success). The results indicate that drinking people are more likely to win than non-drinking people when comparing the times of winning. Alcohol also affects various behaviors of drinking players at any stage (pre-flop, post-flop, turn and river) and drinking gamblers are less likely to give up than non-drinking gamblers, but more likely to all-in, bet, check, raise bet, and call one's bet at any stage.

Keywords Alcohol · Gambler · Gambling behavior · Poker game

1 Introduction

Gambling and alcohol consumption are mutually reinforcing activities. When gamblers are playing in a casino or in any gambling-related games, various alcoholic beverages are often held in gamblers' hands. By increasing blood alcohol levels to stimulate the brain, gamblers would engage in high-risky behaviors. Alcohol consumption is a dominant factor in impacting gambling controlling behaviors [1].

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Through drinking the alcohol, gamblers' desire to gamble would be increased. The study of Barrett et al. [2] has proved that the alcohol may greatly increase the tendency to gamble with video lottery terminal (VLT) by providing participants with moderate toxic alcohol or placebo drinks, and an opportunity to gamble with real VLT. Some studies have shown that the drinking has a significant influence on the behavioral control of gamblers. Compared with non-drinking gamblers, the gamblers with drinking problem have showed greater problems in several areas of impaired impulse control [3]. However, Ellery and Stewart [4] argue that the alcohol maintains non-pathological gamblers' irrational beliefs about VLT games.

According to the above theoretical and empirical research evidence, there is a close relationship between gamblers drinking alcohol and gambling behaviors. Almost all of these studies, however, have focused on simple alcohol-containing experimental or VLT gambling games, while few have studied on gamblers' involvement in Texas Hold'em type games. To our knowledge, there are no studies that analyze the relationship between gamblers' drinking and gambling outcomes in Texas Hold'em Poker Short Game, as well as behaviors of gamblers stimulated by the alcohol and other relevant influencing factors. Therefore, it is of great necessity to study the relationship between drinking problem and gamblers' behaviors in Gambling Game.

Texas Hold'em has 52 cards (without two jokers) and at least two poker players are required to play at the same game. Each player is given two poker cards as starting hand, and the ultimate goal is to get the best combinations of cards. The order of play is played clockwise along the tournament table, starting on the left-hand side of the declarer button. Usually, the first two players on the left-hand side of the button need to place a small blind and a large blind to start the bet. Five cards are dealt in succession, the first three together, and the fourth and fifth separately. These five cards are known as the Commons, and between cards, there are four rounds (pre-flop, flops, turns, and rivers) players can bet or give up. After all the betting in the game, if the winner cannot be determined, the game enters the showdown stage, which means that all the players show their starting hand to compete with each other, and the one with the highest score would win. In contrast to regular Texas Hold'em Poker Game, Texas Hold'em Poker Short Game chosen in this paper removes 16 cards from the poker 2, 3, 4, and 5, leaving only 36 cards to play. In traditional games, 10JQKA is defined as the maximum straight, but in short game, A can be defined as 5, meaning A6789 is the minimum straight. Rules about comparison of poker cards (default): Flush than Full House, flush larger than calabash, Royal Flush > Straight Flush > Four of a Kind > Flush > Full House > Straight > Three of a Kind > Two Pairs > Pair > High Card. The reduction of the number of cards, accordingly, make up fewer card combinations, which means that the difficulty of players to calculate and judge the poker is also decreasing. Reducing the total number of poker cards by discarding small cards also increases the probability that players would get high cards. Even if the value of the starting hand is not good enough, players are willing to continue playing, making the ratio of the participation significantly improved, and the probability of the high card is greatly higher than the traditional Texas Hold'em, and there is also a great chance for players to make a counterattack.

The main purpose of this paper is to study the influence of drinking on players' behaviors and game outcomes in Texas Hold'em Poker Short Games, and then analyze how the drinking causes these behaviors and game results. To answer these questions, this study has recorded the data concerning 914 worldwide players (612 drinkers and 302 non-drinkers, in this paper, drinking people are someone who have had a drink in the games, whereas non-drinking people are someone who do not drink in the games.) from 149 rounds of poker game of Texas Hold'em Poker Short Cash Game in Triton Poker from 2018 to 2019 by watching videos shared from video website, Bilibili and YouTube. The answers to these questions are of great practical significance to analyze the influence of drinking on gambling behaviors and results of gambling games. This study also adds to the limited literature on the effects of the alcohol on player' behaviors in Texas Hold'em Poker Short Games.

This study examined the influence of the alcohol on players' winning ratio and gambling behaviors in poker games. The results show that drinking people are more likely to win than non-drinking people when we compare winning times. Drinking people are more likely to win than non-drinking people if their chip stacks are more than the average chips; otherwise, non-drinkers are more likely to win than non-drinkers. The alcohol would affect the players' behaviors at any stage, drinkers are less likely to give up, but more likely to all-in, bet, check, raise bet, and call one's bet than non-drinkers at any stage. Consider that drinking affects the player's behaviors of giving up and calling one's bet. In pre-flop, drinkers are less likely to give up than non-drinkers, but in post-flop, turn and river, drinkers are more likely to give up than non-drinkers. In pre-flop, post-flop, turn or river, drinking players are more likely to call one's bet than non-drinking players. Drinking would impact players' final gains and losses, and when we compare losers' above-average losses, non-drinkers are more likely to have above-average losses than drinkers. When we compare winners' above-average gains and below-average gains, or losers' below-average losses, drinkers are more likely to have below-average losses than non-drinkers. Drinkers are more likely to win than non-drinkers, regardless of winning rate of starting hand.

The results in this paper show that drinking gamblers have an advantage more than non-drinking gamblers in the games, possibly because the samples of the data is not enough, the individual cases in the sample are contingent, the particularity of the rules of Texas Hold'em Poker Short Games, and other reasons. Thus, it is not recommended that gamblers drink alcohol in the gambling games.

In the next section, we present the current literature to understand the progress of research issues related to the relationship between alcohol and gamblers. Section 3 shows the sources of data and provides statistical data on key variables and associated descriptive analyses. Our estimated results and discussions are in Sect. 4. The last part summarizes the whole paper.

2   Literature Review

Drinking and gambling often co-occur, and the drinking is a principal factor affecting gambling behavior control ability. Corbin and Cronce [5] used opportunity-based slot machine tasks to explore the effects of alcohol, initial gambling outcomes, impulsivity, and gambling cognition on skill-based video poker tasks. Participants are randomly assigned to either the alcohol or placebo group and given $10 to bet on a simulated video poker task. Compared with placebo, participants in the drinking group placed smaller bets than those in the placebo group, though the effect was not statistically significant and went in the opposite direction among gamblers willing to undertake more risks. However, these findings contradict previous research suggesting that the effects of alcohol on gambling behaviors may vary depending on the type of gambling.

Relatively small amounts of alcohol had a significant effect on the mental processes of gamblers, which underpin self-control over gambling [6]. On a psychological level, the alcohol would increase the desire to gamble. In an eye-tracking task, Ritchie [7] sought to determine whether exposure to alcohol cues increases gambling desire and priority attention to gambling images. In the experiment, male poker players and non-gamblers are randomly assigned to an alcohol or neutral cue condition. There was no any difference in the way the gamblers looked at the gambling pictures, compared with those in the neutral cue, but participants in the alcohol cue condition prioritized the alcohol image more than those in the neutral cue condition. Barrett et al. studying the acute effects of alcohol and nicotine-containing tobacco on subjective and behavioral responses to electronic music terminal gambling have pointed out that both alcohol and nicotine-containing tobacco may greatly increase the propensity to gamble with VLT, but they may do so through different processes.

On a medical level, the idea concerning the alcohol affecting the behaviors of gamblers is complicated. The characteristics of problematic gamblers are examined, who called the Connecticut Commission on Problem Gambling helpline based on whether they had self-reported alcohol using problems between 2000 and 2001. Potenza et al. argue that compared with gamblers without alcohol using problems, problematic gamblers showed greater problems in multiple areas of impaired impulse control. By comparing a sample of pathological gamblers who met and did not meet the criteria for alcohol use disorder [8], it has been found that the high incidence of mental illness in pathological gambling may be strongly influenced by co-occurrence of alcohol problems. Ellery and Stewart compared the effects of moderate alcohol poisoning dose; however, blood alcohol concentration of 0.06g%, on video lottery terminal gambling behavior and cognition of non-pathological gamblers and potential pathological gamblers recruited from the community. Their study concluded that alcohol maintained non-pathological gamblers' irrational beliefs about VLT games, but did not affect their gambling behavior.

Gender differences ought to be taken into consideration when studying on gamblers' risk behavior [9]. By establishing independent risk factor models for male and female' gambling problems, Hing et al. [10] identified gender-based similarities

and differences, as well as the factors of problem-free gamblers (drinking problem) and gamblers with risky behaviors among males and females. Hraba and Lee [11] have compared related factors of problem gambling, and gambling behaviors of adult male and female. The results indicate the significant differences on gender in several predictors of problem gambling (loss of control over gambling, consequences of gambling and gambling behavior) and also suggest that alcohol consumption seems to be a more important predictor for males than females. The research of Breslin et al. [12] also supports this view by investigating three possible mediators of gambling choice, alcohol, gender, and thrill-seeking based on 108 healthy volunteers.

Besides, the relationship between the alcohol and the gambling is also related to the size of the bet, the outcome of the bet, the economic affordability of gamblers, and other factors. Giacopassi et al. [13] have examined the association between low-intensity drinking and gambling and a variety of negative outcomes. Based on the data of students from two universities in Memphis, Tennessee and Reno, Nevada, the results showed that drinking while gambling had a significant effect on men and was related to the size of the bet, the extra money earned at the casino, and the affordability of the gambler. Nevertheless, variables associated with alcohol consumption and gambling may be difficult to observe [14], and failure to incorporate these items into empirical models may bias coefficient estimates. Gambling and alcohol consumption, where problems develop when the endogeneity of alcohol use is properly addressed, are complementary activities.

According to the above theoretical and empirical research evidence, there is a close relationship between gambling behavior and gamblers drinking alcohol. However, almost all of these studies have focused on simple alcohol-containing experimental or VLT gambling games, while few have studied on gamblers' involvement in Texas Hold'em type games, possibly because the statistics involved in Texas Hold'em are too large and complex to process. In addition, based on alcohol control experiments or gambling games dominated by VLT, the existing literature mostly explores the factors of gamblers' behaviors through gamblers' drinking condition or alcohol intake. To our knowledge, there are no studies that analyze the relationship between gamblers drinking problems and the outcomes of Texas Hold'em Poker Short Game, as well as various behaviors of gamblers under the influence of alcohol in the games and other relevant influencing factors. Therefore, it is of great necessity to study the relationship between the alcohol and gamblers' behaviors in Texas Hold'em Poker Short Game.

3 Data

The study of the data in this paper is from Triton Poker' Super Hawker Series Short Deck Cash Game, held in Jeju Island, South Korea from 2018 to 2019. Established at the beginning of 2015, Triton Poker is dedicated to providing Texas Hold'em offline live matches, online Texas Hold'em games and relevant information services for the venture capital circle, financial circle, IT Internet, and other high-end industry

amateurs. Through watching the videos of Triton Poker' Super Hawker Series Short Deck Cash Game shared by two video website, Bilibili and YouTube, the video lasting 560 min in total, the data are recorded that all the relevant information of the players in the whole participating process, including the number of players in per game, the drinking situation, beginning pot, starting hand, behaviors in pre-flop, flop, turn and river, and results. The poker data was compiled until 2019, before the impact of COVID-19 pandemic spread around the world. In order to protect the health of players, Triton Poker has officially stipulated that players must wear masks and are not allowed to drink alcohol during the whole competition in the new series conceptions starting from 2020. Therefore, the data of Triton Poker Short Deck Cash Game from 2020 would not be considered in this study.

The data samples from 2018 to 2019 have covered 149 Triton Short Cash Games, with a target sample size of 914 contestants from various countries or regions in the world (Belarus, Canada, China, Hong Kong China, Czech Republic, France, Germany, India, Indonesia, Lithuania, Malaysia, New Zealand, Russia, Turkey, United Kingdom, and the United States), including 612 players drinking and 302 players not drinking in the games. The data collected focuses on the effect of alcohol use impacting on the outcome of the game, as well as a variety of factors, including players' chip stack, starting hand and winning probabilities, players' behaviors in pre-flop, post-flop, turn and river, winning gains and failed losses and their specific amounts, and the public poker in each game.

Table 1 (Summary Statistics) summarizes the definitions and statistics of all variables in the analysis. Depending on the player's starting hand, the player has 45–85% winning ratio. Conditional on whether drinking or not, respectively, calculate the average winning probability of drinking players and non-drinking players based on their starting hand. The average winning rate of drinking players is 51.60%, and that of non-drinking players is 51.45%. Considering players' chips may impact game outcomes, the average amount of chips the players initially holds in each game as a benchmark, to divide into players with more chips and those with fewer chips. The winning ratio of drinking players with above-average chip stack is 9.97%, and that of non-drinkers is 3.31%, but drinking players with below-average chip stack have the winning probability of 8.82% and 9.93% for non-drinkers. According to the results, the eventual winning rate is 18.79% for the drinking and 13.25% for the non-drinking.

Considering whether drinking would affect players' behavior in the games, the times of giving up, calling one's bet, all-in, betting, raising bet, and check are counted, respectively. In pre-flop, the average probability of drinkers giving up is 43.30%, while that of non-drinkers is 51.32%. In post-flop, the average probability of drinking people giving up is 21.24%, and that of non-drinkers is 20.20%. In turn, the average proportion of drinkers giving up is 7.03%, and the mean possibility of non-drinkers is 5.30%. In river, the mean percentage of drinking gamblers giving up is 2.94%, and the probability of non-drinking one giving up is 2.32%. In the whole process, the average probability of drinkers giving up is 74.51%, and the average probability of non-drinkers giving up is 79.14%. In pre-flop, the average proportion of drinking

gamblers calling one's bet is 35.29% and there is 29.80% for non-drinkers. In post-flop, the average probability of drinkers calling one's bet is 4.41% and 2.32% for non-drinkers. In turn, the average probability of follow bet for drinkers is 1.47% while that of nor drinking people is 1.32%. In River, 0.98% drinking players call one's bet and 0.33% for non-drinkers do the same behaviors. In the whole process, the average probability of calling is 42.16% for drinkers and 33.77% for non-drinkers. In the game, the ration of 9.80% drinking gamblers does the behavior of all-in, and non-drinkers account for 9.27%. Drinkers had an average rate of 27.45% checking and non-drinkers' check is 23.84% in the games. The average possibility of drinking people betting is 13.73%, and that of non-drinkers is 7.28%. 9.80% of drinking players raise bet, while non-drinkers had an average rate of 4.64%.

Whether a player drinks alcohol or not has the possibility to affect the final gains or losses. The average amount of all winning gains and failed losses is used as the benchmark, respectively, and divided into four groups, higher or lower than the average amount of wins and losses. The proportion of drinking gamblers with above-average losses is 2.45%, when the ratio of non-drinking people with above-average losses is 2.98%, and in the data of people with below-average losses, the percentage of the drinking players is 3.59% and the percentage of non-drinking one is 3.31%. The average probability of winning above-average amounts was 5.07% for alcoholics, 2.32% for non-alcoholics, but 13.89% for alcoholics winning below-average gains, and 10.93% for non-alcoholics.

The winning possibility of starting hand may also influence the drinking gambler's decision. Based on the average winning probability of the starting hand of all players, it is divided into two groups of high winning probability and low winning probability. The average probability of drinking people with above-average winning probability is 85.33%, the average probability of non-drinking people with above-average winning probability is 82.51%, the average probability of drinking people with below-average winning probability is 14.48%, and the average probability of non-drinking people with below-average winning probability is 17.49%. The eventual winning probability of players who drink alcohol is 20.76% with a high probability of winning; the probability of non-drinking people with high probability is 14.07%. The winning ratio of drinking players with below-average possibility is 1.14%, whereas the non-drinking players with below-average possibility is same 1.14%.

4   Result

In Table 2 (Hypotheses), hypothesis 1, drinking people are more likely to win than non-drinking people when we compare winning times. The initial winning rate of drinking players and non-drinking players is approximately the same. According to the winning ratio of the starting hand of drinking people (S7), 51.60%, and that of non-drinking people (S8), 51.45%, by comparing the winning rate of the final result of players, 18.79% > 13.25%, the winning probability of alcoholics (S57) was higher

than that of non-alcoholics (S58). When stimulated by the alcohol, drinking gamblers are willing to take risks than the non-drinking, even if there is a tiny winning chance.

Hypothesis 2, drinking people are more likely to win than non-drinking people if their chip stack is more than the average chips. In each game, conditional on players initially with the above-average chips stack, compare the winning probability of drinking gamblers (S9) and non-drinking gamblers (S10). According to the result 9.97% > 3.31%, it could be concluded that with the above-average chip stack, the winning rate of players who drink alcohol is higher than that of non-drinkers. When drinking people have enough chips to back them up, they would take more risks whatever the probability of winning they have, but non-drinking people tend not to take risks in order to protecting their chip stack.

Hypothesis 3, non-drinking people are more likely to win than drinking people if their chip stack is less than the average chips. Comparing the winning possibility of alcoholics (S11) and non-alcoholics (S12) based on players with the below-average chips in the games, the result, 8.82% < 9.93%, demonstrates that if players have below-average chips, the winning ratio of drinking people is lower than that of non-drinking people. Non-drinking people with below-average chips would consider the probability of winning greatly, whereas perhaps drinking people stimulated would become anxious and making wrong decisions.

Hypothesis 4, drinking people are less likely to give up than non-drinking people in pre-flop. By comparing the times of giving up of drinking players (S13) and non-drinking players (S14) in pre-flop, 43.30% < 51.32%, it shows that the alcohol would affect the behaviors of giving up of players in pre-flop, and the ratio of giving up of drinking players is lower than that of non-drinking players. Stimulated by the alcohol, drinking people are willing to attempt various probability of starting hands, even with tiny probability of winning, whereas non-drinking people tend to give up initially to avoid more potential losses if met starting hand with low winning rate.

Hypothesis 5, drinking people are less likely to give up than non-drinking people in post-flop. Drinking people have less probability of giving up in post-flop, for three public pokers shown, they could make a fake appearance to scare non-drinking people to give up to avoid losses. However, the results show that the probability of drinking players (S15) giving up in post-flop is higher than that of non-drinking players (S16), 21.24% > 20.20%. Once, drinking gamblers play in post-flop, getting more information from other players' behaviors and public cards, they do not want to take much risks.

Hypothesis 6, drinking people are less likely to give up than non-drinking people in turn. Drinking people have less probability of giving up in turn, for impacted by the alcohol, they are willing to attempt small probability of winning, which maybe affect non-drinking people to give up to avoid losses. By comparing the data of drinking players (S17) and non-drinking players (S18) in turn, nevertheless, 7.03% > 5.30% shows that the proportion of giving up of the drinking is higher than that of the non-drinking. When drinking gamblers get the information in post-flop and turn, they have the tendency not to undertake too much risks.

Hypothesis 7, drinking people are less likely to give up than non-drinking people in river. There are commonly a few players in river, and drinking people are more

likely to continue, which make other players' a feeling that the drinking is with higher probability of winning. Based on the giving up percentage of drinking players (S19) and that of non-drinking players (S20) in river, the results are opposite to the hypothesis 7, 2.94% > 2.32%, and the giving up ratio of drinking players in river is higher than that of non-drinking players, for after knowing the information in flop, turn and river, drinking people almost have clearly known whether their starting hand could make great combination with public poker cards, and risks of continuing games.

Hypothesis 8, drinking people are less likely to give up than non-drinking people at any stage. Comparing the giving up rate of drinkers (S21) and non-drinkers (S22) at any stage in the games, including pre-flop, post-flop, turn and river, 74.51% < 79.14% indicates that the giving up ratio of drinking gamblers is lower than that of non-drinking gamblers at any stage of the game. Stimulated by the alcohol, drinking people are willing to attempt various probability of starting hands at any stage, but non-drinking people prefer giving up immediately if met low winning probability.

Hypothesis 9, drinking people are more likely to go all-in than non-drinking people at any stage. The data of drinking people (S23) and non-drinking people (S24) all-in at any stage, 9.80% > 9.27%, illustrates that the ratio of drinking players' all-in is higher than that of non-drinking players at any stage. Whatever the probability of winning they have, drinking people all-in for making a fake appearance of having significantly great starting hand with excellent probability of winning, which scares other players give up immediately to avoid losses.

Hypothesis 10, drinking people are more likely to call one's bet than non-drinking people at any stage. By comparing all the times of drinking people (S33) and non-drinking people (S34), calling one's bet at any stage, 42.16% > 33.77%, proves that the ratio of drinking players calling one's bet is higher than that of non-drinking players at any stage. Stimulated by the alcohol, drinking people could undertake more risks and are willing to call one's bet at any stage, for making a fake appearance of having great probability of winning, which may scare other players give up.

Hypothesis 11, drinking people are more likely to check than non-drinking people at any stage. The data of all times of drinking gamblers (S33) and non-drinking gamblers (S34) checking at any stage, 27.45% > 23.84%, supports hypothesis 11 that the ratio of the drinking checking is higher than that of the non-drinking at any stage. Whatever the probability of winning they have, drinking people are likely to check for getting the information of three public pokers for making decisions without any loss.

Hypothesis 12, drinking people are more likely to bet than non-drinking people at any stage. Testing the data of drinking players (S37) and non-drinking players (S38) betting at any stage, 13.73% > 7.28%, drinking people would bet more times than non-drinking people. Whatever the probability of winning they have, drinking people bet for making a fake appearance of having great probability of winning, which scares other players give up to some extent.

Hypothesis 13, drinking people are more likely to raise bet than non-drinking people at any stage. The data of drinking people (S39) and non-drinking people (S40) raising bet at any stage tested for verification, 9.80% > 4.64%, supports that

drinking people tend to raise bet than non-drinking people at any stage. Whatever the probability of winning they have, drinking people raise bet for making a fake appearance of having significantly great probability of winning, which maybe scare other players and impact their decisions.

Hypothesis 14, drinking people are more likely to call one's bet than non-drinking people in pre-flop. By comparing the times of drinking gamblers (S25) and non-drinking gamblers (S26) calling one's bet in pre-flop, 35.29% > 29.80%, shows that the ratio of drinking players calling one's bet is higher than that of non-drinking players in pre-flop. Stimulated by the alcohol, drinking people are willing to call one's bet in pre-flop, for initial attempt generally would not take too much losses, instead, players could get the information of three public pokers contributing to making decisions, even with tiny probability of winning, whereas non-drinking people tend to give up initially to avoid more potential losses if starting hand has low winning ratio.

Hypothesis 15, drinking people are more likely to call one's bet than non-drinking people in post-flop. The data of all times of drinking gamblers (S27) and non-drinking gamblers (S28) calling one's bet in post-flop, 4.41% > 2.32%, demonstrates that the ratio of the drinking calling one's bet is higher than that of the non-drinking in post-flop. Drinking people have more probability of calling one's bet in post-flop, for three public pokers shown, their sequential calling could make a fake appearance to scare non-drinking people to give up.

Hypothesis 16, drinking people are more likely to call one's bet than non-drinking people in turn. The data of drinking people (S29) and non-drinking people (S30) calling one's bet in turn tested for verification, 1.47% > 1.32%, indicates that drinking people would call one's bet more times than non-drinking people in turn. Drinking people have more probability of calling one's bet in turn, for impacted by the alcohol, they are willing to undertake more risks to affect non-drinking people's decisions.

Hypothesis 17, drinking people are more likely to call one's bet than non-drinking people in river. Testing the data of drinking players (S31) and non-drinking players (S32) calling one's bet in river, 0.98% > 0.33%, drinking people have the tendency to have times of calling one's bet than the non-drinking. There are commonly a few players in river, and drinking people tend to calling one's bet to make a fake appearance of holding a great starting hand, which maybe impact others' decisions.

Hypothesis 18, drinking people are likely to have above-average losses than non-drinking people when we compare losers' above-average losses. Drinking people stimulated by the alcohol have more probability of betting enormous chip stack, and once they lose, it would be a huge amount of losses. But the data of the above-average losses of drinking people (S41) and non-drinking people (S42) tested for verification could hardly prove the hypothesis 18. The comparison, 2.45% < 2.98%, indicates that drinking people would have above-average losses more times than non-drinking people in games, for drinking people are less likely to be tilted than non-drinking people. Being tilted means that when players have failed many times, they would easily get into a state of frustration in which players adopt a less that optima strategy, resulting in the player becoming overly aggression to make costly mistakes, or players would change their behaviors in next game when they just lose

one game, or players always changing their behaviors whatever they have won or not.

Hypothesis 19, drinking people are more likely to win above-average gains than non-drinking people when we compare winners' above-average gains. The data of drinking people (S43) and non-drinking people (S44) winning above-average chips, 5.07% > 2.32%, illustrates that the ratio of drinking players getting above-average gains is higher than that of non-drinking players. Drinking people stimulated by the alcohol have more probability of betting enormous chip stack, but once they win, it would be a huge amount of gains.

Hypothesis 20, non-drinking people are more likely to win below-average gains than drinking people when we compare winners' below-average gains. Non-drinking people cannot judge whether drinking people play looser (playing looser means that players get weak starting hand more often, or players cheat other players for winning through disguising themselves with excellent starting hand and their poker cards making great combination with public poker cards with high winning probability), but they do not want to give up; therefore, they have the tendency of betting less chip stack to avoid huge risks, and if they win, it would be small gains. Nonetheless, by comparing the below-average gains of drinking players (S47) and non-drinking players (S48) in games, 13.89% < 10.93%, it shows that the ratio of drinking players getting below-average gains is higher than that of non-drinking players, because drinking people are more likely to play looser and non-drinking people are not sure what they have so that they tend to give up for avoiding any risks.

Hypothesis 21, non-drinking people are more likely to have below-average losses than drinking people when we compare losers' below-average losses. Non-drinking people cannot judge whether drinking people would play looser and they have the tendency of betting less chip stack to avoid potential great losses, and once they lose, it would be small losses that they do not worry so much. The hypothesis could not be supported by the data of the below-average losses of drinking gamblers (S45) and non-drinking gamblers (S46), 3.59% > 3.31%, and it shows that drinking people would have below-average losses more times than non-drinking people in games, for drinking people tend to play looser in per game, and once they are debunked by non-drinking people, it would be a loss.

Hypothesis 22, drinking people with more winning probability are more likely to win than non-drinking people. The difference in the winning proportions of the two groups of players of the starting hand is approximately 3%, based on the winning rates of the drinking players with the starting hand (S49) 85.33% and that of the non-drinking players (S50) 82.51%. Through comparing the above-average winning rate of starting hand of the drinking players and non-drinking players in the final result, 20.76% > 14.07%, the difference is approximately 6%, the difference of the winning rate of the result is much higher than that of the starting hand, it is concluded that with the above-average winning probability of the starting hand, the winning rate of the drinking player (S51) is greater than that of the non-drinking player (S52). Excellent starting hand gives drinking people confidence to bet great chip stack, which means that drinking people who play looser also get good cards, affecting the decisions

non-drinking people used to betting conservatively in some extents, even they also have high winning probability.

Hypothesis 23, drinking people with low winning probability are more likely to win than non-drinking people. The difference in the below-average winning proportions of the drinking players and non-drinking players of the starting hand is approximately 3%, the winning rates of the drinking players with the starting hand (S53) and that of the non-drinking players (S54) are, respectively, 14.48% and 17.49%. Through comparing the ultimate results of the drinking players and non-drinking players, both 1.14%, the winning rate of the drinking player (S55) is equal to that of the non-drinking player (S56). The winning ratio of starting hand of drinking people is approximately 3% lower than that of non-drinking people, but their final winning ratio is the same, which could be concluded that with the below-average winning probability of the starting hand, the winning probability of drinking players is greater than that of non-drinking players. Drinking people with less wining probability are more likely to take more risks and they tend to bet great chip stack, which maybe scare non-drinking people to give up.

5   Conclusions

Drinking problem of gamblers has always been an important factor affecting players' behaviors and results in gambling games. Based on a sample of 149 rounds of poker game played by 914 worldwide players from Triton Poker' Super Hawker Series Short Deck Cash Game held in Jeju Island, South Korea, from 2018 to 2019, this study examined the influence of the alcohol on players' winning ratio and behaviors in poker games. The results show that drinking people are more likely to win than non-drinking people when we compare winning times. When players' chips are taken into account, drinking people are more likely to win than non-drinking people if their chip stack is more than the average chips. Non-drinking people are more likely to win than drinking people if their chip stack is less than the average chips.

When considering how alcohol affects players' behaviors at any stage, it turns out drinking people are less likely to give up than non-drinking people at any stage. However, drinking people are more likely to go all-in, call one's bet, check, bet or raise bet than non-drinking people at any stage.

Drinking would affect the players' behavior of giving up and calling one's bet in pre-flop, flop, turn and river. The results of giving up show that drinking people are less likely to give up than non-drinking people in pre-flop. Drinking people are more likely to give up than non-drinking people in post-flop, turn and river. The outcomes of calling one's bet indicate that drinking people are more likely to call one's bet than non-drinking people in pre-flop, post-flop, turn and river.

Drinking would impact the players' eventual gain or loss. Non-drinking people are likely to have above-average losses than drinking people when we compare losers' above-average losses. Drinking people are more likely to win above-average gains than non-drinking people when we compare winners' above-average gains. Drinking

people are more likely to win below-average gains than non-drinking people when we compare winners' below-average gains. Drinking people are more likely to have below-average losses than non-drinking people when we compare losers' below-average losses. The winning rate of gamblers' starting hand would also have an impact on the gamblers' results. Drinking people with more winning probability are more likely to win than non-drinking people. Whereas, drinking people with less winning probability are more likely to win than non-drinking people.

In addition to the gambling factors considered above, this paper also adds other hypotheses and related possible explanations about the influence of gender issues on the relationship between drinking and gamblers' behaviors and game results in Texas Hold'em Poker Short Games. In Table 3, (Hypotheses about gender) hypothesis 24, drinking females are likely to win than drinking males when we compare winning times. Males stimulated by the alcohol are likely to take more risks but with lower levels of impulsive coping than females. Although the stimulation of alcohol gives them confidence to some extent, their judgment may also be affected so that they make wrong decisions. Hypothesis 25, drinking males are likely to lose more money than drinking females when we compare losers' above-average losses. Drinking males have the tendency to bet more chips to pretend they have high rate of winning than females. Playing looser would take more risks, and once other players do not believe, they would fail with great losses. Hypothesis 26, drinking females are likely to winning more money than males when we compare winners' above-average gains. Drinking males stimulated by the alcohol have more probability of betting enormous chip stack to undertake more risks of playing looser, but once they are doubted by females, a huge amount of gains are won by females. Hypothesis 27, drinking males are likely to lose less money than drinking females when we compare losers' below-average losses. Whatever the probability of winning they have, drinking males prefer betting small chips for continuing the game but avoiding great losses, females are not sure whether males play looser, once males fail, they would lose chips. Hypothesis 28, drinking females are likely to winning less money than drinking males when we compare winners' below-average gains. Drinking males tend to play looser at any stage, but sometimes they leak out their flaws due to the impact of the alcohol leading to unconfident behaviors like touching their noses. When females realizing the cheating, they would win. Hypothesis 29, drinking males are likely to all-in than drinking females at any stage. Whatever the rate of winning they have, drinking males tend to all-in than females for disguising themselves with high winning probability to scare other players give up immediately to avoid losses. Hypothesis 30, drinking males are likely to call one's bet than drinking females at any stage. Whatever the probability of winning they have, drinking males tend to call one's bet than females at any stage for making others believe that they have good starting hand, or just the wrong behaviors stimulated by the alcohol, becoming being tilted. Hypothesis 31, drinking males are likely to raise bet than drinking females at any stage. Males are likely to take more risks than females, and raising bet is a way that drinking males play looser to cheat other players for winning. Hypothesis 32, drinking males are likely to check than drinking males at any stage. Perhaps drinking males do not get great starting hand, but they do not want to give up and they check for consider whether

they continue taking risks of playing looser could have the possibility of winning, but drinking females used to checking for seeing more information to make decisions. Hypothesis 33, drinking females are likely to give up than drinking males at any stage. Drinking males stimulated by the alcohol tend to play looser, and females are not sure whether they have great starting hand or not; therefore, females are likely to give up for avoiding more losses. Hypothesis 34, drinking females are more likely to win than drinking males if their chip stack is more than the average. Drinking females with more chip stack are less likely to take risks of playing looser, or their behaviors cheat others successfully, or with excellent starting hand, there are few players doubting to continue, and finally females are more likely to win the games. Hypothesis 35, drinking males are more likely to win than drinking males if their chip stack is less than the average. Whatever the probability of winning they have, drinking males tend to behave aggressively than females, other players cannot judge their starting hand or they are becoming tilted; therefore, other players prefer giving up to avoid losses. However, there is no further analysis of the relationship between gender and gambling game in this paper, for females are underrepresented in Texas Hold'em Game, leading to insufficient data supporting studies.

Due to the analysis of the specific behavior of gamblers' drinking problem in the gambling games, this study fills the blank of the research on the relationship between the alcohol and gamblers' behaviors and gambling outcomes in Texas Hold'em Poker Short Game. The important relationship between the drinking and gamblers' behaviors show that gamblers continuously increase their risk tolerance through drinking, specifically, their behaviors taken in the games are significantly aggressive, which further influences the game results. Although the results of this study show that the drinking gamblers have an advantage more than non-drinking gamblers in the games, there are some caveats: First, the number of samples available is not very large. Texas Hold'em Poker Short Game have been Texas poker circle' prevalence since 2017, and its special rules for being known by the minority of players. Moreover, there are also few international events on Texas Hold'em Poker Short Game. Second, even after analyzing the behavior characteristics of a large number of gamblers, it could not exclude the impact of other related factors on the relationship between the drinking and gamblers' behaviors. Therefore, it is not recommended that gamblers drink alcohol in casinos or in any gambling-related games.

The results have important practical significance for casinos, the state and society. Texas Hold'em is by far the most popular form of poker, attracting and rallying a large number of loyal players around the world. Attaching importance to the drinking behavior of gamblers should not only be responsible for these people through correcting ideological guidance and behavioral constraints, which means correctly guiding gamblers to deal with the relationship between drinking and playing games at the social level and reducing bad habits. It is crucial to promote the rational capital accumulation and social stability of casinos to engage in risky behaviors at the gambling table, including the stimulation of alcohol. Therefore, it is of great necessity to take effective measures to guide gamblers in the casino or any gambling-related games, to develop a correct drinking behavior, reduce drinking for the pursuit

of risk in games, so as to form a great atmosphere of communication at the gambling games.

In part, this suggests that gamblers maybe motivate themselves to take higher-risk behavior in the casino through drinking. In other words, gamblers tend to drink before playing games, for after drinking make gamblers filled with Dutch courage (the false courage or confidence that a person gets from drinking alcohol), they would engage in something risky or scaring that they would not do before. Taking calling one's bet, for example, stimulated by the alcohol, people originally not willing to bet any chip stack get a sense of unfounded confidence that they could undertake more risks, resulting in drinking gamblers' tendency of calling one's bet at any stage.

Appendix

See Tables 1, 2 and 3.

Table 1 Summary statistics

	Variable	Statistic	Explanation
S1	Total players	914	
S2	Year	2018–2019	
S3	Drinking players	612	
S4	Non-drinking players	302	
S5	Games	149	
S6	Probability of winning	45–85%	Average probability of winning, based on starting hand
S7	Drinking * Probability of winning	51.60%	Conditional on being drinking, average probability of winning based on starting hand
S8	Non-drinking * Probability of winning	51.45%	Conditional on not being drinking, average probability of winning based on starting hand
S9	Win * Drinking * More chip stack	9.97%	Conditional on being drinking and with the chip stack higher than the average, average probability of winning based on starting hand
S10	Win * Non-drinking * More chip stack	3.31%	Conditional on not being drinking and with the chip stack higher than the average, average probability of winning based on starting hand
S11	Win * Drinking * Less chip stack	8.82%	Conditional on being drinking and with the chip stack lower than the average, average probability of winning based on starting hand

(continued)

	Variable	Statistic	Explanation
S12	Win * Non-drinking * Less chip stack	9.93%	Conditional on not being drinking and with the chip stack lower than the average, average probability of winning based on starting hand
S13	Pre-flop * Giving up * Drinking	43.30%	Conditional on being drinking, average probability of giving up in pre-flop
S14	Pre-flop * Giving up * Non-drinking	51.32%	Conditional on not being drinking, average probability of giving up in pre-flop
S15	Post-flop * Giving up * Drinking	21.24%	Conditional on being drinking, average probability of giving up in post-flop
S16	Post-flop * Giving up * Non-drinking	20.20%	Conditional on not being drinking, average probability of giving up in post-flop
S17	Turn * Giving up * Drinking	7.03%	Conditional on being drinking, average probability of giving up in turn
S18	Turn * Giving up * Non-drinking	5.30%	Conditional on not being drinking, average probability of giving up in turn
S19	River * Giving up * Drinking	2.94%	Conditional on being drinking, average probability of giving up in river
S20	River * Giving up * Non-drinking	2.32%	Conditional on not being drinking, average probability of giving up in river
S21	All giving up * Drinking	74.51%	Conditional on being drinking, average probability of giving up in the whole period
S22	All giving up * Non-drinking	79.14%	Conditional on not being drinking, average probability of giving up in the whole period
S23	All-in * Drinking	9.80%	Conditional on being drinking, average probability of all-in in the whole period
S24	All-in * Non-drinking	9.27%	Conditional on not being drinking, average probability of all-in in the whole period
S25	Pre-flop * Call * Drinking	35.29%	Conditional on being drinking, average probability of calling one's bet in pre-flop

(continued)

	Variable	Statistic	Explanation
S26	Pre-flop * Call * Non-drinking	29.80%	Conditional on not being drinking, average probability of calling one's bet in pre-flop
S27	Post-flop * Call * Drinking	4.41%	Conditional on being drinking, average probability of calling one's bet in post-flop
S28	Post-flop * Call * Non-drinking	2.32%	Conditional on not being drinking, average probability of calling one's bet in post-flop
S29	Turn * Call * Drinking	1.47%	Conditional on being drinking, average probability of calling one's bet in turn
S30	Turn * Call * Non-drinking	1.32%	Conditional on not being drinking, average probability of calling one's bet in turn
S31	River * Call * Drinking	0.98%	Conditional on being drinking, average probability of calling one's bet in river
S32	River * Call * Non-drinking	0.33%	Conditional on not being drinking, average probability of calling one's bet in river
S33	All call * Drinking	42.16%	Conditional on being drinking, average probability of calling one's bet in the whole period
S34	All call * Non-drinking	33.77%	Conditional on not being drinking, average probability of calling one's bet in the whole period
S35	All check * Drinking	27.45%	Conditional on being drinking, average probability of checking in the whole period
S36	All check * Non-drinking	23.84%	Conditional on not being drinking, average probability of checking in the whole period
S37	All bet * Drinking	13.73%	Conditional on being drinking, average probability of betting in the whole period
S38	All bet * Non-drinking	7.28%	Conditional on not being drinking, average probability of betting in the whole period
S39	All raise bet * Drinking	9.80%	Conditional on being drinking, average probability of raising bet in the whole period
S40	All raise bet * Non-drinking	4.64%	Conditional on not being drinking, average probability of raising bet in the whole period

(continued)

	Variable	Statistic	Explanation
S41	More losses * Drinking	2.45%	Conditional on being drinking, average probability of above-average losses
S42	More losses * Non-drinking	2.98%	Conditional on not being drinking, average probability of above-average losses
S43	More gains * Drinking	5.07%	Conditional on being drinking, average probability of above-average gains
S44	More gains * Non-drinking	2.32%	Conditional on not being drinking, average probability of above-average gains
S45	Less losses * Drinking	3.59%	Conditional on being drinking, average probability of below-average losses
S46	Less losses * Non-drinking	3.31%	Conditional on not being drinking, average probability of below-average losses
S47	Less gains * Drinking	13.89%	Conditional on being drinking, average probability of below-average gains
S48	Less gains * Non-drinking	10.93%	Conditional on not being drinking, average probability of below-average gains
S49	More winning probability * Drinking	85.33%	Conditional on being drinking, average probability of above-average winning probability based on starting hand
S50	More winning probability * Non-drinking	82.51%	Conditional on not being drinking, average probability of above-average winning probability based on starting hand
S51	More winning probability * Drinking * Wining	20.76%	Conditional on being drinking and with the above-average winning probability, average probability of winning based on the result
S52	More winning probability * Non-drinking * Wining	14.07%	Conditional on not being drinking and with the above-average winning probability, average probability of winning based on the result
S53	Less winning probability * Drinking	14.48%	Conditional on being drinking, average probability of below-average winning probability based on starting hand

(continued)

(continued)

	Variable	Statistic	Explanation
S54	Less winning probability * Non-drinking	17.49%	Conditional on not being drinking, average probability of below-average winning probability based on starting hand
S55	Less winning probability * Drinking * Wining	1.14%	Conditional on being drinking and with the below-average winning probability, average probability of winning based on the result
S56	Less winning probability * Non-drinking * Wining	1.14%	Conditional on not being drinking and with the below-average winning probability, average probability of winning based on the result
S57	Winning * Drinking	18.79%	Conditional on being drinking, average probability of winning based on the result
S58	Winning * Non-drinking	13.25%	Conditional on not being drinking, average probability of winning based on the result

Table 2 Hypotheses

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H1	Drinking people are more likely to win than non-drinking people when we compare winning times	Stimulated by the alcohol, drinking people are willing to undertake more risks than non-drinking people, even with tiny probability of winning	S7 > S8, S57 > S58	S7 > S8, S57 > S58	Confirmed	

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H2	Drinking people are more likely to win than non-drinking people if their chip stack is more than the average chips	When drinking people have enough chips to back them up, they would take more risks whatever the probability of winning they have, but non-drinking people seem less willing to take risks in order to protecting their chip stack	S9 > S10	S9 > S10	Confirmed	
H3	Non-drinking people are more likely to win than drinking people if their chip stack is less than the average chips	Non-drinking people with less chips would consider the probability of winning greatly, whereas perhaps drinking people stimulated would become anxious and making wrong decisions	S11 < S12	S11 < S12	Confirmed	

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H4	Drinking people are less likely to give up than non-drinking people in pre-flop	Stimulated by the alcohol, drinking people are willing to attempt various probability of starting hands, even with tiny probability of winning, whereas non-drinking people tend to give up initially to avoid more potential losses when meeting starting hand with small winning probability	S13 < S14	S13 < S14	Confirmed	
H5	Drinking people are less likely to give up than non-drinking people in post-flop	Drinking people have less probability of giving up in post-flop, for three public pokers shown, their continue could make a fake appearance to scare non-drinking people to give up to avoid losses	S15 < S16	S15 > S16		Once they see flop, get a lot more information, and therefore do not want to take too much risk (because maybe they play looser pre-flop)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H6	Drinking people are less likely to give up than non-drinking people in turn	Drinking people have less probability of giving up in turn, for impacted by the alcohol, they are willing to attempt small probability of winning, which maybe affect non-drinking people to give up to avoid losses	S17 < S18	S17 > S18		Once they see post-flop + turn, get a lot more information, and therefore do not want to take too much risk
H7	Drinking people are less likely to give up than non-drinking people in river	There are commonly a few players in river, and drinking people are more likely to continue, which make other players' a feeling that the drinking is with higher probability of winning	S19 < S20	S19 > S20		Once they see post-flop + turn + river, get a lot more information, and therefore do not want to take too much risk

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H8	Drinking people are less likely to give up than non-drinking people at any stage	Stimulated by the alcohol, drinking people are willing to attempt various probability of starting hands at any stage, whereas non-drinking people tend to give up immediately when meeting small winning probability	S21 < S22	S21 < S22	Confirmed	
H9	Drinking people are more likely to all-in than non-drinking people at any stage	Whatever the probability of winning they have, drinking people all-in for making a fake appearance of having significantly great starting hand with excellent probability of winning, which scares other players give up immediately to avoid losses	S23 < S24	S23 < S24	Confirmed	

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H10	Drinking people are more likely to call one's bet than non-drinking people at any stage	Stimulated by the alcohol, drinking people could undertake more risks and are willing to call one's bet at any stage, for making a fake appearance of having great probability of winning, which scares other players give up to some extent	S33 > S34	S33 > S34	Confirmed	
H11	Drinking people are more likely to check than non-drinking people at any stage	Whatever the probability of winning they have, drinking people are likely to check for getting the information of three public pokers for making decisions without any loss	S35 > S36	S35 > S36	Confirmed	

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H12	Drinking people are more likely to bet than non-drinking people at any stage	Whatever the probability of winning they have, drinking people bet for making a fake appearance of having great probability of winning, which scares other players give up to some extent	S37 > S38	S37 > S38	Confirmed	
H13	Drinking people are more likely to raise bet than non-drinking people at any stage	Whatever the probability of winning they have, drinking people raise bet for making a fake appearance of having significantly great probability of winning, which maybe scare other players and impact their decisions	S39 > S40	S39 > S40	Confirmed	

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H14	Drinking people are more likely to call one's bet than non-drinking people in pre-flop	Stimulated by the alcohol, drinking people are willing to call one's bet in pre-flop, for initial attempt generally would not take too much losses, instead, players could get the information of three public pokers contributing to making decisions, even with tiny probability of winning, whereas non-drinking people tend to give up initially to avoid more potential losses when meeting starting hand with small winning probability	S25 < S26	S25 < S26	Confirmed	

(continued)

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H15	Drinking people are more likely to call one's bet than non-drinking people in post-flop	Drinking people have more probability of calling one's bet in post-flop, for three public pokers shown, their sequential calling could make a fake appearance to scare non-drinking people to give up	S27 > S28	S27 > S28	Confirmed	
H16	Drinking people are more likely to call one's bet than non-drinking people in turn	Drinking people have more probability of calling one's bet in turn, for impacted by the alcohol, they are willing to undertake more risks to affect non-drinking people's decisions	S29 > S30	S29 > S30	Confirmed	

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H17	Drinking people are more likely to call one's bet than non-drinking people in river	There are commonly a few players in river, and drinking people are more likely to take risks of calling one's bet to make a fake appearance of holding a significant starting hand, which maybe impact others' decisions	S31 > S32	S31 > S32	Confirmed	
H18	Drinking people are likely to have above-average losses than non-drinking people when we compare losers' above-average losses	Drinking people stimulated by the alcohol have more probability of betting enormous chip stack, but once they lose, it would be a huge amount of losses	S41 > S42	S41 < S42		Drinking people are less likely to be tilted than non-drinking people
H19	Drinking people are more likely to win above-average gains than non-drinking people when we compare winners' above-average gains	Drinking people stimulated by the alcohol have more probability of betting enormous chip stack, but once they win, it would be a huge amount of gains	S43 > S44	S43 > S44	Confirmed	

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H20	Non-drinking people are more likely to win below-average gains than drinking people when we compare winners' below-average gains	Non-drinking people cannot judge whether drinking people play looser, but they do not want to give up, therefore they have the tendency of betting less chip stack to avoid huge risks, and if they win, it would be small gains	S47 < S48	S47 > S48		Drinking people are more likely to play looser and non-drinking people are not sure what they have so the leave the hand
H21	Non-drinking people are more likely to have below-average losses than drinking people when we compare losers' below-average losses	Non-drinking people cannot judge whether drinking people would play looser and they have the tendency of betting less chip stack to avoid potential great losses, and once they lose, it would be small losses that they do not worry so much	S45 < S46	S45 > S46		Drinking people are more likely to play looser and non-drinking people are not sure what they have so the leave the hand

(continued)

	Hypotheses	Explanation	Test	Result	Confirmed	Alternative explanation
H22	Drinking people with more winning probability are more likely to win than non-drinking people	Excellent starting hand gives drinking people confidence to bet great chip stack, which maybe affect the decisions non-drinking people used to betting conservatively, even they also have high winning probability	S49 > S50, S51 > S52	S49 > S50, S51 > S52	Confirmed	Drinking people who play looser also get good cards
H23	Drinking people with less winning probability are more likely to win than non-drinking people	Drinking people with less wining probability are more likely to take more risks and they tend to bet great chip stack, which maybe scare non-drinking people to give up	S53 < S54, S55 ≥ S56	S53 < S54, S55 = S56	Confirmed	

Table 3 Hypotheses about gender

	Hypotheses	Explanation
H24	Drinking females are likely to win than drinking males when we compare winning times	Males stimulated by the alcohol are likely to take more risks but with lower levels of impulsive coping than females. Although the stimulation of alcohol gives them confidence to some extent, their judgment may also be affected so that they make wrong decisions

(continued)

(continued)

	Hypotheses	Explanation
H25	Drinking males are likely to lose more money than drinking females when we compare losers' above-average losses	Drinking males have the tendency to bet more chips to pretend they have high probability of winning than females. Playing looser would take more risks, and once other players do not believe, they would fail with great losses
H26	Drinking females are likely to winning more money than drinking males when we compare winners' above-average gains	Drinking males stimulated by the alcohol have more probability of betting enormous chip stack to undertake more risks of playing looser, but once they are doubted by females, a huge amount of gains are won by females
H27	Drinking males are likely to lose less money than drinking females when we compare losers' below-average losses	Whatever the probability of winning they have, drinking males prefer betting small chips for continuing the game but avoiding great losses, females are not sure whether males play looser, once males fail, they would lose chips
H28	Drinking females are likely to winning less money than drinking males when we compare winners' below-average gains	Drinking males tend to play looser at any stage, but sometimes they leak out their flaws due to the impact of the alcohol leading to unconfident behaviors like touching their noses. When females realizing the cheating, they would win
H29	Drinking males are likely to all-in than drinking females at any stage	Whatever the probability of winning they have, drinking males tend to all-in than females for disguising themselves with high winning probability to scare other players give up immediately to avoid losses
H30	Drinking males are likely to call one's bet than drinking females at any stage	Whatever the probability of winning they have, drinking males tend to call one' bet than females at any stage for making others believe that they have good starting hand, or just the wrong behaviors stimulated by the alcohol, becoming being tilted
H31	Drinking males are likely to raise bet than drinking females at any stage	Males are likely to take more risks than females, and raising bet is a way that drinking males play looser to cheat other players for winning
H32	Drinking males are likely to check than drinking males at any stage	Perhaps drinking males do not get starting hand with high probability of winning, but they do not want to give up and they check for consider whether they continue taking risks of playing looser could have the possibility of winning. Whereas, drinking females used to checking for seeing more information to make decisions

(continued)

	Hypotheses	Explanation
H33	Drinking females are likely to give up than drinking males at any stage	Drinking males stimulated by the alcohol tend to play looser at any stage, and females are not sure whether they have great starting hand or not, therefore, females are likely to give up for avoiding more losses
H34	Drinking females are more likely to win than drinking males if their chip stack is more than the average chips	Drinking females with more chip stack are less likely to take risks of playing looser, or their behaviors cheat others successfully, or with excellent starting hand, there are few players doubting to continue, and finally females are more likely to win the games
H35	Drinking males are more likely to win than drinking males if their chip stack is less than the average chips	Whatever the probability of winning they have, drinking males tend to behave aggressively likely all-in than females, other players are not sure they have excellent starting hand or they are becoming tilted, therefore, other players prefer giving up to avoid losses

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The Role of Education in the Development of Creative Industries: The Case of Kazakhstan

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Abstract The creative industry is one of the most dynamic segments of the global economy today and has a significant transformative impact on socio-economic growth. According to experts and market participants, there are few examples of commercially successful projects in the creative industry of Kazakhstan, but the potential of the industry is underestimated for various reasons. Although the creative sector of the economy is still relatively new and underdeveloped in Kazakhstan, it has a good export potential and can be leveraged to foster a favorable perception of the nation abroad. This article explores the role of education in the development of creative industries. The purpose of the study is a qualitative analysis of the level of the educational system in Kazakhstan involved in the training of personnel for the creative industry. It also offers comprehensive recommendations for its improvement considering local specifics. The work makes a significant contribution to the literature on the creative industries by expanding the concept and complementing the practice of developing countries. The research on the developing creative industries markets in the former Soviet Union's nations offers novel findings and significant new information.

Keywords Creative industries · Kazakhstan · Enterprise curriculum

1 Introduction

Currently, the creative industries are one of the most dynamically developing sectors of the world economy and international trade. The creative industries are industries in which there is a predominance of creative labor along with high-added value. There is no single definition of the concept of creative industries. So, for example, according to John Hawkins, neither creativity nor the economy is something new,

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the new lies in the essence and change in the relationship between them, as well as in what combinations of them create exceptional economic value and well-being. So, he defines the creative economy as "the transaction of creative products."

A distinctive feature of the creative economy from the traditional one is the formation of the central role of the creative person. In a creative economy, people and businesses employ unrestricted resources and gain intellectual rights to them, which can be temporary; whereas in a traditional economy corporations constrained by material resources compete primarily on price. As [1] emphasizes, in creative economies, we are moving from a world of falling profit margins based on scarcity of natural resources and material goods to a world of increasing profit margins based on an infinity of possible ideas and human genius to use those ideas in the production of new products and transactions. In this regard, skills availability and the education level of creative individuals are of particular importance. According to [2], nowadays the creative class is in high demand in the market where several qualitative and quantitative changes that alter the structure and rules of the economy occur. At the same time, the role of innovative education is growing. This system will need professionals who can determine, develop, and transform people who can be classified as members of the creative class.

The economic development of Kazakhstan is mainly due to the export of raw materials, including oil. This fact predetermined the nature of the education system. Priority is given to training employees in fields like mining and engineering which are directly tied to the economy's extractive industry. However, creative industries do not receive the required attention. Even the present training programs for creative specialties are insufficient to meet all of the market demands. The outcome is a lack of competition in the market. The purpose of the study is to analyze the efficiency of the educational system in Kazakhstan in training students who seek careers in the creative industry. It also aims to develop suggestions for the enhancement of training provided at vocational and higher education institutions.

This study is aimed at identifying the features and barriers to the growth of creative industries in the Republic of Kazakhstan during the COVID-19 pandemic. The work significantly contributes to the literature on the creative industries by expanding the concept, presenting unique results, and complementing the practice of developing countries.

2 Literature Review

The concept of creative industries first emerged in the UK with the decision of the British Labor government to establish the Creative Industries Task Force (CITF) [3]. Although the creative industry discourse was introduced in the United Kingdom, it soon spread around the world, including developed countries such as the United States, Singapore, and China. The importance of the creative economy in the modern world has been recognized both in the academic and political spheres.

The original definition of creative industries by the Department of Digital, Culture, Media, and Sports (DCMS) is "individual creativity that may take the form of intellectual property" [4], p. 114. However, there is still debate about the accuracy and consistency of this term. Another widely used definition of the creative industry is "a set of knowledge-based activities focused on, but not limited to, the arts, potentially generating income from trade and intellectual property rights" (p. 115). According to UNESCO [3], creative industries include the following industries: music, film, video, photography, design, advertising, literature, museums, libraries, and interactive media.

In North America, Australia, and Europe, the creative economy is mainly used as a tool for economic recovery and revitalization of abandoned areas, especially in deindustrialized regions, as well as for the development of innovative strategies [5–7]. Meanwhile, developing countries prioritize exploiting their comparative advantage in the cost of cultural production over creating new knowledge [2]. Therefore, it is very important to note that cultural values and social contexts differ from country to country, depending on the level of economic development, political stability, and many other factors. In many developing countries, intellectual property rights (IPRs) are not seen as private goods, as evidenced by frequent piracy and a lack of awareness and respect for copyright [8]. Therefore, it is realistic to anticipate that policies promoting the creative economy will operate differently in these nations and may not always provide the same outcomes.

The work [9] analyzed the creative industries of several developed countries, such as Australia, Great Britain, Canada, the USA, and New Zealand. The authors tried to answer the question: What is the dynamic relationship between the creative industries and the rest of the economy? Their main goal was to assess the "importance" of the creative industries to the modern economy to reorient economic policy support toward creative organizations. These studies thus bring to light an essential point, namely that the economic value of the creative industries can go beyond the simple production of cultural goods or the employment of creatives. It can also play a more general role in stimulating and facilitating change throughout the economy, as evidenced by its dynamic parameters and degree of inclusion in the economy as a whole. As a result of their research, the authors found that the "dynamic value" of creative industries is greater than their "static value," and business representatives of this industry have a significant positive impact on other industries.

Another significant quantitative study in the field of creative industries was carried out by Huberman and Miles [10]. The authors conducted an empirical study based on a survey of more than 2000 creative enterprises in Austria. In addition to being by definition a source of creativity, they discovered that the creative industries also exhibit high rates of technological innovation, directly influencing the amount of industrial innovation in the economy in terms of technologically innovative goods and procedures. The main barrier to fully harnessing the innovative potential of this sector is the lack of time for creative entrepreneurs, reflecting the small average firm size, and the high proportion of individual entrepreneurs. Therefore, initiatives tailored for micro-firms should be developed as part of innovation policies supporting the creative industries.

In general, the literature analysis revealed that there is a lack of high-quality research on the management of creative industries in emerging markets in this area [3, 4, 11]. A paucity of comprehensive research in the developing region, including Kazakhstan, further strengthens the relevance of this topic.

Creative individuals are at the center of venture creation in the creative industry. According to the existing literature, creative personnel are those who use their artistic and creative sensibility to identify opportunities and produce creative products, services, or experiences; whereas, creative entrepreneurs are those who bring together resources to exploit these opportunities as a business [12, 13]. The talent and behavior of the staff are crucial to the success of a creative business [14]. Furthermore, research has revealed that creative professionals are enthusiastic about their work and ready to demonstrate their creativity and artistic ability [15, 16].

An essential element in the development of creative industries is the provision of training that equips students with the necessary competencies to meet the market needs. However, the subject is intricate as creative industries do not fit under the category of traditional education. The complexity of this topic is bound to several factors: rapid and constant change in the market, an infinite variety of creative work possibilities, and a wide range of specialties that could be named creative. First, it is necessary to define what core competencies students should develop for prosperous entrepreneurship within the creative industry. According to [9], students have to know how to use their imagination to establish and develop a project, find unique solutions to the problem, how to risk and be open-minded, and constantly look for new opportunities. All these capabilities are developed in entrepreneurship education which is "a process which develops individuals' mindsets, behaviors, skills and can be applied to create value in a range of contexts and environments from the public sector, charities, universities and social enterprises to corporate organizations and new venture start-ups" [9], p. 4.

A literature review on the topic of education and curriculum development suggests that certain issues hinder growth. For instance, ambiguity about what subjects should be taught, whether entrepreneurship should be included as a subject, and scarcity of pedagogical resources. More importantly, there are not enough competent mentors who can provide coaching and not all higher educational institutions can provide students with enough resources and up-to-date knowledge.

The current curriculum of creative industry entrepreneurship also needs rigorous review and discussion. Up until this point, the main strategy used by universities to support the graduate employability agenda has been the development of general fundamental skills like communication, problem-solving, literacy, numeracy, as well as a few desirable character traits [3]. Additionally, [9] states that the ability to negotiate diverse value judgments, a better awareness of ownership and intellectual property rights, increased media literacy, and a better understanding of the structure of creative careers and how to traverse them will assist in providing better enterprise education. Courses at universities should be reviewed systematically and altered where necessary. Similarly, [17] empathize the importance of provoking an enterprising approach to thinking and encouraging innovative culture starting from the beginning of studies. Likewise, along with teaching specific, domain-tailored skills it

is crucial to demonstrate the significance of individual responsibility for continuous career development.

Oakley [18] pinpoints that current higher education policy emphasizes accreditation of the courses and certificates rather than improving the quality. Another argument the author makes is linking education too tightly to the industry may endanger the traditional way of teaching certain disciplines.

One of the critical moments that requires particular attention is that students come to universities after graduating from schools where creativity and self-expression are suffocated almost to non-existence because of standardization. However, the notion of standardization is contradictory and artificial to the essence of creativity. Instead of raising flexible and competent learners, schools are concentrated on targets and outputs [18]. As economic analysts claim, essential training for entrepreneurship and innovation includes the capacity for failure that schools cannot afford nowadays. Hence, we can conclude that there is a discrepancy between challenges in the economy and academic reaction.

3 Methodology

3.1 Research Context and Method

The use of a qualitative, interpretative, and inductive approach allowed for this study to be exploratory while also focused on discovering, gaining insight from, and understanding the perspectives of the study participants [19].

Kazakhstan is the largest country in Central Asia, and its economic development is primarily driven by the export of raw materials, including oil. Nevertheless, the government has been paying greater attention to the development of small businesses and entrepreneurship. Because of the lack of established companies and large manufacturers in the creative industry, design and fashion develop mainly through the efforts of small businesses and individual entrepreneurs.

According to experts and market participants, there are few examples of commercially successful projects in the creative industry in Kazakhstan; however, the potential of the industry is underestimated for various reasons. Moreover, the creative sector of the economy is quite new for Kazakhstan, and it is underdeveloped; nevertheless, it has a good export potential, which may contribute to forming a positive image of the country.

Kazakhstan is a relatively underexplored context compared with other similar contexts such as the economies of Brazil, Russia, India, China, and South Africa. Like many other post-Soviet countries, Kazakhstan has repeatedly witnessed serious shocks: the collapse of the Soviet Union, high inflation, the transition to a floating exchange rate, and the 2007–2009 global financial and economic crisis. Before the financial crisis, the economy of Kazakhstan had been developing and showing

promising signs. Still, the devaluation of the national currency, which has weakened the currency 80 times over the years of independence, hampered the country's growth. In addition, many challenges exist in the creative industries sector in Kazakhstan, including the lack of an ecosystem of great entrepreneurs and venture capitalists for new start-ups. Hence, this setting provides the range for understanding the post-penetration survival of creative industries, especially those that arise from such adverse conditions. This study explores the ways these organizations fostered their capacities despite challenging home environments and updated their core capabilities during and after the crisis. Given such scenarios, we believe it is time to explore the factors that influence creative industries' survival in Kazakhstan's emerging economy.

3.2   Data

This study applied a mixed-method design. First, a survey was conducted to understand the landscape of creative industries in Kazakhstan, one of the post-Soviet Union countries. This approach allowed us to comprehend the types of businesses, founders' activity, funding structure, and barriers to development. Second, 34 semi-structured interviews were conducted with founders who agreed to a follow-up interview. The interviews helped us capture the motivation of the founders, and the enablers and barriers to successful business development. All interviews were recorded and fully transcribed. We focused on engaging our informants in storytelling and experience sharing during the semi-guided interviews. A qualitative thematic approach can reveal valuable crucial informants' perspectives such as creative industry entrepreneurs [3]. Additionally, qualitative research on the management of creative industries in emerging markets is lacking [3, 4, 11].

3.3   Participants

We chose a targeted sampling technique [20] and listed 34 representatives of the creative industries who already function in the sector [4]. A total of 34 participants took part in the interview. According to the respondents, the main types of creative industries are performing arts (26%), design (20%), craft (14%), software and computing systems (13%), music (13%), cinematography (6%), architecture (3%), television and radio (2%), and interactive entertainment programs (3%). The age of companies is as follows: 52% of organizations have been in existence for approximately 3 years, of which 16% are less than 1 year old. However, several enterprises have existed for more than 10 years (16%). An analysis of questionnaires by forms of legal entity shows that 78% are individual entrepreneurs; 16% are freelancers; 6% are limited liability partnerships, and less than 1% are public funds and creative hubs. Notably, most freelancers work behind the scenes; that is, they

- performing arts
- craft
- music
- architecture
- interactive entertainment programs
- design
- software and computing systems
- cinematography
- television and radio
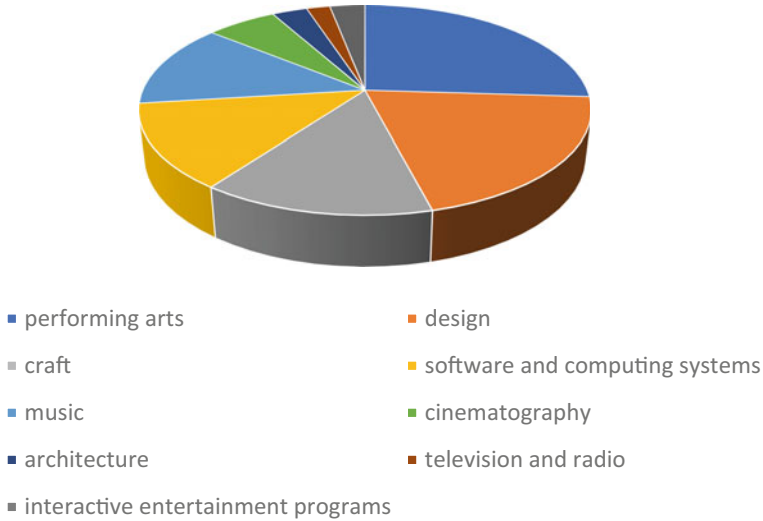
Fig. 1 Main types of creative industries according to the respondents

are not counted in statistics and do not pay taxes. Moreover, 88% of organizations are micro-enterprises with a staff of up to 15 people. This research received ethics approval from the local ethical committee of the Kazakh National University named after al-Farabi for interviews No. 2513 dated 03.08.2020 (Fig. 1).

We used an interview guide [10] for the interviews, which included questions about the variables determining these companies' continued survival, motivation, process, and so on support for the internal market, and the development of opportunities. However, the focus was on the survival factors of these SMEs, being the main subject of this study. Additional codes were also used during the interview. All interviews were conducted in the state language, as this approach suited entrepreneurs. Each interview lasted 60–75 min on average. All of the interviews were taped and afterward transcribed. The respondents were also assured of anonymity, urged to express themselves as freely as possible, and given any other relevant information that would aid their understanding of the topic under investigation.

3.4 Codebook and Data Analysis

We started analyzing the data by recording all interviews. We used the following processing techniques selection, generalization, and coding [10]. The main goal of this process is to draw conclusions and conduct checks within and between codes. As a tool for data analysis, we used the Nvivo 10 qualitative data analysis software [21].

Ultimately, the process resulted in the initial creation of 98 codes from the collected corpus of materials. For further analysis and discussion, the most common topics were selected—those that appeared as a typical code in no less than at least four individual meetings. This process resulted in the selection of 26 codes for further consideration (out of the 98 identified initially). According to the main themes and topics, these 26 codes were structured on thematic network maps. The main themes originated from the data as the lowest or subsidiary comments, which in themselves reveal limited information about the text in its entirety, represent a theme when read in the context of other main themes. Therefore, a topic is a medium or higher-order that gathers and organizes the main issues into groups or groupings of similar questions to present them as main ideas.

A global theme can be formed by combining these themes that ultimately incorporate the key meanings discovered and validated by the corpus of data. As a result, a theme network was established, taking as a starting point the main themes and internal work toward a global theme through the themes [22]. Therefore, the transcripts were subjected to efficient "microanalysis" [8], p. 57 by carefully examining the transcripts line by line, and developing and inductively applying logical level codes and related hypothetical notes to address recognized classes, examples, and topics. Codes were created inductively "up" from information right off the bat in the coding system since thoughts emerged from the information as opposed to "down" from past thoughts, activities, or hypotheses [23]. These codes and associated notes are analogous to the "open source" and "theoretical notes" found in grounded theory [23]. Figure 1 shows an overview of this theory, which is described in the preceding paragraph.

The emergence of patterns from the data allowed us to combine codes into groups that formed categories. The category (e.g., opportunities) was first found by pattern analysis, and then it was further separated and split down into subcategories (e.g., marketing, technology, or management capabilities). After a few rounds of emphases and correlations between registers, we reduced our concentration to a center arrangement of abilities. We were able to focus on the important opportunities that affect the survival of enterprises in this market by taking this strategy.

4   Results

The increasing role of creativity in everyday life has shifted all concepts to traditional education. According to the results of the survey, it was revealed that the majority of representatives of the creative sector are dissatisfied with the quality of higher education and consider it as "… a waste of time." So, for example, an interior designer with 20 years of experience claims that "I received knowledge in the city of Almaty, the Kazakh leading architectural and construction academy. Shortly, it is called KazGASA. Then, I got knowledge at the school of design because this is the country's higher educational institution. They don't teach how to use software; they only talk about theory. I had to find an internship separately because

they didn't provide any internships for work and I had to study at a design school. There was an internship with the design school program. The jeweler, who got a job in a jewelry workshop, was outraged by the fact that "he wasted 4 years of his life studying in vain, while he learned everything necessary for work in 1 month during an internship." Traditional educational methods inevitably limit the diversity of institutional cultures, academic practices, and student learning experiences. In addition, they create a learning environment characterized by risk avoidance, fear of failure, and outward purposeful behavior [19]. In this regard, there is a need to revise traditional methods of education. Modern educational processes should include the development of creative skills, such as ideas for developing self-contained or "flipped" learning resources, inspiring learning environments for creativity, or using audiovisual resources as a critical thinking tool.

The educational system has several shortcomings that impede the growth of the creative industry sector. One shortcoming is the lack of practice during training when students do not understand how to apply theory in real life. Additionally, outdated software adversely impacts the development of the sector. This is especially true for the closely related technology IT sector. The programmer noted that "the programs that they used in training have not been used for more than 30 years." In general, the IT sphere is developing very dynamically and new programs and applications are constantly appearing. "The system of higher education is unlikely to somehow have time to adapt all this to the educational system," the programmer noted. Thus, modern technologies undoubtedly play are crucial to complex data analysis and management for making long-term decisions in highly specialized areas. Without a thorough understating of how to apply modern technologies, a specialist will not be able to complete the tasks. This factor reduces his competitiveness in the labor market. The scarcity of qualified specialists, on the one hand, leads to the use of foreign personnel who is more costly and do not always correspond to the characteristics stated in their resume. On the other hand, it results in the drain of domestic personnel who travel overseas to obtain a decent education.

The retardation of current educational programs and the deficit of good technology have led creative professionals to turn to digital technologies to gain additional knowledge. The use of new technology-assisted learning tools such as mobile devices, smart boards, MOOCs, tablets, laptops, simulators, dynamic visualization, and virtual labs has changed attitudes toward the traditional education system in higher schools and institutions. The Internet of Things (IoT) has been proven to be one of the most cost-effective methods for training young brains. It is also a robust mechanism for integrating a world-class learning experience for all. The young musician replied that "… I got the knowledge of arranging exclusively on the Internet. Now there is free access to YouTube, where people like me, and of course knowledgeable people, post their work and post step-by-step steps on how it all happens. Therefore, the Internet is now just a storehouse of knowledge for any field of activity, not just for me. So, I get knowledge now from the Internet."

It is becoming more and more obvious that conventional classroom teaching techniques do not offer a real-time learning environment, quick evaluation, or higher levels of engagement. New educational technology and digital learning tools are
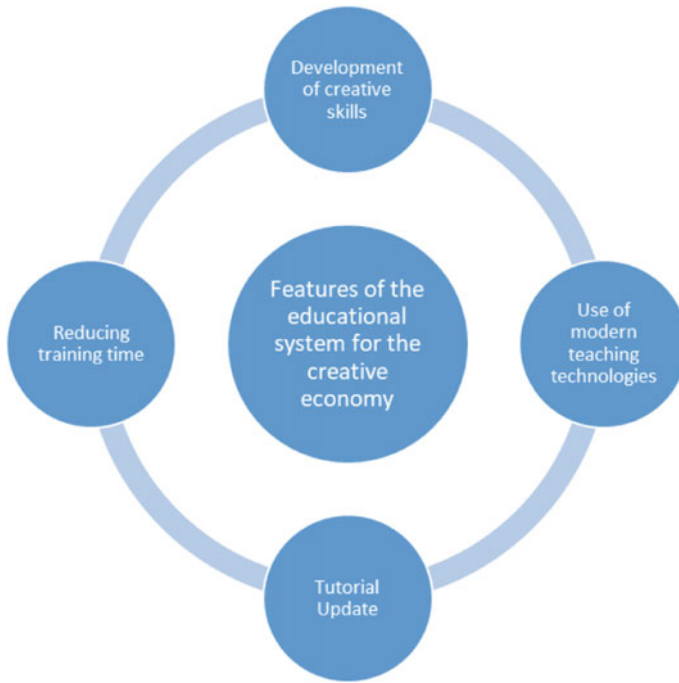
Fig. 2 Features of the educational system for the creative economy

filling this gap. Access to digital technologies through a smartphone allows you to gain knowledge anywhere in the world. The artist notes "… the borders have been erased. If earlier we had to go somewhere in Europe to gain knowledge of new techniques; now everything is available which is an advantage for us. We have become more competitive." The abundance of digital technologies should make universities review the current education system and alter programs so they include new forms and methods of training. It should be noted that the adaptability and unobtrusiveness of modern technologies make learning more attractive for the next generation. Creative professionals are unwilling to spend time on lengthy forms of learning (Fig. 2).

5   Conclusions

In summary, education in the creative industries sector directly depends on the level of technological equipment of higher educational institutions, the relevance of curricula, and the demand for specialties. Promising creative competencies are mainly acquired through additional education, including independent use of digital technologies. As a result, the market goods segment is where competencies for the development of qualitative characteristics of human capital are formed. The training of specialists

using budgetary funds for the branches of the innovative economy is scarce and primarily concentrated in the traditional creative specialties sector. The development of educational programs at various levels in the field of creative industries, starting from the school age, is critical for the development of an innovative and creative economy in Kazakhstan. The core of the creative industries is made up of creative people, the shortage of which becomes the main hindrance in the development of an innovative economy. The state needs to revise traditional methods of education toward more advanced forms of education.

6 Limitations

The survey was conducted during the pandemic. As a result, all interviews were conducted online. It was impossible to assess the respondents' facial expressions and gestures. It should also be noted that many respondents did not have any income during the pandemic, and some were depressed. To some extent, the abovementioned factors negatively impacted their attitude to work in general.

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Policy Analysis for Strategies of Sustainable Development of Chu-Mango Value Chain in Vietnam

Kiet Hong Vo Tuanf Truong and **Shaufique Fahmi Sidique**

Abstract The study is to apply a policy analysis matrix (PAM) and SWOT matrix to identify macroeconomic policy efficiency, establish policy scenarios, and suggest strategic solutions for the sustainability of the Chu-mango value chain. The results prove that macroeconomic policies significantly influence the economic efficiency and competitiveness of export channels (protection of output price, exchange rate, and subsidization of domestic costs). Channel 1 adapts well to changes in macroeconomic policies and maintains economic efficiency and international competitiveness in all scenarios. Channel 2 is strongly affected by free on board (FOB) price policy. It will lose economic efficiency if the FOB price declines by 20%. Another policy from the government is to improve the mango quality of Channel 2 to provide it to Channel 4. It is a policy to develop domestic channel 4 for import substitution. Channel 3 is sensitive dynamic with an output price policy and is a disincentive to export expansion. It only promotes exports when the FOB price increases by 20% or the exchange rate decreases by 20%. The paper also suggests 10 strategies to sustainably improve the Chu-mango value chain. Strategic solutions for upgrading the efficiency of the Chu-mango value chain sustainably are suggested by SWOT analysis from sharing ideas of stakeholders in whole chain. Particularly, the results contribute to the basic principle of the PAM in analyzing comparative advantage and policy efficiency of international trade, especially in the tropical fruits and vegetables field.

Keywords Macroeconomic · Scenarios · Policy analysis · Strategic solutions

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1 Introduction

There is no difficulty identifying why agricultural policy analysis is increasing concerns of policymakers, economists, and the government. Quantitative and qualitative analysis is a dynamic tool in the policymaking process to ensure targets, constrictions, and consistent policies for agricultural fields. This permits policies to be changed in steps with an alteration in the economy and priorities set up for the agricultural field.

Bushara et al. [1] stated that the agricultural sector plays a central role in the domestic economy of developing countries. Usually, it makes up fifty to half of the gross domestic product. Even the proportion of the agricultural labor force is higher. In recent years, there has been a thinking alteration between agriculture and industry, in which the agricultural sector is supplier food, raw material, and labor for industry development. It is apparent that strong agriculture is a fundamental motivation for industrial and economic growth. Several governments continue to profoundly intervene in the agricultural market, both directly and indirectly, through-level tools and macro and trade policies. For example, macro (exchange rate and interest rate), trade (export and import), and sector (output and input). It reflects linkages of economic activities, such as production, processing, delivery, wholesaling, and retailing. This allows them to determine problems that need to be solved by properly efficient policies.

Chu-mango has emerged as a major fruit for domestic consumption and international export. Opportunities for the Vietnamese mango subsector are very large before significant demand in both domestic and international markets. However, to be able to compete with competitors, it requires strict coordination among stakeholders along the chain from production to consumption as a systemic approach to ensure that products reach their destination in good quality conditions, and identify proper policies to boost sustainable development of the whole chain. Therefore, the main purpose of this study is to determine the characteristics of stakeholders in the chain, measure macroeconomic policy efficiency, and establish policy scenarios to improve the competiveness of the Chu-mango value chain. Strategic solutions are proposed in this study to upgrade the efficiency of the Chu-mango value chain.

2 Methodology

2.1 Sampling Technique

In the present study, we sampled the populations at multiple stages. First, the Mekong Delta (MD) was chosen because of its central role in mango cultivation in Vietnam, accounting for 62.8% of the production volume and 48.2% of the production area in Vietnam [2]. Second, to obtain valid questionnaire items and reliability, we performed

Table 1 Number of sampling observations

Main actors	Observations	Data collection	Year
1. Famer	267	Questionnaire	2018
2. Cooperative/farmer group	5	Questionnaire	2019
3. Collector	30	Questionnaire	2019
4. Wholesaler	30	Questionnaire	2019
6. Export enterprise	7	Questionnaire	2019
7. Processing firm	5	Questionnaire	2019
8. Supermarket, fruit shop	15	Questionnaire	2019
9. Agricultural department, center for trade promotion (provincial level)	16	Group discussion (4 staffs/group)	2018
10. Local authorities (district, commune level)	16	Group discussion (4 staffs/group)	2018
11. Farmer group	24	Group discussion (6 farmers/group)	2018
12. Transporter	16	Questionnaire	2019
13. Agro-input dealers	10	In-depth interview	2019
14. Central market of fruit and food	4	In-depth interview	2019
15. Agency of phytosanitary inspection 2	1	In-depth interview	2019
Total	491		

four field trials (An Giang, Dong Thap, Tien Giang, and Vinh Long), with 10 respondents in each trial. Finally, a simple random technique was used to collect data from 491 respondents (Table 1).

2.2 Empirical Model

Policy Analysis Matrix (PAM)
The analytical framework of the PAM is applied in this study to measure the efficiency of policy at market prices and social prices on farming and trading systems in the agriculture sector. It was developed by Monke and Pearson [3] and augmented by Masters and Winter-Nelson [4]. The structure of PAM is a table with three rows containing components: revenue, cost (tradable and domestic cost), and profitability. The first row shows the indicators calculated at the market price. The indicators in the second row are computed at the social price. The third row shows the divergence between the first and second rows, which reflects policy intervention. The matrix helps policymakers identify the capacity of international competitiveness, economic efficiency (comparative advantage), policy effects, and either protection or lack of protection in agricultural fields [5–10].

Table 2 Policy analysis matrix (PAM)

Items	Revenues	Costs		Profit
		Tradable inputs	Domestic factors	
Market prices	A	B	C	D
Social prices	E	F	G	H
Policy effects	I	J	K	L

Source [5]

This study is contributed PAM and value chain analysis (VCA). Thus, it is a set of activities for a segment of a value chain [11]. A segment of a domestic value chain (a domestic marketing channel) is selected to determine business activity at market price, while the value chains of the export market segment (marketing channels for export) are accounted for at the social price. The PAM of each marketing channel has four columns and three rows (Table 2). The first column is *revenue,* which is defined as the number of units sold multiplied by the unit price. The second column is *tradable inputs* that directly generate outlays of foreign currency (if important items). The third column is *domestic factors* produced by internal countries or non-tradable factors (labor and natural resource rent). The fourth column is *profits* that are defined as revenues minus tradable inputs and domestic factors.

The cost structure of PAM is derived from stakeholders, inputs, and marketing costs in the Chu-mango value chain. The cost is divided into two cost categories (tradable input and domestic factors) at market and social prices. In this study, input cost (root fertilizer, leaf fertilizer, paclobutrazol, herbicide, insecticide, fungicide) is divided into tradable input and domestic factors depending on the percentage of meeting domestic commodity demand. Marketing costs from farmers (energy, wrapping bag, transport, hired labor, machine depreciation, family labor, and land rent) and other stakeholders᾽ marketing costs are given to domestic costs. In the case of domestic factor costs at market prices, the opportunity cost (machine depreciation, family labor, and land rent) is rejected. In particular, tradable outputs (FOB price) and tradable inputs (CIF price) are multiplied by the shadow exchange rate (SER).

The shadow exchange rate can be estimated through the following formula:

$$SER = OER * (1 + FX \text{ premium})$$

where as:

- SER: Shadow Exchange Rate
- OER: The official exchange rate (OER—Official Exchange Rate) in the 2018–2019 period (published by Ministry of Finance [12]) was 22,622 VND/USD.
- The FX premium recommends 20% (0.2) by the World Bank for developing countries [13].

The opportunity cost: Assuming a somewhat efficient labor market, the opportunity cost of labor during the production phase is assessed in actual prices paid by

households. The price of home land rent for mango growers determines the opportunity cost of land. The internal resource costs were used to compute all land costs. By assuming constant efficiency for years and the value loss every year, the potential cost of agricultural equipment is calculated [11].

Output transfers: $I = A - E$
Input transfers: $J = B - F$
Factor transfers: $K = C - G$
Market profits (Actual Profitability): $D = A - B - C$
Social profits (Economical Profitability): $H = E - F - G$
Net profit transfers: $L = D - H = I - J - K$

$D > 0$, the domestic channel at the market price generates profit under the current policy and market conditions and is competitive.

$H > 0$, the export channel at social price would be able to make a profit even without benefiting from a subsidy or being constrained by taxes and is said to have a comparative advantage.

Relative Competitiveness Indicators

$$\text{Private cost ratio (PCR): } C/(A - B)$$

PCR > 1 indicates that the domestic channel utilizes a greater value of domestic factors than the value added, and is not profitable.

PCR < 1, the system is profitable.

$$\text{Domestic Resource Cost (DRC): } DRC = G/E - F$$

DRC = 1, the export channel is not conducive, and foreign currency savings are not equal to domestic production (products produced beneficial neutrality).

DRC/SER < 1, the product has a comparative advantage.

DRC/SER > 1, the product does not have a comparative advantage.

$$\text{Social benefit-cost (SBC): } SBC = E/(F + G)$$

SBC > 1, the export channel is an efficient business channel,

SBC < 1, the export channel is not profitable for the exporting business.

Nominal protection coefficient on tradable outputs (NPCO): NPCO $= A/E$

NPCO > 1 indicates that the domestic channel at market price benefits from protection.

NPCO < 1 indicates that policy intervention occurs as an incentive for the export channel at a social price.

Nominal protection coefficient on tradable inputs (NPCI): NPCI $= B/F$

NPCI > 1 indicates that the domestic channel at market price is paying higher than for tradable input costs (promotion for the export channel at social price).

An NPCI < 1 indicates that the domestic channel at market price benefits from protection by subsidization of tradable input costs.

Effective protection coefficient (EPC): EPC = (A − B)/(E − F)

EPC > 1, the domestic channel at the market price is protected with a higher added value than the export channel.

EPC < 1, the domestic channel at the market price receives a lower-added value than the export channel at the social price (incentive to export activities).

Subsidy ratio to producers (SRP): L/E

An SRP > 0 indicates the overall transfer profit from the export channel to the domestic channel and limited exports.

An SRP < 0 indicates the overall transfer profit from the domestic channel to the export channel and export incentive.

SWOT Matrix

In recent decades, the SWOT framework has become a well-known tool for strategic analysis. It is widely used by researchers and practitioners. According to [14], SWOT analysis was introduced by professors at the Harvard Business School in the 1960s. This is a strategic tool for supporting decision situations. SWOT is popularly applied to the agricultural sector in developing nations. In fact, the main function of the tool is to provide strategic planning in marketing and company management. It includes two internal factors (strengths [S], weaknesses [W]), and two external factors [opportunities (O) and threats (T)] [15]. Weihrich [16] stated that the SWOT matrix provides four strategic categories based on combinations such as S-O strategies (Strengths-Opportunities), S-T strategies (Strengths-Threats), W-O strategies (Weakness-Opportunities), and W-T strategies (Weakness-Threats) (Table 3).

Table 3 SWOT matrix

Factors	Opportunities (O)	Threats (T)
Strengths (S)	S-O strategies	S-T strategies
Weaknesses (W)	S-O strategies	S-T strategies

Source [14]

3   Results and Discussion

3.1   *The International Competitiveness and Policy Effects*

The distribution system of the Chu-mango value chain includes two main channels. The export channels (marketing channels 1, 2, and 3) and domestic channels (marketing channels 4).

Channel 1   Farmer → Cooperative → Export Enterprise
Channel 2   Farmer → Cooperative → Wholesaler → Processing Firm
Channel 3   Farmer → Collector → Wholesaler (China)
Channel 4   Farmer → Collector → Wholesaler → Supermarket

According to [11], the disparity between competitive and comparative advantage in value chain analysis for policymaking is defined based on VCA and PAM. Competitive advantage is the result of vertically linked economic activities, calculated by market prices (the domestic channel). A comparative advantage is the outcome of vertically linked economic activities, computed by social prices (export channels). In this study, the PAM is constructed for each selected agricultural system using data on farming, farmers to export enterprises, farmers to processors, and farmers to wholesaler marketing. More specifically, channel 4 is computed at the market price to compare with other export channels at social prices (channels 1, 2, and 3). It is discussed in a number of policy effects based on insights from domestic and export-oriented channels. Channel 4 is the main domestic channel at market price.

Table 4 provides essential information for calculating economic indicators based on market and social prices for marking channels 1, 2, and 3. Channel 4 is computed based on an actual marketing channel of Chu-mango, which is consumed in the Vietnamese market. The positive value of market profitability (794.86 USD/ton) indicates the competitiveness of the Chu-mango production system in terms of current technologies, input and output prices, and policy transfers. It is reasonable to expect future expansion of production systems. In addition, the social profitability for channels 1, 2, and 3 is positive, implying that marketing channels 1, 2, and 3 use scarce resources efficiently at social costs. This implies that the exporting commerce of Chu-mango can generate foreign exchange earnings through marketing channels 1, 2, and 3. In general, Chu-mango marketing channels are profitable businesses for both market and social prices.

The findings in Table 4 present the revenue and profit transfers between the market and social prices. The valuation of revenue and profit transfers in Channels 2 and 3 are positive. This means that channels 2 and 3 can earn profits without assistance from the government or subsidizing policy. On the other hand, revenue and profit transfers in channel 1 between market and social price are negative, implying that the government's policy intervention reduces the profitability of the business and production system in channel 4 in order to encourage exporting activity for channel 1, signaling a profit transfer from channel 4 at market price to channel 1 at social

Table 4 Policy analysis matrix for the marketing channels 1, 2, and 3

Channels	Revenue	Cost		Net profit
		Tradable inputs	Domestic factors	
The channel 1 at social price, the channel 4 at market price				
Market price	2142.92 ± 10.97	250.40 ± 187.64	1097.66 ± 146.24	794.86 ± 311.77
Social price	8711.01 ± 44.61	424.37 ± 318.01	5843.76 ± 397.71	2442.87 ± 656.05
Policy effects	−6568.09 ± 33.64	−173.97 ± 130.36	−4746.10 ± 301.68	−1648.02 ± 388.23
The channel 2 at social price, the channel 4 at market price				
Market price	2142.92 ± 10.97	250.40 ± 187.64	1097.66 ± 146.24	794.86 ± 311.77
Social price	1552.76 ± 7.95	144.97 ± 108.64	1084.30 ± 135.81	323.48 ± 223.68
Policy effects	590.19 ± 3028	105.43 ± 79.01	13.36 ± 98.92	471.37 ± 136.97
The channel 3 at social price, the channel 4 at market price				
Market price	2142.92 ± 10.97	250.40 ± 187.64	1097.66 ± 146.24	794.86 ± 311.77
Social price	1706.39 ± 8.74	300.49 ± 225.17	755.26 ± 282.41	650.65 ± 463.62
Policy effects	436.53 ± 2.24	−50.08 ± 37.53	342.4 ± 196.45	144.21 ± 214.14

Unit USD/ton
Source Field survey data in 2018 for farmer, in 2019 for other actors
Note Tradable input is CIF price, Tradable output is FOB price

price. For example, government policies advocate finance for VietGAP and GlobalGAP registration, traceability codes, training programs, commercial promotions to encourage exports.

Table 5 shows that the international competitiveness indicators in mango business and production. The results indicate that PCR value is 0.59 (less than one) at the market prices. It means that one unit of added value is produced from the channel 4, it needs 0.41 unit of domestic resources. This proves the channel 4 can be run without supporting policies from government, implying it has competitive advantage in Vietnamese market (import substitution). Besides, the DRC coefficients have values less than one at social prices (0.71 in the channel 1, 0.78 in the channel 2, and 0.59 in the channel 3), which indicates Chu-mango production and export is competitive and has comparative advantage in three channels given current technologies, output values, input cost, and policy transfers. The SBC ratios of the channels 1, 2, and 3 are of 1.40, 1.30, and 1.91, respectively, showing exporting business of mango can save foreign exchange 1.40, 1.30, and 1.91 times more as compared to its costs at

Table 5 Synoptic view of PAM indicators in the export channels

Indicators	Channel 1	Channel 2	Channel 3
PCR	0.59 ± 0.15	0.59 ± 0.15	0.59 ± 0.15
DRC	0.71 ± 0.07	0.78 ± 0.16	0.59 ± 0.35
SBC	1.40 ± 0.13	1.30 ± 0.21	1.91 ± 0.76
NPCO	0.25 ± 0.00	1.38 ± 0.00	1.26 ± 0.00
NPCI	0.59 ± 0.00	1.73 ± 0.00	0.83 ± 0.00
EPC	0.23 ± 0.01	1.34 ± 0.03	1.37 ± 0.13
SRP	-0.19 ± 0.04	0.30 ± 0.09	0.08 ± 0.13

Source Field survey data in 2018 for farmer, in 2019 for other actors

social prices. In particular, the export channels (the channel 1 and 3) of fresh mango can earn higher foreign exchange than that of processing mango (the channel 2).

There are differences in the values of NPCO in the export channels (0.25, 1.38, and 1.26 for channels 1, 2, and 3, respectively). In channel 1, NPCO is less than one (0.25), which promotes the production and business of export channel 1 by the output price policy. This implies that the revenue of export channel 1 at the social price is 75% higher than that of domestic channel 4. On the other hand, NPCO of channels 2 and 3 are more than one, implying that consumers of channels 2 and 3 are taxed, and domestic channel 4 at market price benefits from the protection of output; its revenue is 38% and 26% greater than the revenue of channels 2 and 3 at social price.

For the NPCI index, the value of NPCI in channel 2 is 1.73 greater than one, indicating the domestic channel 4 indirect taxes on tradable inputs, because they pay higher than for tradable input costs. This means that government policies do not support the inputs for channel 4 at the market price. Meanwhile, NPCI values of the channels 1 and 3 are 0.59 and 0.83 less than one, implying that the channel 4 at market price benefits from protection of tradable inputs cost equivalent to 41% in the channel 1, and 17% in channel 3. In addition, the finding reveals that the EPC coefficient in channel 1 is 0.23 less than one. This indicates that channel 4 receives a lower added value than channel 1 at the social price and is taxed more for tradable inputs than outputs. This is an export incentive for channel 1. In contrast, the values of EPC in channels 2 and 3 are 1.34 and 1.37 (more than one), which means that channel 4 is supported by the government by the subsidy policy of tradable output price.

Based on the information given in Table 5, the SRP value is negative (−0.19) in channel 1, implying that net profit is transferred from channel 4 at market price to channel 1 at social price and taxpayers. This shows that 19% of the divergence as a result of taxation policy is used as an incentive for the export of channel 1. However, channel 4 receives approximately 30% positive support from the government through the transfer of net profit from channel 2, and an insignificant amount of about 8% of net profit from channel 3. Generally, the government pays attention to the incentive to export activities of Channel 1, encouraging mango quality improvement (mango

grades 3 and 4 transfer to mango grade 2) to supply to domestic channel 4 instead of export channel 2, and is a disincentive for export to the Chinese market (channel 3).

Overall, the production and business of channel 1 is encouraged by the government through the policy of output protection and added value increase, but there is no subsidization of tradable input costs. The government advocates channel 2 through a protected policy of tradable input costs. There is no support policy for Channel 3, which is an export channel to the Chinese market. This lays emphasis on the strategy of the government transferring domestic market development (Channel 4) instead of exports to the Chinese market via a bother gate (Channel 3). Channel 4 is supported by the government with a subsidy policy of tradable output compared to channel 2, and subsidies for both tradable input and output compared to channel 3.

3.2   Analysis of Policy Scenarios

According to [17], PAM does not reflect the potential changes in policy indices. Thus, sensitive analysis should be carried out to measure the influence of changes in FOB prices, tradable costs, domestic costs, and exchange rates on competitiveness and policy indicators at $\pm$ 20% [18, 19].

The results from Table 6 provide information about scenarios of DRC, SBC, SRP, and EPC by altering 20% of the FOB price, tradable cost, domestic cost, and exchange rate compared to the baseline scenario. The results indicate that DRC and SBC are strongly impacted by changes in FOB prices, domestic costs, and exchange rates rather than tradable costs. For example, DRC and SBC at social prices are improved by around a fifth in three channels when the FOB price and exchange rate increase by 20%, and domestic cost reduces by 20%. Alteration of 20% of the tradable cost results in a change in a small minority of DRC and SBC (less than 9%). In particular, a 20% decrease in the FOB price leads to a remarkable reduction in DRC by approximately 28% in channels 1 and 2, and 40% in channel 3. This shows that the comparative advantage of the Chinese channel depends heavily on the export price compared to other channels.

For the EPC index, an increase of 20% in the FOB price and exchange rate in channel 1 showed an 18% decline in EPC value. Even if the FOB price and exchange rate decrease by 20%, the EPC value in channel 1 is still less than one. This reflects the benefit of channel 1 to increase more quickly than channel 4, implying that there is an incentive for Chu-mango fresh exports in channel 1. In contrast, the EPC values in the scenarios of channels 2 and 3 were greater than one. This confirms that there is an incentive to develop a business production system in Channel 4 rather than export activities in Channels 2 and 3, especially when the FOB price decreases by 20%.

In the scenarios of channel 1, the value of SRP is negative when the FOB price, tradable cost, domestic cost, and exchange rate increase by 20%. This implies that the profit of channel 1 is higher than that of channel 4. The government continues to boost the export business of Channel 1. Increasing the FOB price by 20% leads to an SRP increase of approximately 68.4%; however, the FOB price decreases by 20%,

Table 6 Sensitivity analysis of the export channels

Indicators	Increase 20%			Decrease 20%		
	Channel 1	Channel 2	Channel 3	Channel 1	Channel 2	Channel 3
DRC	0.71 ± 0.07	0.78 ± 0.16	0.59 ± 0.35			
FOB price	0.58 ± 0.06	0.64 ± 0.12	0.46 ± 0.24	0.90 ± 0.10	1.01 ± 0.23	0.83 ± 0.67
Tradable cost	0.72 ± 0.08	0.80 ± 0.18	0.61 ± 0.39	0.70 ± 0.07	0.76 ± 0.14	0.53 ± 0.26
Domestic cost	0.85 ± 0.09	0.95 ± 0.19	0.72 ± 0.44	0.57 ± 0.06	0.63 ± 0.13	0.48 ± 0.29
Exchange rate	0.57 ± 0.06	0.62 ± 0.13	0.47 ± 0.28	0.85 ± 0.09	0.94 ± 0.20	0.70 ± 0.42
SBC	1.40 ± 0.13	1.30 ± 0.21	1.91 ± 0.76			
FOB price	1.68 ± 0.16	1.56 ± 0.25	2.30 ± 0.92	1.12 ± 0.11	1.04 ± 0.17	1.53 ± 0.61
Tradable cost	1.39 ± 0.14	1.27 ± 0.22	1.87 ± 0.76	1.42 ± 0.13	1.33 ± 0.20	2.04 ± 0.77
Domestic cost	1.18 ± 0.11	1.10 ± 0.18	1.63 ± 0.64	1.73 ± 0.18	1.58 ± 0.27	2.23 ± 0.94
Exchange rate	1.73 ± 0.18	1.59 ± 0.28	2.26 ± 0.94	1.18 ± 0.11	1.10 ± 0.17	1.66 ± 0.64
SRP	0.19 ± 0.04	0.30 ± 0.09	0.08 ± 0.13			
FOB price	-0.32 ± 0.04	0.09 ± 0.07	-0.10 ± 0.10	0.01 ± 0.06	0.63 ± 0.11	0.36 ± 0.16
Tradable cost	-0.18 ± 0.05	0.32 ± 0.09	0.10 ± 0.13	-0.20 ± 0.04	0.28 ± 0.10	0.04 ± 0.11
Domestic cost	-0.05 ± 0.05	0.44 ± 0.09	0.19 ± 0.16	-0.32 ± 0.04	0.16 ± 0.09	0.01 ± 0.10
Exchange rate	-0.35 ± 0.04	0.03 ± 0.08	-0.13 ± 0.10	-0.03 ± 0.05	0.58 ± 0.10	0.30 ± 0.15
EPC	0.23 ± 0.01	1.34 ± 0.03	1.37 ± 0.13			
FOB price	0.19 ± 0.01	1.10 ± 0.04	1.09 ± 0.04	0.29 ± 0.02	1.72 ± 0.00	1.86 ± 0.47
Tradable cost	0.23 ± 0.01	1.37 ± 0.01	1.41 ± 0.19	0.23 ± 0.02	1.31 ± 0.06	1.28 ± 0.02
Exchange rate	0.18 ± 0.02	1.04 ± 0.06	1.05 ± 0.05	0.28 ± 0.01	1.65 ± 0.01	1.68 ± 0.21

Source Field survey data in 2019

resulting in a positive SPR value, indicating that there is an export incentive transfer to domestic consumption. Dropping 20% of domestic cost and exchange rate led to an increase of 68.4% in SRP and a decrease of 84.2% in SRP; in contrast, SPR values decreased by approximately 73.7% by increasing the domestic cost by 20%, and an increase of 84.2% in SRP from a 20% growth rate. Thus, the macroeconomic policies of the FOB price, domestic cost, and exchange rate significantly influence the SRP

in channel 1. Scenarios in channel 2 indicate that the SRP is positive, implying that the government maintains a quality improvement policy to obtain mango grade 2 for Channel 4. In channel 3, the government often does not encourage the export of fresh Chu-mango to the Chinese market. In particular, an increase of 20% in the FOB price and exchange rate leads to a negative value of SRP instead of positive values as baseline scenarios. There is a policy alteration from limited exports to export incentives.

3.3   Strategic Solutions for Sustainable Development of Chu-Mango Value Chain

The findings in Table 7 indicate the internal and external factors of the Chu-mango value chain, which provides strategic solutions for sustainability. It consists of nine strengths, seven weaknesses, four opportunities, and eight threats. Policy implications are recommended based on the key findings from the strategy planning of the SWOT analysis. It encompasses 10 strategies with 15 specific activities, as follows:

S-O Strategies
Strategy 1: Development of business linkage model Farmer-Cooperative-Company.
Activity 1 : Local authority at the provincial level is an active recommendation business linkage model for large mango enterprises located locally.
It shows the concern of local authority on companies, businesses, and helps companies connect to large raw material regions. This makes it good to expand the business operations of companies. Dialog should present priority policies that local authorities can support in progressing the business linkage model. This has paved the way for companies to invest their businesses locally for a long time.
Activity 2 : A simplified administrative formalities for business linkage model.
Information about support policies (business premises, taxation, and preferential loans) and essential conditions of the business linkage model are exact to enterprises. In particular, staff teams are responsible for administrative formalities and documents related to support policies.
Activity 3: Dissemination information on business linkage model to local authority at district and commune levels if factories are located in districts and communes.
Discussions related to contract farming should be held at the district and commune levels with participating enterprises, cooperatives, farmers, and local authorities.
Activity 4: Monitoring, evaluating, improving business linkage model.
Stakeholders in the business linkage model should regularly organize evaluation sections after each cropping season to facilitate the development of the model in the next season.

Strategy 2: Enhancing management capacity, marketing skill and safety production organization of cooperative, and farmer group.

Activity 5: Strengthening role and responsibility of cooperative progression as a business production organization, rather than production organization.

The director of the cooperative not only formally delegates cooperative management, but is also a representative member of the cooperative to sign contract farming and trade. Thus, managers must have knowledge and skills in production organizations, marketing, communication, and trade negotiations.

Strategy 3: Government and enterprise should coordinate institutes and universities to execute researches and development projects related to product quality and market demand.

Activity 6 : Investigating consumers' preferences for intrinsic and extrinsic mango attributes in domestic and international markets.

This helps companies identify the demand for various market segments with different product qualities. This allows companies to propose suitable marketing and production strategies to expand their business activities.

Activity 7: Improving production process and fruit quality.

New production processes should be considered to increase the pet and disease resistance of mango orchards in climate change. The study of mango variety improvement should not be ignored, especially in studies that help mango skin become thicker. This allows enterprises to export further markets through shipping lines.

W-O Strategies

Strategy 4: Investment for rural infrastructure and transportation toward connection between production and consumption better.

Activity 8 : Government and local authorities should prioritize the budget of the new rural program to conduct in mango farming regions.

Using the budget from the national program for new rural development is a feasible solution for building rural infrastructure and transportation. This helps small-scale farmers access the central fruit market, wholesalers, and companies. It contributes to production organization among farmers and facilitates the establishment of cooperative and farmer groups.

Strategy 5: Delivery processing mango products via collaboration processor and modern domestic retail system.

Activity 9: Evaluating the potential of the domestic market for processing mango products in supermarkets and mini shops.

The Vietnamese market is large, with 100 million people and a young population. This is a promising market for mango processing and processing. Successful exploitation in the domestic market is a good opportunity for companies, turnover growth.

S-T Strategies

Strategy 6: Boosting collaboration between cooperative/farmer group and quality agro-input dealers/company.

Activity 10 : Establishing collaboration between cooperative/farmer groups and quality agro-input dealers/company.

This collaboration helps agro-input control and management. It helps farmers ensure the quality and quantity of fertilizer and agrochemical sources to avoid banned active ingredients and low agro-inputs.

Strategy 7: Investment policies appeal to big companies to build factories in large mango farming areas.

Activity 11: Calling processing firms and export enterprises open factories that are located locally instead of other provinces.

Support policies (business premises, taxation, and preferential loans) should be expanded to attract local companies to build local factories. It not only contributes to mango consumption, but also brings to job opportunities and income increases for local labor.

Strategy 8: Ensuring stable macroeconomic policies (output price, exchange rate policy, material cost, salary).

Activity 12: Maintaining the stability of macroeconomic policies is a prerequisite for investing in companies and development for a long time.

The government needs to engage in stable macroeconomic policies for a long time. This helps enterprises plan progressive strategies in medium and long periods.

W-T Strategies

Strategy 9: Training in production organization, market access, product competitiveness, quality management.

Activity 13: Training organization for stakeholders in Chu-mango value chain

- Training on organizational governance and business planning
- Training on market awareness and value chain
- Training on export requirements of advanced markets
- Training on new technology application
- Training on good agricultural practice and safety certification.

Strategy 10: Attending international fair, trading promotion, negotiating free trade agreement for advertising Vietnamese mango trademark and exporting market expansion.

Activity 14:Trading negotiation, free trade agreement participation, and trading promotions to expand foreign markets.

Mango is a popular fruit in Vietnam after banana. It is usually given in free trade agreements and commercial negotiations at the bilateral and multilateral levels. Thus, importing taxes for fresh fruit and mango products is very low or zero. Exporting enterprises should exploit this aspect well for trade promotion and market expansion.

Activity 15: Concern in potential markets in ASEAN and Asia.

To consider potential markets in ASEAN, such as Malaysia, Singapore, and Taiwan, which have high mango import demand. For example, Malaysia is one of the ten most mango importers in the world. Transporting by shipping lines to Malaysia and Singapore takes about 3–4 days, and it is cheaper than other markets by airplanes. It tackles the weakness of Chu-mango (ripe quickly and thin skin) (Table 7).

Table 7 Analysis of strategies for sustainable development of Chu-mango value chain

SWOT	Opportunities (O) O1: Advocating policies from government and local authorities related to production, consumption and training program O2: Development of processing and exporting companies and business linkage model O3: New free trade agreements (CPTPP, EVFTA, UKVFTA, AEC, etc.) O4: Demand increase of mango products both domestic and international markets	Threats (T) T1: Increase of pets and disease in production T2: Increase of agri-input price, poor quality T3: Selling price dynamic T4: High transport cost T5: Weak logistic (storage, irradiation and vapor heat treatment factory) T6: Competition to countries, mango in ASEAN T7: Impact of extreme weather, climate change T8: Strict sanitary and phytosanitary requirements from importer
Strengths (S) S1: Soil, agro-climate, water source S2: Local labor for mango cultivation well S3: Several farming experience years S4: Many collectors and wholesalers in local S5: Near central markets of fruit and vegetables S6: Established cooperative, farmer group S7: Mango seasons around-year S8: The largest mango region in Vietnam S9: Agri-input-dealers network	S-O Strategies: (1) S_{1367}, O_{12}: Development of business linkage model Farmer-Cooperative-Company (2) S_{156}, O_{134}: Enhancing management capacity, marketing skill, and safety production organization of cooperative and farmer group (3) S_{458}, O_{1234}: Research and development in market and product quality	S-T Strategies: (6) S_{3679}, T_{128}: Boosting collaboration between cooperative, farmer group and quality input-dealers and company (7) S_{458}, T_{34578}: Investment policies attract big companies to build factories in large mango farming areas (8) S_{178}, T_{358}: Ensuring stable macroeconomic policies (output price policy, exchange rate policy, input cost policy)
Weaknesses (W) W1: Small-scale and fragmentation W2: Lack of contract farming in transaction W3: Main fresh mango consumption W4: Ignoring domestic market for processing product with 100 million people W5: Lack of market information share among actors W6: Lack of Vietnamese mango Trademark at international market W7: Poor rural transportation	W-O Strategies: (4) W_{1257}, O_{12}: Investment for rural infrastructure and transportation toward connection between production and consumption better (5) W_4, O_{24}: Delivery processing mango products via collaboration processor and modern retail system	W-T Strategies: (9) W_{125}, T_{678}: Training in production organization, market access, product competitiveness, quality management (10) W_{56}, T_{68}: Attending international fair, trade promotion for advertising Vietnamese mango trademark and exporting market expansion

Source Field Survey Data, 2019

4   Conclusion

Export channels 1, 2, and 3 had comparative and competitive advantages, and domestic channel 4 was competitive (import substitution).

Export channel 1 was the first priority from the government, including the output protection policy and added value increase policy from channel 4. Channel 1 adapted well to changes in macroeconomic policies, and it maintained economic efficiency and international competitiveness in all scenarios. However, the macroeconomic policies related to the FOB price and exchange rate had a strong impact on the SRP.

Channel 4 was the second priority from the government, comprising the subsidy policy of tradable output price and added value increase policy from channel 2, subsidy policy of tradable input and output price, and added value increase policy from channel 3.

There was no government support policy for Channel 3 to export to the Chinese market through border gates.

This study proposes 10 strategic solutions with 15 specific activities to enhance the sustainable development of the Chu-mango value chain.

In general, this study provides an integrated tool for quantitative and qualitative policy analysis comprising PAM and SWOT. This is as an evidence for the combination of quantitative and qualitative analysis is a dynamic tool in the policymaking process to ensure targets, constrictions, and consistent policies for agricultural fields.

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Market Analysis of Television Channels in Kazakhstan

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Abstract Television is an integral part of the modern cultural world. This paper studies the television market in Kazakhstan and presents the participants of the television services market. The organizational and legal forms of national TV channels and the types of basic television services are studied. The major indicators of economic activity of large TV channels of Kazakhstan is analyzed, such as JSC «Agency «Khabar»», JSC «Republican Television and Radio Corporation «Kazakhstan»», JSC «Commercial Television Channel», JSC «Television and Radio Company «Yuzhnaya Stolitsa»». The results showed that for Kazakhstan TV needs further transformation and expansion of paid Internet television, also collaboration of TV and social networks, such as YouTube, Facebook, Instagram, and TikTok. In addition, for large domestic TV channels with state participation, the state's share in the share capital should be reduced.

Keywords Television · Market · Channels

1 Introduction

Television now occupies a special place in the social and economic development of any state. Modern society is characterized by global cultural processes that are provided by new digital broadcasting technologies and disseminate not only information but also spiritual values [1]. Kazakhs are a television nation, half of them using television as the main source of news and information [2]. Through television,

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the State influences the formation of public awareness among citizens. Television, which has a great influence in shaping the opinion of both the individual and society, is the largest media institution contributing to the formation of a national identity [1].

The coronavirus pandemic affected the development of the market of television channels both in Kazakhstan and abroad. While some sectors of the economy lost revenue in 2020, television has increased its viewing of content by boosting remote viewers, and e-commerce is gradually becoming a separate media channel. The coronavirus pandemic has had an unexpected impact on the media market. The structure of media consumption has temporarily changed. During the months of isolation, television showed an unprecedented increase in the audience [3]. In this regard, the relevance of the research of the television market in the Republic of Kazakhstan has arisen.

The aim of the research is to develop recommendations on the basis of the market analysis of television channels in Kazakhstan and the main trends in its development.

2   Literature Review

The theoretical foundations of television as a type of media are presented in the dissertation of Doctor Kabiyeva [1] and in the reviews conducted by international organizations [2, 4]. The main statistical data on participants in the television market and the television services provided are available on the official websites of the central state bodies of the Republic of Kazakhstan [5, 6]. Important financial indicators are reflected in the annual audited financial statements of four major TV stations, such as the joint stock companies «Khabar», «KTK», «Kazakhstan», «TRK Almaty» [7–10]. Controversial materials are reflected on the official sites of electronic periodicals [11–13], as well as published scientific articles and conference proceedings [3]. However, it should be noted that there is no specific information on the analysis of the TV channel market and the services provided in this area.

3   Methodology

Television is by far the most popular platform for media consumption. An increasing number of people receive their television through a cable or satellite subscription. Over the past several years, satellite and cable reception have made inroads into the previously dominant position of terrestrial broadcast as the favored mode of television reception [4].

The research focuses on the television market, its participants, the volume of television services by type, and the main economic indicators of the major participants. Quantitative statistical methods were applied in the course of the research: absolute, relative, and average; grouping and chain substitution based on official statistics using

Excel 2016. In addition, methods of scientific knowledge, comparative analysis, and interpretation of data on the analysis of the television market in Kazakhstan were used.

4 Analysis and Results

At the beginning of the analytical part of the report, we shall consider participants of the TV market in Kazakhstan. According to official figures on October 19, 2020, 4597 mass media were registered in Kazakhstan. Of these, 3432 were periodicals, 175 television channels, 74 radio stations, 395 news agencies, and 265 online publications. Foreign channels—256.
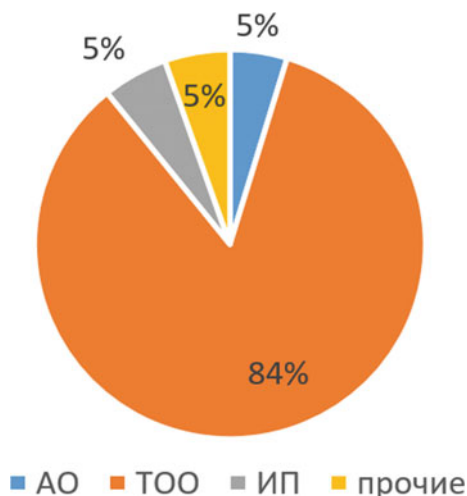
On July 1, 2021, 184 domestic and 267 foreign television channels were registered in Kazakhstan.

We will analyze the Kazakh television channels registered on July 1, 2021. The total number of television channels was 184, of which 16 were inactive and 168 were active, as given in Table 1.

Table 1 Analysis of domestic TV channels in Kazakhstan on July 1, 2021

Legal forms of operating TV channels						
Regions	Number	JSC	LLP	Sole proprietorship	Others	Inactive	Total
KZ	24	3	12		3		24
Nur-Sultan	24	1	10			5	29
Almaty	31	1	27	3		1	32
Akmola region	2		1		1		2
Alma-Ata's region	4		3		1		4
Aktobe region	5		5				5
East-Kazakhstan region	6		4	2			6
Jambyl region	2		2				2
West-Kazakhstan region	2		2				2
Karaganda region	14		11	1	2	4	18
Kostanay region	9	1	8				9
Kyzylorda region	1		1			2	3
Mangystau region	1		1				1
Pavlodar region	6		5		1		6
North-Kazakhstan region	2		2				2
Turkestan region	35	1	31	2		4	39
Total	168	7	125	8	8	16	184

According to Table 1, it can be seen that the dominant form of TV companies is 125 limited liability partnerships and seven joint-stock companies. Most of the television channels are located in major metropolitan areas, such as Almaty, Turkestan, and Nur-Sultan. If you look at the types of business, 50% of joint-stock companies in the sphere of television work in the capital of Kazakhstan—Nur-Sultan. There are 24 national television channels. The remaining 144 television channels provide television services to all regions of Kazakhstan.

The main organizational and legal forms of operating television companies are joint-stock companies and limited liability partnerships (see Fig. 1).

Figure 1 shows the organizational and legal forms of the 168 existing TV channels, which include 7 joint-stock companies or 5%, 125 limited liability partnerships or 84%, 8 individual business TV companies (5%) and 8 other TV channels (5% are branches, state institutions, production cooperatives).

On July 10, 2021, in addition to national television channels, 267 foreign television companies are operating in Kazakhstan. Table 2 shows the number of foreign television channels operating in Kazakhstan.

On the basis of Table 2, it should be noted that Russia, the UK, and the USA are the top three countries among foreign television channels. The highest share of participation in the Kazakh television market is held by 69% of TV channels of the Russian Federation. They include such TV channels as «MUZ TV», «Russia-24», «Dom Kino», «Time: Far and Near», «Music of the first», «First channel. Worldwide network», «REN-TV INTERNATIONAL», etc. In second place—7.9% of owners of foreign TV channels are UK TV companies: «BBC World News», «National Geographic HD», «Fox Life» etc. Finally, the TV channels of the United States of America have 6.4% of the total volume of foreign TV channels: «Nickelodeon», «MTV Club», «MTV Hits», «VH 1 European», «MTV80s» and others. For the most part, all foreign TV channels have a clearly defined format of thematic direction:

Table 2 Share of foreign TV channels in Kazakhstan

Countries	Number	Share, %
Russia	184	69
USA	17	6.4
Great Britain	21	7.9
France	14	5.2
Turkey	6	2.2
Luxembourg	7	2.6
Estonia	16	6.0
Cyprus	1	0.4
Spain	1	0.4
Total	267	100

news, scientific cognitive, for children, educational, informational-entertainment, music, etc. The share of other foreign TV channels does not exceed 6%.

Below is the volume of services rendered by enterprises and individual entrepreneurs in the sphere of television of Kazakhstan for 2016–2019 (see Fig. 2).

Figure 2 shows the volume of services provided for the production of films, videos, television programs, phonograms and music recordings, and for programming and broadcasting. Both services tend to increase. Thus, in 2017, there was a sharp increase of 58% in the production of films, videos, television programs, phonograms, and music recordings, and a gradual increase in subsequent years, 7% on average. In 2019, there was a significant increase of 28% in programming and broadcasting services.

Fig. 2 Dynamics of the volume of services rendered by enterprises and individual entrepreneurs in the field of television in Kazakhstan

Table 3 Structure of television services provided, %

Services	2016	2017	2018	2019
Production services for films, videos, television programs, phonograms, and music recordings	36	45	44	40
Program development and broadcasting services	64	55	56	60
Total	100	100	100	100

Table 3 shows the structure of the television services provided.

Television programming and broadcasting services predominate in the total number of television services provided, accounting for over 55%. It should be noted that the proportion of services provided annually for the production of films, videos, television programs, phonograms, and music recordings has declined since 2017.

If the statistics on services in Kazakhstan are further explored, we may note that in the total volume of services for the production of films, videos and television programs, phonograms, and music recordings are the highest in the three sub-services and in the total programming and broadcasting services—the four sub-services are given in Table 4.

As stated above, out of seven joint-stock companies in the field of television services, four joint-stock companies are major television corporations. Among them are JSC «Agency «Khabar»», JSC «Republican Television and Radio Corporation «Kazakhstan»», JSC «Commercial Television Channel», JSC «Television and Radio Company «Yuzhnaya Stolitsa»».

Let us analyze the main economic indicators of the activities of the TV stations, such as the revenues from services rendered and the net profit for 2016–2019 based on the annual financial reports [7–10].

Figure 3 shows the evolution of the revenue large TV corporations.

On the basis of the data presented in Fig. 3, it can be said that the JSC «Republican TV and Radio Corporation «Kazakhstan»» is the leader in terms of revenue, since

Table 4 Detailed list of television services in Kazakhstan

Title	Total services in the general structure	The most essential services with the maximum volume
1. Services for the production of films, videos and television programs, phonograms, and music recordings	21	1. Television production services 2. Film production services 3. Film screening services
2. Programming and broadcasting services	12	1. Original television broadcasts 2. Online television production and broadcasting services, excluding subscription 3. Television production and broadcasting services other than subscriptions 4. Time for TV commercials
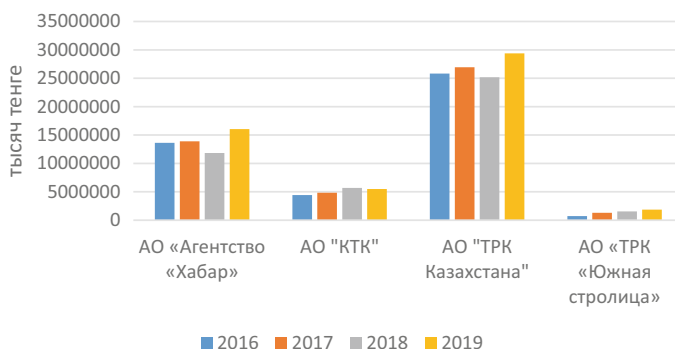
Fig. 3 Revenue of large TV corporations in Kazakhstan

this TV company has an extensive network of branches in all regions of Kazakhstan. For 4 years, the rate of revenue has constantly fluctuated. However, in 2019, the amount of revenue increased by 17% and reached over 29 billion tenge. The second TV company in terms of sales is JSC «Agency «Khabar»», which in the results of 2019 had an income from television services in the amount exceeding 15.0 billion tenge, and compared to 2018, an increase of 51% should be noted. The other two TV corporations had lower revenue from services, but it is worth noting the annual growth trend. But in 2019, JSC «KTK» revenue decreased by 20% compared to 2018.

The next economic indicator is the net profit of the broadcasters for the period under review. Let us carry out a quantitative analysis of the net profit for 2016–2019 (Table 5).

Table 5 Analysis of net profits of TV companies in Kazakhstan

TV company	Net profit, thousand tenge				Growth rate, %			
	2016	2017	2018	2019	2016	2017	2018	2019
JSC «Agency «Khabar»»	67,865	115,089	166,543	401,861	100	1.7 times	145	2.5 times
JSC «KTK»	338,778	67,807	302,516	33,890	100	20	4 times	11
JSC «Republican TV and Radio Corporation «Kazakhstan»»	477,957	154,097	−239,231	330,685	100	32	−155	3 times
JSC «Television and Radio Company «Yuzhnaya Stolitsa»»	8533	103,541	143,800	12,099	100	12 times	139	8

The biggest increase of net income is the telecorporation «Agency «Khabar»», so according to the results of 2019 net profit amounted to 401,861.0 thousand tenge with annual twofold increase. The movement of net profits has a tendency to fluctuate in the study period: a sharp decline in 2017 by 68% and a negative result in 2018. In 2019 alone, net income increased almost threefold. The JSC «KTK» showed a significant decrease in net profit by 11 times from 302,516 thousand tenge in 2018 to 33,890 thousand tenge in 2019. Similar situation had JSC «Television and Radio Company Yuzhnaya Stolitsa» which has decreased in net profit by 8 times in 2019.

5   Discussion

Nowadays, the TV market in Kazakhstan are undergoing a dramatic transformation. About 58% of the respondents, according to TNS Central Asia, turn on TV at least once a day. On average, every inhabitant of Kazakhstan spends about 3 h and 26 min every day in front of the TV. The trend in the coverage of television broadcasting (recall, in 2017–2018—58%) is decreasing. In 2013–2014, it is 71%, in 2014–2015—66%, in 2015–2016—64%. It also has a tendency to reduce the time spent watching live TV, though less significantly, from 3 h 38 min in 2013–2014 to the above mentioned 3 h and 26 min in 2017–2018 [11].

At the present stage, there is a mixed model of financing of television: state budget—advertising—sponsorship. This is a consequence of the limited resources allocated to State funding of television [1].

The Kazakh television market consists mainly of major State-owned TV companies. The main source of these broadcasters is State funding and State procurement.

However, nowadays there is a common problem with all state television—the lack of a clear and articulated brand with clear goals and objectives for the audience. Therefore, it's very difficult to talk about content matching. The public TV channel should clearly define its format, according to which program and production policies are drawn up [1].

Most of Kazakhstan's media content companies are forced to adapt to world trends and changing demand from customers. Some of the players started going into social media and entertainment. In general, the domestic content market is becoming increasingly uncompetitive and dependent on public funding [12].

According to J'son and Partners Consulting, at the end of 2016, the penetration of pay-per-view television in the republic was 31% of households. The bulk of subscribers to pay-per-view television are concentrated in cities, with IPTV operators and cable operators working with different signal delivery technologies having the largest share. At the end of 2016, according to J'son and Partners, the cable companies served 60.8% of the subscriber base of pay-per-view television, and IPTV operators—29.5%. At the same time subscribers are gradually switching to digital technologies—according to 2017, the share of digital television was 47%. Switching to digits is being actively promoted by the operators themselves, as it addresses the long-standing problem of managing subscriber bases and illegal connections [13].

The domestic pay-per-view television market is not sufficiently developed and requires further promotion. However, the market has enormous potential in the COVID-19 pandemic. In 2021, the market is facing even greater shocks. There is information that the Ministry of Information and Public Development is preparing a reform of the State information order [12].

An increase of Internet penetration is certain; similarly the number of new media projects will be growing, but with the political environment as it is, few of them will provide substantial news value. Still, the Internet will remain the freest space for public debate and is likely to grow in prominence as a news source [4].

As the coronavirus pandemic gains even more momentum, many experts believe that television will be relevant in the coming years, and in the future there should be a collaboration of digital TV and online social networks. Thus, according to Eduard Hovhannisyan, Deputy General Director of Krutoy Media for Commercial Activities: "However, in addition to the market shrinkage, quarantine caused other changes—a digital transformation of media channels took place. This happened even with those channels that until recently remained traditional …".Television has learned to create content in a new way, which has increased its speed and allowed it to compete with digital channels [3].

6   Conclusion

In conclusion, in order to further develop the television market in Kazakhstan, we would like to draw the following conclusions and recommendations:

1. On the basis of an analysis of the television market in Kazakhstan, it should be noted that further transformation and expansion of private and online pay-per-view TV is needed.
2. Existing domestic broadcasters should consider further policies to expand the audience through collaboration of TV and social networks such as YouTube, Facebook, Instagram, TikTok, and others.
3. In general, the main economic indicators of the activity of large media companies have a positive trend of growth, but thus, these major players of the domestic TV market are «monopolists» and give rise to imperfect competition. In this connection, the denationalization of major television stations should be carried out by reducing the State's share in equity.

Thus, the national television market has great potential for future and effective development.

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Tourism and Hospitality Management

Segmenting Generation Z Based on Their Intention to Comply with Non-mandatory Governmental Protection Measures During the Tourism Period

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Abstract Tourism is considered one of the most important economic sectors, and for countries like Greece which were hit harshly by the financial crisis, tourism is even more crucial. The Coronavirus disease 2019 (COVID-19) generated a drawback on tourism revenues worldwide due to the measures undertaken to minimize the transmission of the virus. Greece, which was under lockdown and curfew in 2020, reopened its borders (May 14, 2021) to enjoy revenues from inbound tourism to ease the country's economic condition. In this tourism mode, the government had already distributed vaccines and had withdrawn many of the initial measures, while some basic ones such as wearing a mask or keeping a distance of two meters in public places kept on existing. Therefore, it is up to the citizens' free will to keep complying (or not) with the non-mandatory-protective or withdrawn measures from the government. With these in mind, this paper presents research that segments the Generation Z (Gen Z) cohort, based on its intention to comply with the non-mandatory protective measures during the summer tourism period. Adopting an online questionnaire from May to July, a total of 1086 Gen Zers participated. Four segments arose, the "Partial intention to comply segment", the "Personal hygiene segment", the "High awareness and precautious segment", and the "No intention to comply segment". Based on the

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results, implications for effectively approaching this segment to take self-protective measures from SARS-CoV-2 and its variants are discussed.

Keywords Generation Z · Intention to comply · Non-mandatory measures · COVID-19 · SARS-CoV-2 variants · Tourism period

1 Introduction

Many countries rely heavily on tourism and recreation, especially in times of economic crisis, tourism is one of the vital economic sectors to generate revenues. For countries like Greece, which struggled to get out of the financial crisis for more than ten years, tourism is even more vital and is considered the "heavy artillery" of the economy [1, 2]. Though, the Coronavirus disease 2019 (COVID-19) generated a drawback on tourism revenues, for Greece and worldwide.

The World Health Organization [3] March 11, 2020, labeled COVID-19 as a pandemic. Concerning Greece, after two consecutive lockdowns in 2020, from the 5th of April 2021 the government started lifting the restriction measures and gradually de-escalated them in order to reopen tourism on the 14th of May 2021. Conditions for entry into the country to limit the spread of COVID-19 were specified by the Government Gazette [4]. According to the data provided by the National Public Health Organization [5], on May 14, 2021, the day of reopening tourism the COVID-19 cases were 373,881 with 11,322 deaths, while on the 1st of September 2021 (starting point of declining tourism period), this number had escalated to 590,832 and 13,743 cases and deaths, respectively. These numbers reveal a 58.03% increase in cases and a 21.38% increase in COVID-19 deaths in about 3½ months.

Even more, from the first cases of COVID-19 with the "severe acute respiratory syndrome coronavirus 2" (SARS-CoV-2), a considerate number of variants appeared [6], while vaccinated citizens could also be infected [7, 8]. Therefore, precautionary measures are still the best strategy for people to be protected.

Age is a significant factor in the SARS-CoV-2 and its variants' transmission, morbidity, and mortality. Previous studies demonstrate that infected people with no symptoms are contagious, and this group of people is usually young ones [9, 10].

Taking all the above into consideration, this study has as its aims to segment the younger adult cohort, i.e., the generation Z cohort (Gen Zers) based on its intention to comply with proactive preventive behavior after the government withdrew the main restrictions (lockdown, curfew, and closure of entertainment activities) during the tourism season.

2   Literature Review

There are a plethora of studies referring to COVID-19 which focus on six main axes: virus pathophysiology [11]; symptoms and transmission [12]; vaccines [13]; variants [14]; government measures and citizens' behavior [15], and the impact of COVID-19 on various facets of life such as the economy, mental issues, education, etc. [16, 17].

Though, one understudied subject is the segmentation of generational cohorts' behavior as regards issues of COVID-19 ($N = 347$ studies on June 14, 2022; https://scholar.google.com). The majority of studies that fell into this category were exploring shopping behavior and work-related or education-related issues. As to the cohort that is of interest, i.e., the Gen Z cohort, this number is sufficiently smaller ($N = 147$) and they, in the majority also studied the above subjects, while there was also a handful that dealt with tourism (e.g., as an experience). As regards attitudes, behavior, or compliance with protective measures, multiple articles have been found that concern Gen Z behavior toward COVID-19. Fewer though, have focused on their prevention measures or coping with the pandemic, especially after the first wave.

Since we did not find research directly associated with our aim and objective, published work that was closely related is presented. Table 1 presents the studies that refer to the Gen Z cohort in the context of COVID-19 measures and preventive behavior or tourist-related behavior during the COVID-19 pandemic.

From Table 1, it is obvious the lack of studies that refer to segmenting the Gen Z cohort based on protective behavior during the early post-pandemic tourism period, and therefore research is needed.

Specifically, only two studies carried out segmentation analysis. Kamenidou et al. [18] measured if Greek citizens complied with the preventive measures announced by the government during the first wave of the pandemic. They also proceeded to segmentation; though they did not use generational cohorts and the study was during the lockdown. They found five segments, the "Meticulous Proactive Citizens", the "Self–isolated Citizens", the "Cautious Citizens", the "Occasionally Cautious Citizens", and the "Unconcerned Citizens". They also found that the "unconcerned citizens" (4.6% of the sample) did not comply with any of the measures implemented by the government or self-protective measures and were mainly young citizens (<25 years old), single, dependent on others (including university students), and with the highest (compared to other segments) citizens residing in rural areas.

Sánchez-Pérez et al. [19] segmented Spanish consumers' propensity to change their tourist behavior patterns due to COVID-19 and found three segments: "The true believers", the "Cautious travelers", and "The prophets of doom".

3   Methodology

Data is drawn from Greece with the targeted sample unit the Greek adult generation Z (Gen Z) cohort, born between 1994 and 2003 in 2021 when the research was

Table 1 Studies referring to the Gen Z cohort and health-related issues of COVID-19

Authors	Generational cohort	Issue studied	Country/Data	Segmentation
Jose [20]	Z	Factors that influence the adoption of the COVID-19 Vaccine	Abu Dhabi $N = 30$ Qualitative	⊠
Kamenidou et al. [21]	Z	Information sources (providers and channels) trusted for COVID-19-related information	Greece $N = 1411$	⊠
Karabay et al. [22]	Z	Psychological consequences of COVID-19 on attitudes, behaviors, and future expectations of Gen Z	Turkey $N = 299$	⊠
Simic and Pap [23]	Z	Behavioral intentions toward the prescribed measures of COVID-19	Croatia $N = 442$	⊠
Truong et al. [24]	BB, X, Y, Z	How the media influenced preventive behaviors against COVID-19	Vietnam $N = 609$	⊠
Kamenidou et al. [25]	SG, BB, X, Y, Z	Attitude toward the government and the way it handled the COVID-19 crisis	Greece $N = 3359$	⊠
Liu et al. [26]	Z	Dark side of social media use during COVID-19 lockdown	UK $N = 322$	⊠
Min et al. [27]	X, Y, Z	Effects of threat and coping appraisals on consumers' Co-creation behaviors during COVID-19	$N = 310$	⊠

(continued)

Table 1 (continued)

Authors	Generational cohort	Issue studied	Country/Data	Segmentation
Ramayanti et al. [28]	Z	"Knowledge and attitudes toward the use of masks, keeping distance, and washing hands as a means of preventing COVID-19"	Indonesia $N = 147$	☒
Rončák et al. [29]	Z	Effect of safety concerns on changes in travel behavior during COVID-19	Czech Republic $N = 150$ and $N = 126$	☒
Sánchez-Pérez et al. [19]	☒	Consumer's propensity to change their tourist behavior patterns due to COVID-19	Spain $N = 1000$	☑
Seabra et al. [30]	Y and Z	Impact of the acceptance of COVID-19 national governments' restrictions imposed on citizens' safety perceptions of daily life and plans	Egypt, Portugal, Turkey $N = 348$	☒
Zheng et al. [31]	BB, X, Y, Z	How people impose trust, fear, and perceived threat in post-pandemic travel decisions	China $N = 1208$	☒
Abraham et al. [32]	BB, X, Y, Z	COVID-19 pandemic impact on travel attitudes and behavioral intentions	International travelers $N = 216$	☒
Deckman et al. [33]	Z	Attitudes about the impact of the SARS-CoV-2 on personal health, financial and job concerns, views on shelter-in-place laws, and 2020 voting intentions	USA $N = 1008$	☒

Table 1 (continued)

Authors	Generational cohort	Issue studied	Country/Data	Segmentation
Kamenidou et al. [18]	☒	If people take the necessary COVID-19 precautions and segmentation	Greece N = 3359	☑
Kamenidou et al. [34]	Z	Knowledge of COVID-19 and interest in obtaining information regarding the virus disease	Greece N = 762	☒
Masters et al. [35]	BB + SG, X, Millennials (Y), Z	Risk perceptions and social distancing practices	USA N = 1068	☒
Lebrun et al. [36]	X, Y, Z	Influence of the COVID-19 on intention to travel	France N = 655	☒

undertaken [37]. The 24-item question on which segmentation was based was stated: "Outbreaks of the virus mutations have already been reported, and the government has not taken strict action such as a lockdown or movement restrictions, while we are in the tourism season mode. Please state whether this summer you are willing to comply with the following non-mandatory government practices as a means to protect yourself from getting infected or spreading the SARS-CoV-2 variants and COVID-19". These non-mandatory preventive measures (not the scale) were adopted from the study of Kamenidou et al. [18]. Answers were presented on a seven-point Likert-type scale ("1 = very low intention to comply, 2 = low intention to comply, 3 = somewhat low intention to comply, 4 = neither high nor low intention (neutral) to comply, 5 = somewhat high intension to comply, 6 = high intension to comply, 7 = very high intention to comply"). These 24 protective measures do not include wearing a mask and isolation when coming from abroad (non-European countries), since these measures were considered mandatory at the time of the research.

The questionnaire was distributed online employing a non-probability sampling method from May to the end of July 2021 and collecting 1086 valid questionnaires, which was adequate for the analysis performed [38]. Data analysis included descriptive statistics, factor analysis, K-means cluster analysis, and chi-square tests for segment profiling based on gender, place of residence, and profession ($a = 0.05$; $p < 0.05$).

The content validity of the 24 non-mandatory measures was based upon the content validity of the previous studies that used these items and the initial organizations that recommended them (although, the majority of them were removed over time). Face validity was confirmed by the pilot test which examined its readability and

understanding [39]. Cronbach alpha assessing the scale's reliability ($a = 0.960$) was adequate [40].

4   Results

4.1   Sample Profile

Females consisted 49.2% of the sample and males 50.8%. Regarding age, 57.3% were Gen Zers up to 21 years old, and the older Gen Zers (age 22–26) consisted of 42.7%. Also, they were in their majority single (95.8%), university students (56.7%), and resided in a city (64.6%).

4.2   Factor Analysis

Factor analysis was implemented to decrease items into fewer variables to proceed to segmentation analysis. Factor analysis was performed with Principal Component Analysis with varimax rotation which offered three factors/dimensions (KMO = 0.961; BTS = 23,872,487; df = 276; $p = 0.000$). All three factors interpret 71.4% of the total variance (52.6%; 14.2%; 4.6% for the first, second, and third dimensions correspondingly). The first dimension is called "Personal hygiene and self-isolation" because it integrates items that have to do with both issues. As regards self-isolation, this has to do with isolation from vulnerable groups or isolation if they or the people that they were in contact with, tested positive. This dimension incorporates 12 non-mandatory protective measures and has a mean score of the factor (MSF) MSF = 5.23 (Std = 1.47) and Cronbach $a = 0.951$. The second dimension is called "Social interaction" because it incorporates items that deal with minimizing social activity and social distancing. This dimension incorporates 10 non-mandatory measures, has MSF = 3.87 (Std = 1.74), and also Cronbach $a = 0.951$. The third dimension is called "COVID-19 related information" because it includes items that have to do with obtaining information related to the COVID-19 disease and virus variants. This dimension incorporates two (2) non-mandatory measures, has MSF = 4.63 (Std = 1.69) and Cronbach $a = 0.901$.

Also, from the 24 protective measures examined, the three most intended to comply with by Gen Zers based on their mean value (MV) are "Strict compliance with hygiene standards regarding shared toilets (evidence of the fecal–oral transmission)" (MV = 5.51); "Avoid contact with individuals who have an acute respiratory illness" (MV = 5.44); "Respiratory hygiene (covering the cough or sneeze drops by wearing a face mask and washing the hands often)" (MV = 5.35). On the other hand, the non-mandatory measures that they have the least intention to comply with are "Using single-use hand gloves in public settings" (MV = 3.29); "Movement to

public services, organizations, and areas wearing hand gloves" (MV = 3.34); and "Checking body temperature, monitoring for fever, cough, or dyspnea daily" (MV = 3.55).

4.3 Segmentation Analysis

The three dimensions extracted from factor analysis were continuously treated as new variables and used in segmentation analysis. Segmentation of the Gen Z cohort sample was accomplished through K-means cluster analysis, offering four (4) meaningful segments, while ANOVA tests configured that each cluster was statistically different from the others. In Table 2, the four clusters are reported, the number of members included (N), the results of the ANOVA test (F, p), as well as the final cluster centers (FCC; under the columns with the numbers 1–4).

Chi-square tests between the clusters and Gen Zers' gender, age, profession, and area of residence were also realized to explore the profile of the segments and to reveal any statistically significant differences. Results revealed that profession and area of residence showed statistically significant differences ($\chi^2 = 39.933$; df = 21; $p < 0.001$; and $\chi^2 = 33.996$; df = 6; $p < 0.001$, respectively).

Segment No. 1: "Partial intention to comply segment". This segment is aware of the dangers that COVID-19 incorporates, if infected, but intend to comply with two out of the three non-mandatory government protective measures. This segment has the intention to comply with the measures that refer to "Personal hygiene and self-isolation" measures as well as seeking "COVID-19-related information". They do not have the intention to comply with measures that deal with social interaction. This segment comprises 17.5% of the total sample, and its profile is young Gen Zers (born after 1999; 75.3%), females overrepresenting males (53.2%), university students (64.2%), residing in the city (63.2%). This segment compared to others has the highest percentage of Gen Zers that: are younger; residing in semirural areas (towns; 24.7%), and university students. It also has compared to the other segments,

Table 2 Gen Z segments based on their intention to comply with non-mandatory COVID-19 protective measures

Dimensions	1 $N = 190$	2 $N = 348$	3 $N = 331$	4 $N = 217$	F	p
Personal hygiene and self-isolation	5.95	4.98	6.45	3.14	733.031	0.000
Social interaction	2.48	3.85	5.95	1.94	1363.003	0.000
COVID-19 related information	5.59	3.92	6.30	2.39	1146.512	0.000

Sample: $N = 1086$

the smallest percentage of older Gen Zers (24.7%), federal employees (2.1%), and the people living in villages (12.1%).

Segment No. 2: "The personal hygiene segment". This segment intends to comply with the non-mandatory government measures that refer to personal hygiene, while it tends to be indifferent toward the other two non-mandatory measures. This segment comprises 32.0% of the total sample. The profile of this segment has as follows: young Gen Zers (born after 1999; 65.5%), males slightly overrepresenting females (51.4%), university students (53.2%), who reside in the city (62.6%). This segment, compared to others, has the smallest percentage of Gen Zers that are businesspeople (3.7%). It has compared to the other three segments, the highest percentage of private employees (23.3%), skilled/unskilled workers (37.8%), and Gen Zers that live in villages (25.3%, the same percentage as segment No. 4).

Segment No. 3: "High awareness and precautious segment". This segment is highly aware of the dangers that COVID-19 features if infected, so they intend to comply with all the non-mandatory government measures to protect themselves and others. This segment comprises 30.5% of the total sample, and its profile is young Gen Zers (born after 1999; 69.2%), males and females at the same percentage (50.2% and 49.8% respectively), university students (60.1%), residing in the city (69.8%). This segment compared to others has the smallest percentage of Gen Zers that are private employees (14.8%), skilled/unskilled workers (10.8%), and people living in semirural areas (towns: 10.3%). They also have the highest percentage of people residing in the city (69.8%).

Segment No. 4: "No intention to comply segment". This segment is the segment that is probably not aware of the dangers that COVID-19 integrates if they are infected or believes that because they are young, they will not "pass it heavily" so they do not intend to comply with any of the non-mandatory by the government measures to protect themselves and others. This segment comprises 20.0% of the total sample, and its profile is young Gen Zers (born after 1999; 71.0%), males overrepresenting females (54.4%), university students (50.7%), who are living in the city (61.3%). This segment compared to others, has the smallest percentage of Gen Zers residing in the city and the smallest percentage of university students. It also has the highest percentage of Gen Zers (along with segment No. 2) that live in villages (25.3% for both segments).

5 Discussion

As uncovered by the literature review, there is no similar research to compare the results from this one directly. Therefore, any comparison in this discussion is done indirectly and with caution.

Bulotaitė et al. [41] examined citizens' intention to obey COVID-19 preventive measures (post-pandemic period) and discovered that 10% of the sample reported that they do not adhere to the proactive measures (wearing a mask and distance in communicating). Though, the specific study did not refer to Gen Zers neither did it

carry out segmentation analysis. The issue of mask-wearing is mandatory outside the home settings (also everyone complied), therefore, not measured in our study. Regarding the two-meter distance, although it is obligatory in shops, it was tested in our study because, as it was often observed, even though citizens consider it important did not often apply it in practice.

Taking into account the MV of the two-meters-distance item, it reveals that Gen Zers are indifferent (MV = 4.29; neither do nor do not intend to comply). Typically, proactive methods that have to do with restrictive social interaction do not seem to be managed optimally by Gen Zers. On the other hand, measures that deal with hygiene are scored higher and Gen Zers somewhat intend to follow these preventive measures, excluding wearing masks.

Segmentation revealed that in three out of four segments, i.e., for the 69.5% of the sample (N = 755), minimizing social interaction (among this the two-meter distance) is not something that the Gen Zers intend to comply with. It also revealed that two of the four segments intend to comply with the "Personal hygiene and self-isolation" dimension, while one segment *tends* to comply with it. Lastly, two of the four segments intend to seek information about the virus and disease.

This is partially in line with the study of Kamenidou et al. [18] where the segment "Unconcerned Citizens" is similar in behavior to the "No intention to comply segment" of this study. The group "Unconcerned Citizens" did not comply with any of the measures implemented by the government and were mainly young citizens (<25 years old), single, dependent on others (including university students), and with the highest (compared to other segments) percentage residing in rural areas. Though again this comparison is made with caution since this study compared with the study of Kamenidou et al. [18] examines cohorts (not simply age), behavior after restrictions removals, and time-set during a tourism period—one year after the first lockdown. The same comparisons with cautious can be made for the "Meticulous Proactive" and "Cautious Citizens" segments compared to the "High awareness and precautious segment" of this study, which consisted of people that complied with every measure tested here.

Lastly, the groups "Occasionally Cautious" and "Self-isolated Citizens" of the study by Kamenidou et al. [18] seem to be similar to the "Personal hygiene segment" and the "Partial intention to comply segment", in the sense that they have similar behavior. Though, these comparisons are made with caution as pointed out earlier.

6 Conclusion, Limitations, and Directions for Future Research

This analysis offered an insight into the Greek Gen Z cohort regarding segmentation based on self-reported intention to comply with non-mandatory self-protective measures of COVID-19, SARS-CoV-2, and its variants when restrictions were removed during the tourism period. Considering the derived segments, government

officials may create social marketing campaigns to raise awareness and behavioral change to minimize COVID-19 cases. As Gen Zers are raised in a high-tech environment, message dissemination cannot be made through the traditional information paths, such as mass media [42]. Therefore, digital communication is considered a substantial means of communicating with this cohort. Munsch [43, pp. 19–20] in his study found that "…exposure to digital marketing communication and advertising using popular music has the potential to capture Millennial and Generation Z attention", and "Generation Z attention to digital marketing communication and advertising is more likely if an admired and respected person conveys the message", therefore message dissemination using Gen Zers' opinion leaders would be beneficial.

Limitations of this research refer to the sampling method (non-probability), the sampling unit (adult Gen Zers), the sampling frame (not used), and the area where the study was realized (one country: Greece). These limitations could be food for future research. Though, despite them, its contribution to prior academic studies is major, since it offers information on a generational cohort that has been understudied regarding COVID-19 as regards self-taken proactive post-COVID measures.

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Information Technologies and Cultural Tourism—The Case of the Virtual Museums

Vitor Santos

Abstract The introduction of strategies that include information technology in the development of public cultural policies may potentiate the cultural democratization processes and boost tourism. The use and impact of information technology while facilitating cultural production and as an enabler instrument broadening of cultural public is a key piece in the way of the amplification of cultural tourism. In this article, it is argued that the introduction of strategies that include information technologies in the development of public cultural policies enhances the cultural tourism. Specifically, this article seeks to demonstrate the use and impact of information technologies while promoting cultural production and as a facilitator process of increasing cultural audiences, as well as being a key player in the way of cultural democratization and contribute to a more sustainable tourism.

Keywords Culture · Tourism · Democracy · Technology

1 Introduction

Culture should be a vehicle and an end of developmental processes of society, as it promotes the quality of life and well-being of its citizens, maintains the collective memory, and embodies the creative expression of the actors and social groups [1]. It is therefore important to promote global and local policies that, firstly, encourage creativity and cultural production and, secondly, enable the extension of audiences facilitating the access to cultural resources and boosting the tourism.

The World Tourism Organization (UNWTO) defines Cultural tourism as a type of tourism activity in which the visitor's essential motivation is to learn, discover, experience and consume the tangible and intangible cultural attractions/products in a tourism destination [2].

Maria de Lourdes Santos defends the development of a Sociology of Culture which aims to identify a number of issues concerning the characterization of culture,

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its transformations and the place it occupies in contemporary societies, in order to avoid a vision of culture as an isolated reality only within the reach of the elites [3]. In pursuing this goal, she argues that the main focus of approach of cultural policies should be the qualification of the offer, the promotion of artistic creation, the funding and regulation of the market and widening the participation in cultural life. Augusto Santos Silva maintains that speaking of public cultural policies means speaking of conditions of freedom and citizenship in democratic societies [4]. José Madureira Pinto also points out that government intervention and regulation are irreplaceable and must provide mechanisms for "vigilance", based on institutional and organizational formulas to value the autonomy of the creators and, at the same time, able to counteract any tendencies towards centralization and self-consecration that are likely to inhibit an effective participation in cultural processes of democratization [5].

According to these authors, it is for the Governments to accomplish the mission of fostering the democratization of culture, by promoting better access to cultural resources, respecting the plurality of cultures and fulfilling its role of active guardian of participatory democracy.

However, although we can witness, from the end of the Second World War, a cultural democratization movement, the form and the importance that has been given by the various governments to political and cultural investments is quite diverse. As Augusto Santos Silva points out, there appears to be an ideological confrontation between the "traditionalist right wing" and "modern left wing" that determines the formation and implementation of cultural policies [6].

In terms of the development of global policies, as it has often happened throughout history, what may appear to be unanimous, it is not. For example, the United Nations (UN) did not include any purpose/objective directly related to the development and democratization of culture when the "The objectives of the Millennium" were established [7] and, today, it still does not include any explicit objective for culture in the set of 17 objectives of sustainable development of mankind for the next 30 years, "The Road to Dignity by 2030" [8].

But the prospect of the European Union is different as it recognizes the need to induce in its member states an increased emphasis on public policies for culture, considering a better progressive integration of Europe. Programmes such as "Creative Europe" are an excellent example of this vision [9].

In this article, it is argued that the introduction of strategies that include information technologies in the development of public cultural policies enhances the cultural democratization processes and boosts tourism. Specifically, this article seeks to demonstrate the use and impact of information technologies while promoting cultural production and as a facilitator process of increasing cultural audiences, as well as being a key player in the way of cultural democratization and contribute to a more sustainable tourism.

2　Technology at the Service of Cultural Production

From the beginning, technology is established as a determining factor and responsible for the creative production and the way we look at art and culture. As Helena Barbas states, the model of the artist-engineer embodied by Leonardo da Vinci has never been confined to Renaissance. Artists have always used their skills as engineers taking advantage of the various developments of contemporary Sciences, in order to implement the latest scientific findings in their artistic production [10].

In the curriculum of Art history, both the content and the methodology reflect the innovations in technology. For instance, the invention of oil paint led to the change of fresco painting to oil painting and the production of paint tubes has accounted for innovating impressionist techniques which allowed artists to venture out of the studio and paint outdoors [11].

As it happens in nature, where according to evolutionary theories, living beings adapt themselves throughout centuries in order to survive, so happens with the phenomenon of artistic creation in which the incorporation of technology is part of this "evolutionary" process. Morriss Kay claims that creating visual art is one of the defining characteristics of the human species, but the paucity of archaeological evidence means that we have limited information about the origin and evolution of this aspect of human culture [12].

Information technologies can be defined as the use of computers to create, process, store, retrieve and exchange all kinds of electronic data and information [13]. For Barbas [10], computers, software and the internet are just an extra tool that artists can use in their practices in a new age of interdisciplinary approaches. But what Barbas calls "just an extra tool" is actually something transcendent because in this new world, Web 2.0, anyone can easily produce and consume content without specific training. As this is, in itself, an unusual fact in the history of modern times, it shall be accompanied by another component: the coexistence of the roles of producer and consumer. For the first time in human history, each of us can simultaneously be producer and consumer of the same resource: the Knowledge. We should therefore be concerned about how connective technology has already changed the way we learn, ever since the Internet and its informational and relational smartphone applications through became virtually ubiquitous [14]. This characteristic induces the constant discussion of the contents, allowing, on one hand, individual reflection and on the other hand, a combined reflection within the community.

The discussion on the introduction of new information technologies (IT) in the cultural production is not new. As a matter of fact, in 1968, Pontus Hultén organized a futuristic exhibition on art and mechanical technology at the Modern Art Museum in New York—MOMA. Following this direction, in 1968, the Institute of Contemporary Arts in London, has also organized the conference "Cybernetic Serendipity" focused on the relationship between computers and creativity [15]. In 1970, the organization Experiments in Art and Technology, Inc. (E.A.T.), which is dedicated to search for ways of collaboration between artists and engineers has organized a multimedia demonstration at the Osaka world Expo in the Pavilion of Pepsi. Some of the most

famous artist-engineer collaborations in this exhibition were focused on the artistic use of information technologies such as computers and telecommunications [16]. In 1970, the art critic Jack Burnham has also organized the exhibition "Software, Information Technology: a new meaning for art", at the Jewish Museum, New York, focused on software application as a means of interaction with the audience [17, 18]. After these pioneer events, the discussion has endured, and it has been the subject matter of many debates, studies, events and even academic dissertations.

At present, information technologies prevail. For example, writers use computers and word processors, painters make use of software for simulation and previsualization of his paintings, musicians use automatic melodic synthesizers and generators and sculpture applies CAD/CAM systems and 3D printers for prototyping. As a result of the advances in the computer market, access to this software is very economic, if not free, and its use almost always trivial. Such availability makes it possible for all people to be potential cultural producers and makes us think of a new idea of popular culture, much more dangerous than the one that is referred to in the text of 1944 by Adorno and Horkheimer [19]. Mass production of cultural goods, which was encouraged and made available by the mass media in order to "manipulate" the population is, this time, generated by society itself in an autophagic process. A good example are those home videos—despite being—mostly trifling and futile, they are seen and commented enthusiastically by millions around the planet. Fisher maintained that the distinction between art and non-art suggests the existence of a hierarchy of forms of expression, with the highest forms of art, therefore better ones, while the lower forms are not art and so are, at best, a distraction, or a pernicious tool, at worst [20]. The proliferation of these "distractions" and "pernicious tools" is perhaps the price to pay for the propagation of the access to the tools and creative production techniques.

3 Technology at the Service of the Cultural Tourism

Art makes use of technology mainly because it provides new tools, and forms of support and representation. But, on the other hand, art and culture can also work with technology as that allows the extension of the audience. Such an extension is possible by using single or combined multiple technologies and their application in different promotion strategies as well as the availability of the tourist cultural offer.

A good example is the use of the internet and virtualization technologies to allow visualization, contact and even remote interaction with cultural goods.

An advanced form of interaction, with increasing frequency, can be obtained by the use of so-called virtual reality technologies. In particular, fully immersive technologies, just with virtual objects, allow the spectator to have ("feel") contact with remote cultural goods and with the other spectators as if physically present. As shown by Parker, art, its contexts and display arrangements can be electronically transported out of exhibition spaces and be examined by individuals who may have never even entered a museum [21]. Such technology configures itself as an important

part in promoting the democratization of culture by stimulating an increased access to cultural goods. For example, by allowing an Indian spectator, with limited financial resources, to make a "visit" to the Metropolitan Museum of Art without leaving home in the antipodes of America. The augmented reality technology (Augmented Reality) in which there is immersion in the real world with the addition of virtual elements also allow spectators to get almost instantaneous information on cultural goods without having to recur to the acquisition of additional explanatory material or hire specialist services.

In addition to the remote access to cultural goods, one important expression of the impact of information technologies in the public is that we can be observe in the so-called Interactive Art—art form involving, in some way, the participation of the spectator [22]. Although this interaction can also be achieved without recourse to information technology, for example, the physical interaction of the viewer with works of large dimensions, such as large sculptures or artistic installations, more sophisticated interactions rely on sophisticated computation and electronic technologies. It is commonplace to use computers and sensors to respond to motion, sounds, heat or other sorts of stimulation. Apart from the works of art on the Internet and electronic art being susceptible of a high degree of interactivity, allowing the viewer to navigate the "work", in some cases, this local or remote participation induces dynamic changes of the work both in behaviour and form. An interesting example of this type of interactive art is the 12 m high D. Tower sculpture made by Lars Spuybroek and Q. S. Serafijn, exposed in Doetinchem in the Netherlands, which changes colour as a result of the interaction of cybernauts [23]. An application of interest of virtual reality in physical installations is the computer-generated interactive experience made available to visitors of museums allowing them to travel in space and historical time without having to leave the museum premises [24].

The available online books, music, films, reproductions of works of art, specialized periodicals and scientific and literary texts, despite the copyright-related controversy and intellectual property and the consequent impact and challenge to the sustainability of cultural goods, have also decisively contributed to broaden the cultural public. In addition to the existence of virtual libraries, virtual museums, numerous sites sharing music, videos, movies or serials, there are multiple thematic sites and ad hoc offers focused on authors, geographies and even in many academic works.

Information technology, particularly the automatic translation systems are already fundamental to break down linguistic barriers between cultural producers and consumers. It is expected that in less than two years, Microsoft will come out with the "universal translator" via Skype [25]. Such a system will allow instantaneous automatic voice translation in any existing language on the planet allowing two people to communicate normally using their native languages. This will have a positive impact on the extension of cultural theatre audience, opera or other spoken performances, to the extent that, regardless the language used in the performance, anyone will have an immediate understanding of what is said by listening to their own language. In addition, the automatic translation technologies from sign language into spoken language and from spoken language into sign language will remove traditional accessibility

barriers to dumb and/or deaf people [26]. Other examples of how accessibility technologies can remove barriers for these handicapped audiences are such systems that convert music and sounds into vibrations capable of being perceived by deaf people [27] or systems for partially sighted people which enable visual experiences that were previously forbidden to them.

4 The Case of the Virtual Museums

At present, museums are facing the challenge of better communicate and attract their public who, as a result of the evolution of society, have increasingly less available time to dedicate to culture and are, on the other hand, challenged with a greater number of competing offers. Most museums are confined spaces, created with the main objective of preserving and safeguarding our heritage [28]. This reality tends to change, insofar as the different actors will gradually become aware of the need to make use of new technologies to better communicate and facilitate new experiences to diverse audiences.

Currently most physical museums already have a web presence. However, this presence converts into varying degrees of available online information. Although there are museums that provide internet simple contact and offer basic information leaflet type, for example general information and a list of their exhibitions, there are totally virtual museums, only online, for example the International Museum of Women [29]. Amidst are those with physical facilities but also offer, at varying degrees of virtualization, exhibitions, interactive features, multimedia and searchable or browsable online collections. Such a diversity of positioning towards virtualization can be partially explained, according to Cunliffe, because museum professionals have only very recently become aware of the need to analyse the usability of virtual museums and have recognized the need to create their own guidelines for Internet [30].

There are nowadays several museums that can be visited "without leaving home". A good example, among many, is the NMNH (National Museum of Natural History) located in Washington, D.C., in the United States, dedicated to inspiring curiosity, discovery and knowledge about the natural world through the exposition of collections, exhibitions and educational extension programmes. Opened in 1910, the main building on the National Mall has an overall area of 140,000 m^2 and about 30,000 m^2 of exhibition and public area (equivalent to the size of 18 football fields). With an increasing focus on virtualization and interactivity, the museum is nowadays an excellent example of education and international cultural sharing, making accessible all its immense physical area to anyone with Internet access [31]. Figure 1 presents a virtual interface screen of this museum.

The software allows visitors to make a virtual tour using a computer (Windows, Mac, Linux) or mobile device (iPhone, iPad, Android). The tour is a self-guided virtual tour, room to room, or a virtual selection of areas and visit exhibitions within
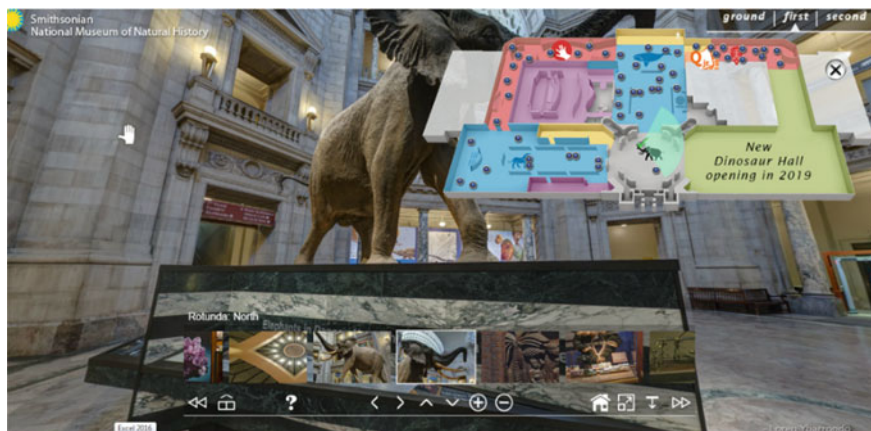
Fig. 1 Virtual interface of the National Museum of Natural History

the natural history museum building, as well the research of collections that are being exposed at the time or even exposed in the past.

In most virtual tours, visitors can navigate between the adjacent rooms by clicking on the links represented by blue arrows on the floor or, alternatively, use the navigation map in the upper right corner of the screens.

A visit to this museum in https://naturalhistory.si.edu/visit/virtual-tour is essential.

5 Conclusions

Emilio Vilar underlines that in the last years, we have witnessed the democratization and industrialization of culture; he wonders, however, if this will mean in fact an improved quality of life or, on the contrary, a decreasing in the quality level of cultural manifestations [32]. The discussion of the role of information technologies in the cultural tourism and in the democratization of the access to the production and consumption of cultural goods raises, as we have seen, a wide range of issues ranging from the quality of cultural production to the sustainability of cultural goods markets.

Having no intention to give a final response to any of these questions, in this text, in view of the above, the idea emerges that regardless the advantages or disadvantages brought about by technology, history will certainly recognize computer science, information theory and systems theory as fundamental intellectual models which, in combination with the advent of digital computing and telecommunications, have played a unique and significant role in the cultural tourism and "democratization" of culture.

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Sustainable Practices in Hotel Chains—A Comparative Analysis of Official Annual Hospitality Sustainable Reports from Listed Companies in Macau SAR, China

Ana Sofia Kong Santos and João Alexandre Lobo Marques

Abstract In the last few years, the tourism industry has experienced rapid expansion and diversification, making it one of the fastest-growing financial industries in the world. Consequently, the hotel industry has significantly affected the environment's long-term viability. Many hotels have begun voluntarily implementing environmentally sustainable practices as they become more aware of their ecological footprint. There has been a great deal of discussion about the effects of hotel operations on the environment and tourism sustainability in Macau. It is because of these negative impacts that hoteliers have adopted green practices in an attempt to minimize them. By developing sustainability reports, hotels can set goals, measure performance, and manage change, resulting in better sustainability. It could also be viewed as a strategy to enhance the company's sustainability reporting to ensure stakeholders know what the company does. The objective of this study is twofold based on the analysis of the official sustainability reports of four major hotel chains. Firstly, seven categories of sustainable practices effectively adopted by these chain hotels are identified and clusterized. Second, it is presented in which areas some hotels performed more efficiently than others, considering the UN Sustainable Development Goals (SDGs) as a reference. The results allow a comprehensive clusterized analysis of the industry in a highly developed gaming and entertainment area of South China and create a clear comparison between relevant players and their concerns about sustainability practices.

Keywords Tourism industry · Environmentally sustainable practices · Macau hotels · Sustainable reports · Sustainable development goals (SDGs)

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1 Introduction

Tourism has experienced rapid growth and diversification in the past few years, making it one of the fastest-growing financial sectors worldwide [1]. As a result, the hotel industry has considerably impacted the long-term viability [2] of the environment since they utilize large quantities of electricity and water and generate large amounts of pollution and waste [3].

With hotels becoming aware of their ecological footprint, many started voluntarily implementing environmentally sustainable practices. This helped them achieve cost reduction, efficiency, and increased profits and improve their brand value and competitive advantage [3]. United Nations Brundtland Commission 1987 defined, sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" [4]. From the resulting pressure from the government, media, and consumers, hoteliers [1] are held with more social responsibility [2]. They have increased their involvement in implementing more eco-friendly practices [1].

Hotels in Asia started to embrace green hotel practices more proactively with the establishment of the Asia–Pacific Hotels Environmental Initiative (HEI) in 1994, and for Southeast Asia, with the implementation of the Association of Southeast Asia Nations (ASEAN). With the help of these organizations, many hotel chains in Asia have adopted green initiatives as a critical element of their strategies [5], in which the most common practices are water and energy tracking [6].

Macau is well known for its tourism industry, particularly the gaming industry, which is a substantial source of the city's revenue. The increasing number of hotels has produced a significantly negative impact on the environment. The major barrier that Macau faces is constrained environmental management practices. This is due to the hotel industry's customer base and the severe shortage of human resources in response to the tourism boom [2]. Nevertheless, Macau hoteliers have a high level of environmental awareness, and many have started to introduce environmentally sustainable practices in the hotels since they can benefit from reducing operating costs, increasing the tourist products quality, attracting new markets, increasing brand value, and enhancing hotels image [3].

To acquire more customers, hoteliers use customer engagement strategies to connect with customers at different stages of their stay [7].

Customer engagement is a psychological process that results in customer loyalty. Positive customer experiences and outcomes increase engagement, such as brand trust, affection, and future purchase intention [8].

With companies in the hospitality industry actively promoting green awards and certifications, they attract environmentally conscious guests and help the hotel brand stand out from other hotels that are not as environmentally conscious. Being environmentally sustainable allows the hotel to reach a whole new market of the public, contributing to expanding its brand [9]. For some, green practices and certifications are crucial in guests' decisions on selecting hotels since they support and praise them. However, many customers remain indifferent to or even opposed to going

green because they believe green products are inferior or overpriced. Some have a negative view of these practices since they believe it doesn't benefit the guests but only the hotels [10].

The objective of this study is twofold based on the analysis of the official sustainability reports of four major hotel chains. Firstly, a total of seven categories of sustainable practices effectively adopted by these chain hotels are identified and clusterized. Second, it is presented in which areas some hotels performed more efficiently than others, considering the UN Sustainable Development Goals (SDGs) as a reference.

Therefore, the paper is structured in the following manner. To contextualize the research topic, first, a literature review is conducted. A discussion of the research method is followed by the results and discussion of the research, and then the conclusion.

2   Literature Review

This section provides a brief overview of state of art related to sustainability. It describes its appearance, its definition, and how its development can ensure sustainable economic growth, social inclusion, and environmental protection across the globe. Additionally, it discusses how sustainable development impacts the tourism industry and supply chain management. A detailed analysis is also provided of hotels' environmental impact and the solutions being implemented by the hospitality industry to mitigate this impact. Sustainable hotels are often referred to as these solutions. Additionally, since the study focuses on Macau, the hospitality industry and its adoption of sustainable practices will also be examined. Lastly, the importance of implementing environmental compliance and sustainability reports will be discussed.

2.1   Sustainability

As the world realized that we were facing an imminent ecological crisis, sustainable development became one of the driving forces of history in the last half of the twentieth century [11]. This increased awareness of the environmental and social impacts of global warming, energy consumption, prices, and the business implications of eco- and social sustainability [12].

Based on the historical overview, it is seen that sustainability originated in ancient times and has roots in ancient civilizations. This is due to the population growth and consumption issue that has, however, become significantly more acute since the Industrial Revolution. As present and future generations began to realize that they would not be able to maintain their living standards in perpetuity, a mode of thinking emerged that would eventually lend itself to the emergence and global adoption of sustainable development [11].

Sustainability is achieved by transforming government policies and regulations, establishing voluntary social responsibility programs built on consciousness, and educating the public about changing consumption patterns.

Various efforts have been made to research and define sustainability. However, some felt there was a limited perception of sustainability. Others found that the term could only be explained by examining its many interconnected components that make up the definition of sustainability. The study found divergent perspectives on sustainability definitions depending on the aspects that were examined.

Nevertheless, the Brundtland World Commission report provides the most familiar definition of sustainability. In this context, the term refers to "the development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs" [13]. Achieving sustainability requires a shift in meaning from one that is general to one that is more specific and quantifiable to monitor progress toward achieving sustainability objectives [12].

2.2 Sustainable Development

In 1980, the International Union for Conservation of Nature and Natural Resources introduced sustainable development. In the closing remarks of the report, it was stated that "human beings, in their quest for economic development and enjoyment of the riches of nature, must come to terms with the reality of resource limitation and the carrying capacities of ecosystems, and must take account of the needs of future generations" [14].

In the United Nations, sustainable development constitutes the overarching paradigm. According to the Brundtland Commission Report of 1987, sustainable development can be defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [15]. The adoption of Agenda 2030 and its 17 Sustainable Development Goals (SDGs), along with the 169 associated targets, reaffirms the world's commitment to Sustainable Development: to ensure sustained economic growth, social inclusion, and environmental protection while doing so in partnership and peace [16].

2.3 Sustainable Tourism

The tourism industry is one of the world's fastest-growing industries [13], and it is a valuable contributor to world economic growth [17]. The industry provides foreign exchange and employment to many countries, especially those under development, and contributes to their social, economic, and environmental well-being [13].

There was consequently a rise in concerns over the problems and challenges posed by tourism. Several regions were experiencing real problems because of tourism

entrepreneurs and tourists visiting these communities. Economic, social, and environmental impacts from this process can be both positive and negative. This led to the rise of sustainable tourism, an alternative to mass tourism. The new form of tourism is, in some way, a response to the negative effects that tourism can have on destinations in terms of supply and demand [17].

A sustainable tourism approach must also maintain a high level of tourist satisfaction, ensure a meaningful experience for tourists, educate them regarding sustainable tourism practices, and raise their awareness of sustainability issues. The key stakeholders can include individuals within the local community as well as business developers, tourists, and community leaders. They must be involved in the development of sustainable tourism. This is because, without their participation, it would be difficult to achieve a balance between equity, the environment, and economic factors [18].

2.4 Green Supply Chain Management

During the last couple of decades, experts around the world have increasingly been called upon to think more eco-friendly and find the most effective green solutions due to impacts such as global warming, climate change, waste, and air pollution [19]. Green supply chain management (GSCM) contributes to organizational sustainability, as identified by [20]. Different stakeholders, including governments and customers, are putting heavy pressure on companies to mitigate any harmful effects they may have on the environment [19]. Moreover, this has led to strict environmental regulations, such as the Waste Electrical and Electronic Equipment Directive in the European Union [21].

A green supply chain could reduce environmental pollution, lower production costs, create economic growth, provide a competitive advantage in terms of customer satisfaction, a better image, and improved reputation, and enable companies to export their products to environmentally friendly countries [19]. Its management approach can reduce the environmental impact of industrial activities without sacrificing quality, cost, reliability, performance, or energy efficiency. Therefore, it is possible to meet the demands of environmental regulations while simultaneously enhancing overall economic success [22].

2.5 Hotels' Environmental Impact

One of the largest industries in the world is tourism, accounting for 10.4% of worldwide gross domestic product (GDP) and a key driver of economic growth worldwide [23]. In contrast, tourism activities seriously degrade the environment and contribute to the increased emissions of greenhouse gases (GHGs) associated with its growth [24].

According to forecasts, the tourism industry will use double the amount of freshwater, land, and food within 25–45 years and will be more energy-intensive by that time. There is a strong correlation between climate change and tourism. Despite massive contributions to greenhouse gas emissions from the tourism sector, which are mostly attributed to transportation, the sector is also subject to profound effects due to climate change. This is because it is a particularly vulnerable industry to the effects of global warming and environmental degradation [25, 26]. As the primary form of accommodation, hotels are also one of the largest segments of the travel and tourism industry. However, hotels are also major contributors to climate change [27] as they use a significant amount of energy and water in the conduct of their day-to-day activities [28, 29].

Hotel managers face serious environmental and reputational problems because of these issues. As consumers become progressively environmentally aware of these issues [30], as well as pressure emanating from the tourism industry and modern laws and regulations [31], this has heightened the concern of companies, including hoteliers to become more "green-consciousness." The hospitality industry is both a contributor to and a victim of climate change, despite its growth and contribution to the industry [27]. This has led to hoteliers adapting to this "green wave" by incorporating eco-friendly features into their services and transforming their business into "green hotels" or "environmentally friendly hotels" [32].

Green Practices in Hotels. Tourism is experiencing rapid development and prosperity within the hotel industry, which is presently benefiting from this growth. Despite increased competition due to additional providers and potential competitors, managers of tourist hotels are continually seeking strategies to improve profitability and growth [33].

When a firm is faced with fierce competition, declining sales, a relatively mature market, and other threats, [34] suggest adopting a diversification strategy. This is so that these issues can be overcome. Diversification helps firms to enhance performance by transferring strategic assets and core competencies to other business units, thereby generating synergy and increasing performance [35].

Concerning this aspect, consumers' rising interest in environmentally responsible practices and sustainability has influenced the industry to implement green practices in hospitality management. They reduce their environmental impact by including green practices in their daily activities [36]. It gives hotel managers a unique opportunity to capitalize on this diversification and differentiation factor in the market. Adapting to this new green trend, hoteliers are now offering eco-friendly features to their products and transforming their facilities into "green hotels" or "environmentally friendly hotels" [29].

2.6 Macau Hotels

Macau's tourism industry, particularly its gaming industry, has made it a world-renowned tourism and gaming destination and is also one of its major sources of income. 72% of Macau's gross domestic product (GDP) is attributed to this industry [37]. Upon liberalization of the casino licenses in 2002, several world-class hotels and resorts were established with investments from Macau, Hong Kong, the United States, and Australia [2].

With the negative impacts of integrated resorts on the environment, researchers typically mention several environmental concerns. They include air pollution, waste generation, energy consumption, water pollution, noise pollution, traffic jams, and parking difficulties [38]. For instance, the development of integrated resorts in Macau has resulted in increased consumption and generated a substantial amount of waste. With this, sea reclamation is one of the characteristics of the development of Macau's integrated resorts.

Therefore, the urgency of incorporating green practices in integrated resorts is more severe, given the number of integrated resorts and tourists and their corresponding negative impacts on the environment. Integrated resorts engage in green practices for a variety of reasons. A green practice helps integrated resorts develop an attractive image by enhancing their green images and competitive advantages [3].

Green Practices in Macau Hotels. It has been observed that the hotel industry in Macau contributes significantly to the level of environmental sustainability and the sustainability of tourism in Macau. Some measures were taken to reduce these negative impacts [2]. Hoteliers are hindered in adopting green practices due to poor customer demand, poor environmental knowledge, and an absence of regulations. Around 80 percent of hotels have implemented strategies to reduce energy consumption and water consumption (77.8%) and waste (77.8%).

The most common green practices adopted by hotels are those that provide cost savings. Among them are installing energy-efficient light bulbs, using energy-saving systems, and placing signs to encourage guests to conserve energy. Over 59.3% of hotels have established strategies to increase employees' environmental awareness, and more than 48.1% of hotels have negotiated with suppliers for environmentally friendly products. A mere 29.7% of hotels have an official environmental policy, 13.5% of hotels have a designated employee or employees for environmental management, and 21.6% of hotels have donated outdated products to community groups and audited their environmental performance [2].

2.7 Environmental Compliance

In recent years, we have seen a growing emphasis on environmental issues in our daily lives and in how we conduct business. In response to the negative impacts on our environment, such as climate change and severe pollution, governments and

other regulatory bodies have created a wide range of laws, regulations, and standards, known as environmental compliance. As a result, the environment is protected even if businesses continue to manufacture and reach out to multiple markets. In addition to reducing pollution, improving wildlife protection, and maintaining a green landscape for posterity, it contributes to achieving economic development while maintaining a healthy environment.

Performing an environmental compliance assessment correctly can be a valuable tool for businesses seeking to limit their exposure to the substantial liabilities associated with noncompliance with environmental laws and regulations. Increasingly, companies perform environmental compliance assessments as a matter of routine. There are two primary purposes for these assessments. An environmental assessment can pinpoint areas of noncompliance with environmental requirements in ongoing or past operations for companies engaged in routine operations. On the other hand, if a company intends to acquire another company or its assets, an environmental assessment can identify any environmental liabilities that the prospective purchaser may be required to assume due to the acquisition. As a result of these differing motivations, different types of environmental assessments are conducted [39]

2.8 Sustainability Reports

The social embeddedness of a company's stakeholder environment prevents it from acting in isolation. An organization's purposes are determined by the various stakeholders who are pursuing different economic, ecological, and social goals and demanding information on those goals. Consequently, corporate sustainability management must ensure that the economic, environmental, and social effects of corporate activities are managed systematically and provide stakeholder information regarding sustainability-related issues and how they are being addressed. As part of the sustainability management process, processes and structures are designed to ensure sustainable corporate and business development and contribute positively to society's development as a whole [40]. It is, therefore, necessary to organize information creation and information flows in line with the requirements of reporting, communication, and dialogue with key stakeholders. Sustainability reporting is a key channel through which organizations meet these demands [41].

Sustainability reports enable organizations to set goals, measure performance, and manage change so that their operations will become more sustainable. It may also be viewed as a strategy to enhance the company's sustainability reporting to ensure that stakeholders are aware of the company's performance [42]. It is also effective in improving corporate transparency, improving brand value, reputation, and legitimacy, enabling benchmarking against competitors, showcasing competitiveness, motivating employees, and supporting corporate information and control processes [41].

3 Research Methodology

The research is fundamentally based on secondary sources, from analyzing and comparing official annual ESG (Environmental, Social, and Governance) reports of four major Hotel chains in Macau to determine and compare the most areas and strategies. This information, as a result, provides a basis upon which environmentally sustainable measures were done and will be taken in the future.

The selected hotel chains achieved Gold and Silver classifications in the 2020 Macau Green Hotel Awards. Moreover, since sustainability reports for the year 2021 have not yet been published, hotel chains with official sustainability reports for the year 2020 were considered. Since the reports are public and data can be shared with no restrictions, the four major hotel chains are Sands China, Melco, Wynn, and Galaxy.

Sustainability reporting aims to disclose and communicate social, environmental, and governance (ESG) goals and the company's progress toward achieving them. As a result of sustainability reporting, companies have improved their corporate reputation, built consumer confidence, increased innovation, and improved risk management. Hotel chains selected for the study have established goals that follow global standards in the environment, social, and governance areas as well as aligned with United Nations Sustainable Development Goals (SDGs) in the areas where they could have the most significant impact. The SDG is also aligned with the hotel's strategy and priorities for engaging with the government, the community, and stakeholders.

A comparative analysis was done by comparing the four selected official sustainable hotel reports and distinguishing their similarities and differences. This allows it to better understand the issue and see how they engage and communicate their environmentally sustainable practices.

4 Results and Discussion

Before presenting the integrated data of the four chains for comparison, the first contribution of this work is focused on the identification of the seven most relevant clusters, now on called Key Focus Areas, presented in Fig. 1.

Fig. 1 Identification of seven Key Focus Areas

Key Focus Areas

- Procurement
- Environment
- Energy Management
- Water Management
- Food Management
- Waste Management
- Transportation

4.1 Focus Areas and Their Correspondent Measures

Procurement

The sustainable procurement department is responsible for procuring products that comply with the company's environmental standards. To achieve the company's goals, plans are developed to determine a baseline that can be used to track performance, identify priority categories and advantageous technologies, and train professionals. Furthermore, all suppliers must adhere to governmental requirements, pass background checks, and adhere to their Supplier Code of Conduct. In turn, it is expected that all suppliers will hold their suppliers to the same high standards.

All hotel chains, except for Galaxy, have mapped the United Nations Sustainable Development Goals (SDGs) to their operations to determine how they can contribute to the global agenda. As shown in Table 1, all chains have been awarded sustainability awards and certifications due to meeting the expectations of third parties and stakeholders. Sands is the only hotel chain to have implemented a long-term cycle for corporate sustainability, which is a five-year cycle, as opposed to others that have annual cycles.

To maintain classifications, reputations, and interaction with the community, hotel chains are working with universities and foundations. In addition, they ensure they are trained and educated about sustainability to benefit their team members and make them feel like part of something worthwhile. However, Sands and Melco are the only companies encouraging staff members to communicate ideas and solutions.

Regardless, they all support the local community by buying their goods, supporting new business opportunities, providing cash donations, and volunteering for local causes. Only Wynn has not done so in terms of partnering with organizations to find sustainable solutions.

In terms of supply management, all hotels are environmentally sustainable in this area and even encourage disposable alternatives. Despite all of them insisting that their plastic single-use plastic is eliminated, recycled, and reused, Wynn and Melco are the only two that have constructed onsite automated bottling plants as an alternative to plastic bottles.

Melco is the only hotel chain that has established risk management meetings. Melco and Sands implement similar measures to manage climate-related risks and opportunities.

Environment

As to innovating and creating a full cycle of building life, Sands and Melco are the chains that consider this when executing the construction of a new building or renovating it. During hotel development and renovations, Melco and Galaxy purchase sustainable materials (see Table 2).

Chains must conduct green meetings and events. This is to communicate to their customers and clients that they are also making efforts to create a sustainable environment for them. Melco has not yet offered this measure to its hotels. Sands is

Table 1 Procurement-related sustainability measures

Area	Measures		Sands	Wynn	Melco	Galaxy
Procurement	Environmentally responsible operations	Long-term corporate sustainability cycle	✓			
		Sustainability awards and certifications	✓	✓	✓	✓
		Emission targets aligned with the UNS SDGs	✓	✓	✓	
		ESG recognition	✓	✓	✓	✓
		Operate building with continued resources conservation	✓	✓	✓	✓
		Introduction of new technologies	✓	✓	✓	✓
		Circular economy approach	✓	✓	✓	✓
		Benchmark practices	✓	✓	✓	✓
		Materiality assessment	✓	✓	✓	
		Ensure relevance of sustainability strategy to stakeholders' expectations and core business	✓	✓	✓	✓
		Audits	✓	✓	✓	✓
		Educate, train, and inform team members	✓	✓	✓	✓
		Encourage staff members to communicate ideas and solutions	✓		✓	
		Partner with Universities and foundations	✓	✓	✓	✓
		Include third party verification of the efforts	✓	✓	✓	✓

Table 1 (continued)

Area	Measures		Sands	Wynn	Melco	Galaxy
	Community	Closely connected with local community and SMEs	✓	✓	✓	✓
		Partner with organizations to find sustainable solutions	✓		✓	✓
		Support new business opportunities	✓	✓	✓	✓
		Good and services purchases from local suppliers	✓	✓	✓	✓
		Cash donations to local causes	✓	✓	✓	✓
		Volunteering	✓	✓	✓	✓
	Sustainable products	Supply chain Sustainability	✓	✓	✓	✓
		Supplier meet government standards and supplier code of conduct	✓	✓	✓	✓
		Promote disposable alternatives	✓	✓		✓
	Plastic reduction	Eliminate, reuse, replace and recycle single-use plastic products and packaging	✓	✓	✓	✓
	Risk management	Onsite automated water bottling plant		✓	✓	
		Hotel risk management meeting			✓	
		Manage climate related risks and opportunities	✓		✓	

the only hotel chain recognized for its sustainable event management and has established a green meeting program. Sands and Wynn have sponsored and supported green events, but Galaxy is the only chain developing green workshops. Wynn is the only one that has showcased sustainability through projects.

Table 2 Environment-related sustainability measures

Area	Measures		Sands	Wynn	Melco	Galaxy
Environment	Green buildings	Create a full cycle of building life	✓		✓	
		Innovate building	✓		✓	
		Purchase sustainable materials during hotel development and renovations			✓	✓
	Green meetings and events	Awards for sustainable management evens	✓			
		Host and support green events/zero waste events	✓	✓		
		Green workshops				✓
		Green meeting programme	✓			
		Showcase sustainability through projects		✓		

Energy Management

Regarding environmental performance, all four hotel chains have invested in energy efficiency and have implemented goals to reduce greenhouse gas (GHG) emissions. The only companies to receive procured renewable energy certificates (RECs) and have deoxidized emissions annually are Sands and Melco. Sands and Wynn have taken appropriate actions to preserve natural resources and ecosystems.

Investments in new and sustainable technologies such as solar energy plants and LED lights were implemented by three hotel chains except for Wynn, as seen in Table 3. However, Sands and Melco are the only two companies that have implemented solar photovoltaic systems. Wynn has been the only one to modify the steam pipeline to regulate the steam supply.

All four companies have upgraded fixtures and systems to reduce energy usage and minimize or eliminate carbon emissions. Additionally, they were able to implement energy conservation measures. However, all hotels except Galaxy have installed renewable energy systems, and Wynn was the only company that developed methods of reusing energy.

Except for Sands, all hotel chains provide charging stations for electric vehicles. Sands is the only chain with energy sourced from China winds and has improved the plant efficiency. And Galaxy is the only chain that has done community-wide energy-saving initiatives.

Table 3 Energy-related sustainability measures

Area	Measures		Sands	Wynn	Melco	Galaxy
Energy	Energy efficiency	Solar energy plant	✓		✓	✓
		LED light	✓		✓	✓
		Solar photovoltaic systems	✓		✓	
		Chargers for eletric vehicles		✓	✓	✓
		Upgrade fixtures and systems	✓	✓	✓	✓
		Modify steam pipeline to regulate the steam supply		✓		
		Energy sourced powered by China winds	✓			
		Reuse energy		✓		
		Reduce energy usage	✓	✓	✓	✓
		Renewable energy	✓	✓	✓	
		Minimize or eliminate carbon emissions	✓	✓	✓	✓
		Dioxidize emissions annually	✓		✓	
		Improve plant efficiency	✓			
		Preservation of natural resources and ecosystems	✓	✓		
		Procured renewable energy certificates (RECs)	✓		✓	
		GHG emissions reduction goals	✓	✓	✓	✓
		Enact energy conservation polices	✓	✓	✓	✓
		Community-wide energy saving initiatives				✓

Water Management

Each of the four chains aims to maximize the efficiency of its water consumption. To monitor and reduce water consumption, various measures are used, including utilizing smart technologies, upgrading fixtures and systems, and implementing water conservation policies. Further, they have organized social water conservation projects and programs that involve team members and the community.

Wynn is the only hotel chain that does not comply with such regulations in terms of enhancing water quality and reclaiming or enabling greywater. Additionally, they do not offer water stations to guests. As seen in Table 4, among all companies, Sands is the only one that has utilized condensate water and harvested rainwater.

Table 4 Water-related sustainability measures

Area	Measures		Sands	Wynn	Melco	Galaxy
Water	Water efficiency	Investing in smart technologies/ equipment	✓	✓	✓	✓
		Upgrade fixtures and systems	✓	✓	✓	✓
		Developing monitoring programme	✓	✓	✓	✓
		Encourage sensible water usage	✓	✓	✓	✓
		Enhance water quality	✓		✓	✓
		Enact water conservation policies	✓	✓	✓	✓
		Social water conservation projects and programmes	✓	✓	✓	✓
		Water station for guests	✓		✓	✓
	Water reuse	Reclaim or enable grey water	✓		✓	✓
		Reduce and reuse water	✓	✓	✓	✓
		Use of condensate water	✓			
		Harvest rain	✓			

Food Management

Melco and Sands are the two companies that invest most in improving the efficiency of the food they provide to customers and team members, as seen in Table 5. As well as investing in digital improvements in their kitchens, both establishments offer vegetarian and sustainable green food options. Although Galaxy only offers plant-based and sustainable green menu options and not vegetarian food, each of the above three hotel chains purchases sustainable and green products and understands the importance of maintaining a responsible seafood supply. However, Melco is the only chain attentive when selecting the farms from which the eggs and pork are sourced. Wynn does not describe any efforts related to food efficiency in its sustainability report.

Waste Management

The hotel chains prioritize waste generation areas where they can effectively reduce, reuse, and recycle, proactively managing the overall waste footprint based on three key categories: food waste, general waste from resort operations, and construction waste. Galaxy is the only hotel that does not prioritize construction waste reduction measures and food waste, as seen in Table 6. To minimize food waste, Sands, Wynn, and Melco have invested in technologies that measure and analyze it to manage the food supply. The three companies donate food that is in an acceptable condition. However, reports indicate that Sands and Wynn are the only companies diverting food.

Table 5 Food-related sustainability measures

Area	Measures		Sands	Wynn	Melco	Galaxy
Food	Food production	Digital enhancement in kitchens	✓		✓	
		Plant based fare	✓		✓	✓
		Sustainable and green menus	✓		✓	✓
		Offer vegetarian options restaurants	✓		✓	
		Purchase sustainable and organic green produce	✓		✓	✓
		Understand their seafood supply chain	✓		✓	✓
		Source cage-free eggs			✓	
		Purchase pork from crate-free farms			✓	

The four companies operate to reduce, reuse, and recycle programs for general waste, in which they donate and recycle materials. In terms of diverting waste from landfills, Sands and Melco are the only organizations that have taken this step.

Sands and Melco handle construction waste from new developments, remodeling, and renovations and repairing and recycling their furniture. Wynn has also taken this step to recycle and repair furniture. Currently, Sands is the only company that repurposes and recycles mattresses. A measure that Wynn and Melco took was to repurpose wooden shipping pallets.

Transportation

In this final area, the goal is to reduce the impact of transportation on the environment. Sands is the only hotel chain that explores advanced technologies and uses the least amount of fuel for ferries.

Wynn, Sands, and Galaxy attempt to optimize bus routes and use alternative fuel sources to reduce emissions. And finally, Sands is the only company that utilizes natural gas-fueled vehicles, as seen in Table 7.

5 Conclusions

In summary, four hotel chains are evaluated and compared for their environmentally sustainable measures in this study. The four hotels selected for analysis have won the Macau Green Hotel Award and awards and certifications from other third parties. A secondary analysis was performed to determine why their sustainability report was highly regarded and to gain a deeper understanding of their practices. From the findings of the sustainability reports, seven Key Focus Areas were identified,

Table 6 Waste-related sustainability measures

Area	Measures		Sands	Wynn	Melco	Galaxy
Waste	Food waste	Reduce food waste	✓	✓	✓	✓
		Donate food	✓	✓	✓	
		Food waste measurer and analyzer	✓	✓	✓	
		Diversion of food	✓	✓		
		Food donation programme	✓			
	General waste	Reduce, reuse and recycle programs	✓	✓	✓	✓
		Waste diverted from landfill	✓		✓	
		Divert and donate unused products and materials	✓	✓		✓
		Donate used denim	✓			
		Recycled and donate soap products		✓	✓	✓
		Recycle reused textiles		✓		
	Construction waste	Handle construction waste from new developments, remodels and renovation	✓		✓	
		Furniture repurposed and recycled	✓	✓	✓	
		Matresses repurposed and recycled	✓			
		Repurpose wooden shipping pallets		✓	✓	

Table 7 Transportation-related sustainability measures

Area	Measures		Sands	Wynn	Melco	Galaxy
Transportation	Ferries	Explore advanced technologies	✓			
		Increase fuel economy standards for the ferry fleet	✓			
	Buses	Explore route optimization	✓	✓		✓
		Utilize alternative fuel sources to decrease emissions	✓	✓		✓
		Add vehicles that run on compressed natural gas (CNG)	✓			

and the comparison of each dimension shows that Sands China, Wynn, Melco, and Galaxy hotel chains are keenly involved in sustainability practices. It pertains not only to internal activities but also to get involved in the community, schools, and foundations. The initiative will partner with universities and foundations as well as helping the local community. It should also be noted that water efficiency and energy efficiency are two of the primary focus areas for these four companies regarding sustainability. The results and discussion section indicated that Melco and Sands are the two companies that invest most in improving the food they provide to customers and team members. While Galaxy has a few measures in place in this regard, Wynn does not appear to have any, according to the hotel chain report. When it comes to general waste, Galaxy is the company that has the least sustainable practices in this area and does not even have any measures implemented in construction waste management. Sands is the only hotel chain that explores advanced technologies and uses the least amount of fuel for ferries. In terms of optimizing bus routes and using alternative fuel sources, Wynn, Sands, and Galaxy are the only chains that make such efforts. Melco does not report any transportation measures.

Comparing each hotel chain, Sands has implemented the most sustainability measures. The next company is Melco, which, even though they have no transportation measures, is focusing its efforts on other areas of the hotel. Lastly, Wynn and Galaxy come last since they are the two companies that have the least measures implemented.

A future study could investigate whether Macau residents are aware of the four largest hotel chains in the region in terms of environmentally sustainable practices by conducting a survey. In addition, this study could be useful for people contemplating doing an in-depth interview with managers of these chains since it might introduce them to the sustainability practices implemented if they want to learn how they perceive this issue from their point of view. A final suggestion would be a comparison report that would include data from different years or other big chains in Southeast Asia. By doing so, it would be possible to measure the progress of the implementation of sustainable measures as well as compare Macau's hotel chains with those in Southeast Asia.

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People-Flows: A Proposed Tourist Destination Management Paradigm

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Abstract   Overtourism has, in the past years, grown to become a global issue, turning popular tourist destinations into unsustainable places of congestion, creating visitor dissatisfaction, and forever changing the daily life of nearby residents. Action needs to be taken in order to contain this ever-increasing problem, with technological solutions that will try to simulate and adapt to the complexity of each separate case. This work proposes a holistic approach to destination management, introducing an innovative flow management system, that can use historic data together with real-time reservation and traffic congestion data, in order to produce forecasts and recommendations that will help attraction administrators (museums, sights, monuments, etc.) and policymakers in decision-making. The proposed system is part of an integrated approach, featuring end-user applications for visitors and tourism professionals.

Keywords Overtourism · Destination management · Flow management · Flow monitoring · Crowdedness management

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1 Introduction

After decades of continuous growth, in many popular destinations, tourism has started to create more problems than benefits. Worldwide there are destinations where specific places and attractions occasionally become overcrowded, with unpleasant consequences for the visitors' experience [1]. The phenomenon of overtourism increasingly concerns the travel industry, locals, and businesses in tourist areas [2]. Over-crowdedness at popular tourist destinations often affects the quality of the services provided, the visitor's experience as well as the quality of life and the hygiene conditions for all, resulting in reduced satisfaction, loss of revenue, and a decreased sense of security. Interventions at individual sectors already exist fragmentarily, mainly at organized venues such as museums and amusement parks: real-time crowd monitoring, allocation of parking areas, queue management applications, online ticketing systems, site load-bearing control systems, and port berth allocation.

The reaction of local residents during the last 5 years has worsened the situation. Authorities seek ways and measures to mitigate the problem. Visitor taxes, limited capacities or even closure of areas, made the issue more and more known to the general public. The COVID-19 pandemic hit the tourism industry really hard, to an extent that someone might think that overtourism is no longer an item to discuss. But contrary to initial views, the pandemic has actually magnified the overtourism issue by imposing even stricter rules to people movement and gatherings.

Discussions in the literature are rich regarding issues that need to be addressed in the context of managing popular destinations to tackle the issue of crowdedness. In this respect, there are several approaches providing general overviews and analyses [3, 4], others focusing on policies that must be adhered to [5, 6], as well as works proposing technological solutions. It is notable though that the majority of solutions proposed address the end-users [7, 8], namely tourists or city visitors, while there is a lack of technological approaches to assist policymakers and managers of tourist destinations. For example, the use of geo-referenced information that updates the available information on the tourism activities aims to improve the interaction between public and private agents and visitors [7]. When it comes to administrative systems, efforts mostly focus on monitoring tourist destinations [9, 10], like, for example, in the City of Dubrovnik where live camera feedback is used by machine learning algorithms in order to calculate predictions on visitor flows. Studies report that the adoption of existing solutions is slow and that there is a gap between the level of implementation of smart solutions and their operability in relation to the management of tourist overload [11].

Building upon existing practices and further enhancing and combining them toward holistically approaching the overtourism issue, we introduce the PeopleFlows destination management platform. The aim of PeopleFlows is to propose and implement an innovative flow management system aiming to address or even avoid visitors' over-congestion.

The PeopleFlows proposed solution consists of:

- Smart queue management applications at places where congestion and waiting times occur most (embarkation gates, entrance areas, museums, archaeological sites, public services, etc.).
- End user applications for visitors, tourism professionals, and Destination Management Organisations.
- Interoperability with key external systems, such as reservation systems, access control. Feeding with historical data for presence, flows, and traffic.
- Monitoring of people and vehicle flows through a real-time object detection system, using advanced machine learning techniques on low-cost hardware devices.
- Flow monitoring and processing to forecast flows and provide visitors recommendations for optimal time planning or alternative visitor options with the ability to analyze and process large volumes and streams of data.

Work described in the following sections is focused on the destination management platform and the tools available to attraction manager and destination policymakers. The solutions developed addressing to visitors are presented in [12]. Section 2 presents the PeopleFlows platform architecture, while Sect. 3 goes into detail, presenting the different management tools developed. Section 4 summarizes this work and provides directions for future research in the field.

2 PeopleFlows Platform Architecture

The PeopleFlows platform consists of subsystems that receive, transform, and generate data. These data mainly describe the presence or movement of people to and from areas of interest. Data collection is achieved through heterogeneous channels that are then processed and classified as event-driven data which in turn can be visualized and presented.

A thorough look into the PeopleFlows platform architecture reveals the flow of information and the transformation mechanisms in place (see Fig. 1).

The PeopleFlows ecosystem consists of:

1. Data Collection systems

    a. Check-in applications
    b. Reservation/ticketing systems
    c. Queue management applications
    d. Terminal management systems
    e. Camera installations with real-time object detection capabilities.

2. The Data Collection and Transformation (ETL) subsystem, with the primary goal of controlling, enriching, and converting collected data into homogeneous data
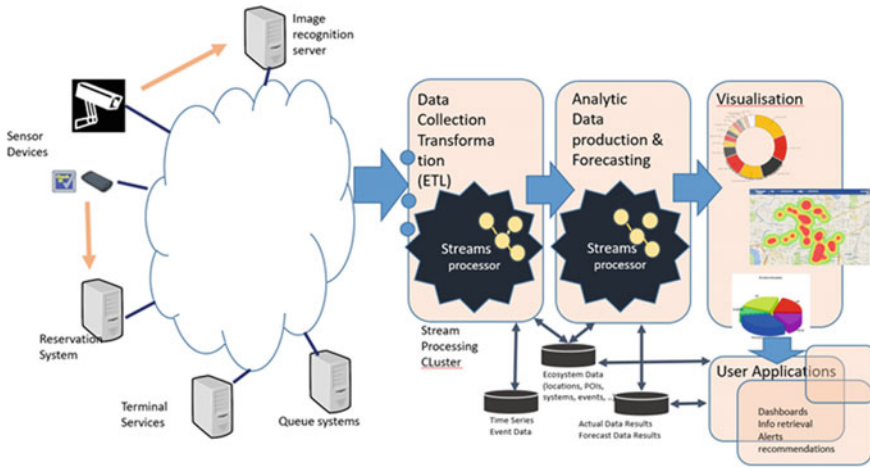
Fig. 1 PeopleFlows architecture

for further processing. A stream data processing system that outputs time series data containing all recorded events.

3. The Data Analysis and Forecasting subsystem, where event data is processed and synthetic data is being generated. The subsystem feeds data analysis and forecast results to a collection of applications for knowledge extraction.

4. Data storages containing:

    a. Event data generated by the processing of data received from heterogeneous systems.
    b. Ecosystem data including metadata, additional information on data sources, areas, events, related to events, etc.
    c. Actual data and forecast data, i.e., the products of the analysis and synthesis of factual data.

5. A visualization engine used to graphically present a certain result collection.

6. End user applications, such as dashboards, business intelligence and decision-making applications, recommendation engines, and alert mechanisms.

3 The PeopleFlows Holistic Approach to Destination Management

3.1 Destination Management Platform

The destination management platform is available to registered users who assume a managerial role. Table 1 summarizes the different functions of the management platform by access level.

Table 1 Available functions per administrator role

Functions/roles	Ticket office employee	Attraction manager	Business intelligence application manager—platform administrator
Ticket issuance	X	X	
Attraction (POI) management	X	X	X
Ticket availability	X	X	
User management		X	X
Attraction (POI) analytics	X	X	X
Destination analytics			X

3.2 Home Page

The home page of the management platform aims to gather and summarize information useful for each user. Employees of a particular attraction (e.g., ticket office and attraction manager), who may be in charge of determining ticket availability, can view the same information on their homepage that focuses on attraction traffic. More specifically, the home page (Fig. 2) includes:

- Tab with attraction information (title, location, opening hours, and ticket prices). In case of content managers, an icon is displayed which navigates to the editing page of the attraction's information.
- Tab with ticket availability per day, which contains links that navigate to the search and issuance of tickets and an icon that leads to the ticket availability editor.
- Current estimates of attraction traffic (road traffic rating, occupancy rate, and waiting time) as well as averages for the selected period (total, current week, current month, or current year).
- Tabs with the current number of visitors, the number of expected visitors for the next hour, and the number of tickets sold on the current day. These tabs also include a comparison rate with the previous day.
- Diagrams for the expected occupancy rate and waiting times for the current day.
- Diagram for comparing the number of statements of intent to visit and the number of bookings with the actual number of visitors per hour.
- Charts with revenue and type of tickets (e.g., regular, discounted, free) sold within a specific time period.

The platform administrator homepage focuses on presenting information about all available points of interest/attractions. More specifically, the home page (Fig. 3) includes:
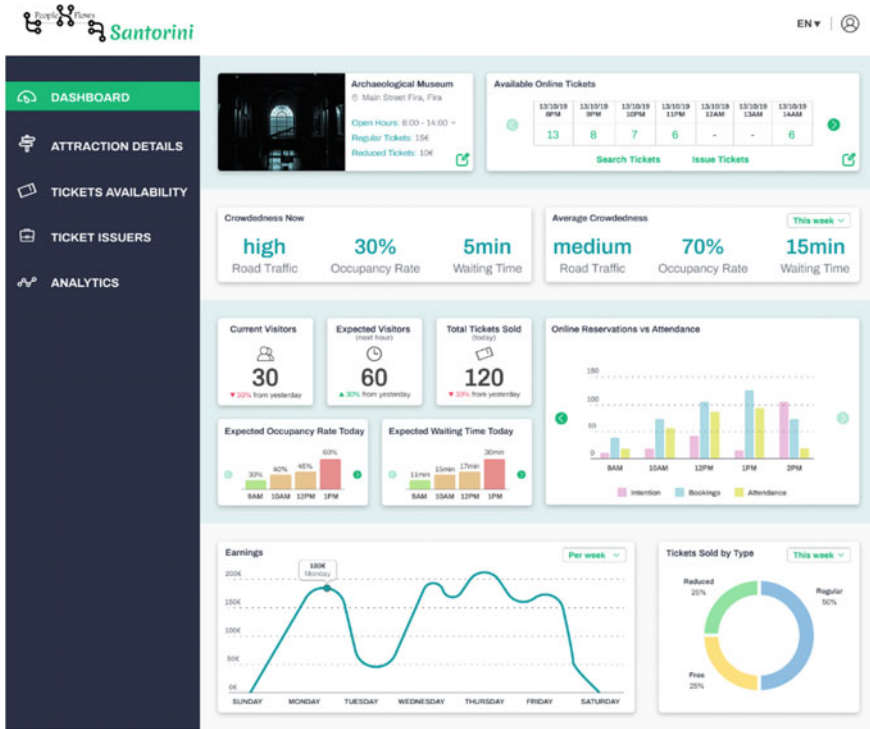
Fig. 2 Ticket office and attraction manager homepage

- Information regarding the number of points of interest that have been registered, categorized according to crowdedness metrics (Low, Medium, High)
- List of the five most crowded attractions predicted for the forthcoming week. The "Decrease Tickets" link allows the administrator to reduce the number of available tickets online. If no tickets are required, this is indicated on the link.
- List of the five least crowded attractions and the respective "Increase Tickets" link that can be used when seemed appropriate. Thus, the platform administrator can easily and quickly control the traffic to the points of interest and take the appropriate actions.

3.3 Ticket Availability Mechanism

The ticket availability page (Fig. 4a) allows the management of tickets available through the booking and appointment service (on the public website and in the interactive information systems). Tickets can be distributed in three different ways: automatically, through the built-in machine learning algorithm, and manually.
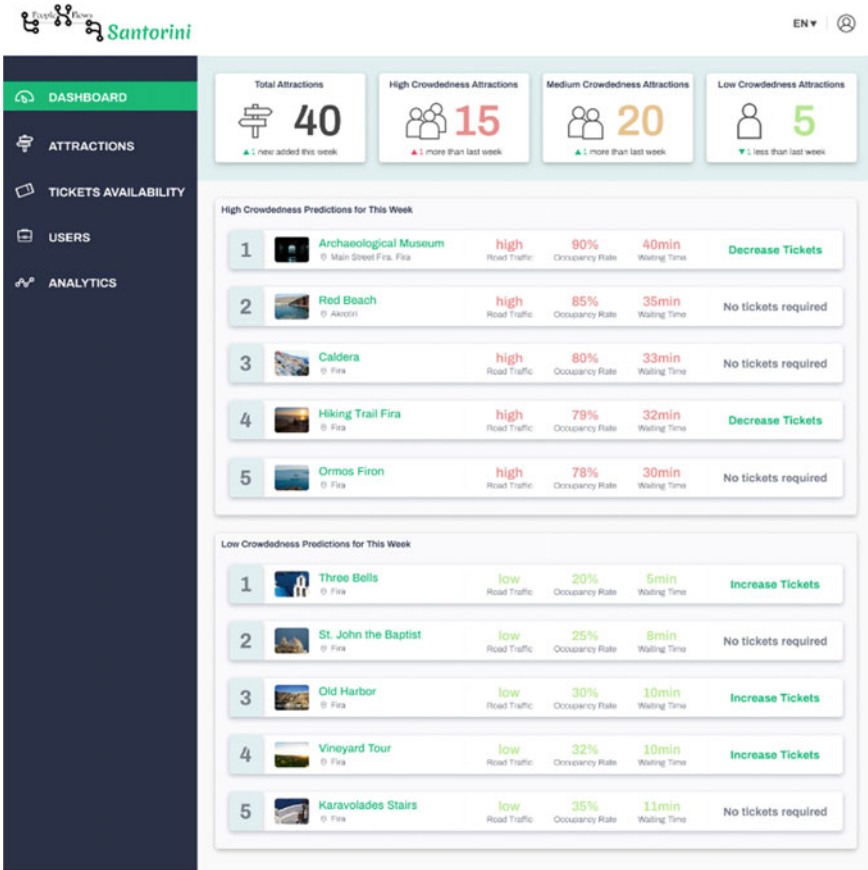
Fig. 3 Platform administrator homepage
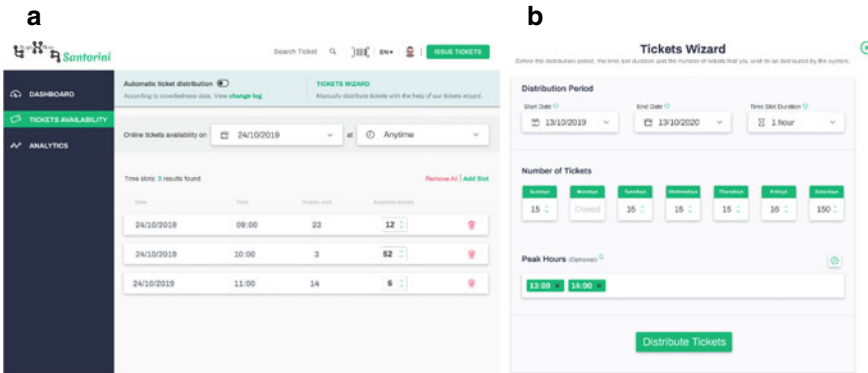
Fig. 4 Ticket availability (**a**) and ticket distribution (**b**) screens

The first way is fully autonomous and is activated by the control switch labeled "Automatic ticket sharing." Upon activation the tickets are automatically distributed by the system based on current and predicted crowdedness metrics and statistics.

The second way is with guidance (Fig. 4b) and is initialized by the "Ticket Wizard" link. In this case, the administrator must select the distribution period (start date, end date, and time limit), the number of tickets per day or per date (if the period is short) and the peak hours at which the system will distribute fewer tickets.

The last way is manual and is done by editing existing tickets and adding new ones. The administrator can select the range of dates and times for which he/she wants to view the available tickets and edit or delete them accordingly. The addition of new tickets is performed through the "Add slot" link.

By selecting the "Add slot" link, a modal window appears (Fig. 5). The administrator can fill the necessary fields (date, time, number of tickets, repetition rate, and repeat until). The diagrams in this window show the number of tickets that are expected to be sold through the website and at the attractions ticket offices during the selected period and are intended to help the user take the right decision.
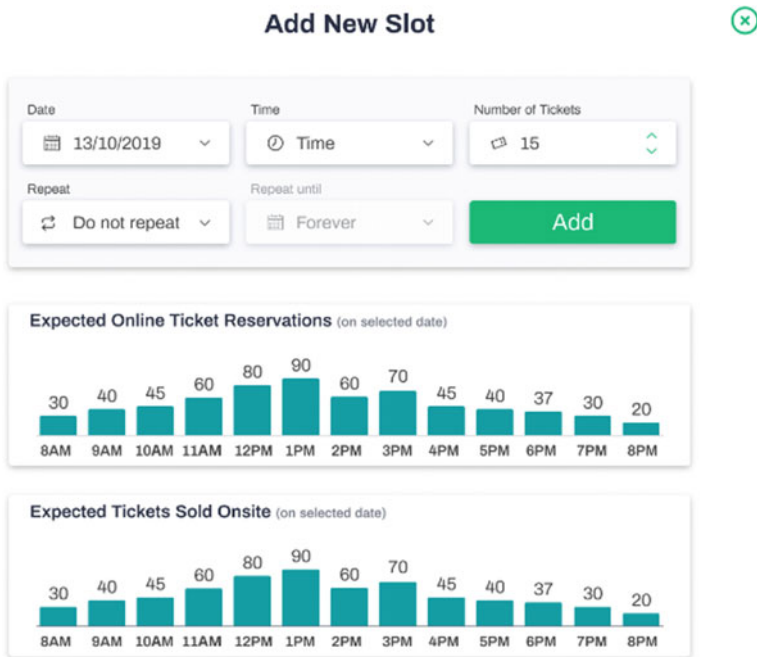
Fig. 5 Manual addition of ticket slots

3.4 Destination and Attraction Analytics

The attraction analytics page displays the statistics of the point of interest for the selected day (Fig. 6). Booking and crowdedness metrics are displayed together with real-time information on ticket bookings for the selected date. For each booking, the confirmation number, the date of booking, the number of people, the expected time of arrival, and the booking status are shown.

In addition to the attraction analytics page, the platform administrator has access to the destination analytics page, which contains an aggregated analytics list of all available attractions (Fig. 7). Information displayed per attraction includes a thumbnail, the destination title, location, current traffic data, and a chart of attendance. By selecting a list item, the user navigates to the respective attraction analytics page.
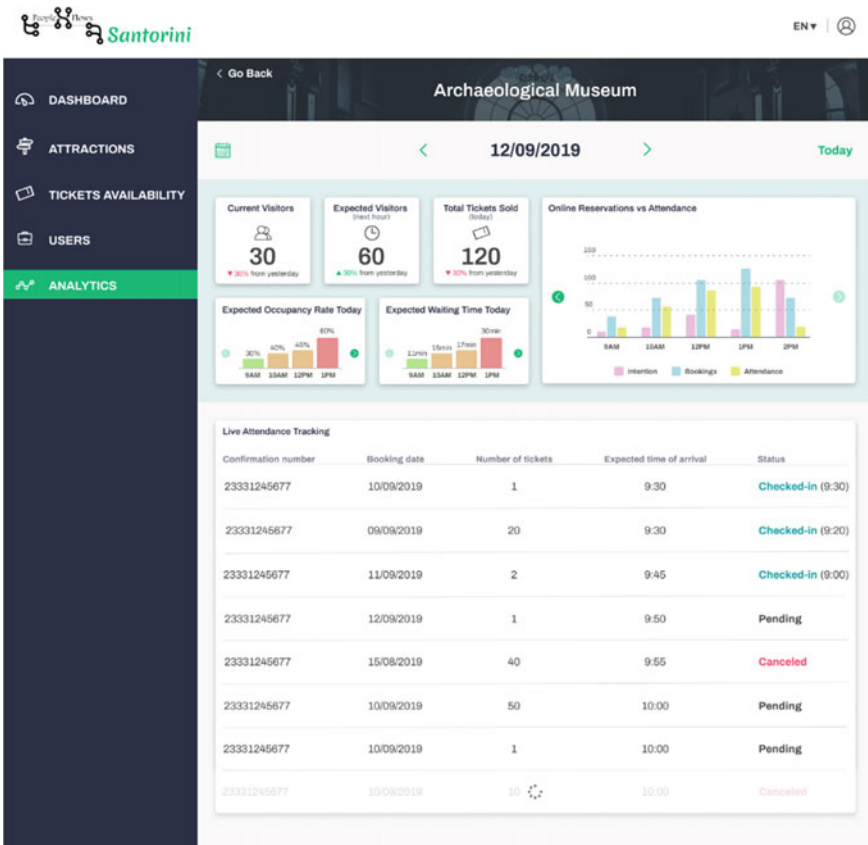
Fig. 6 Attraction analytics
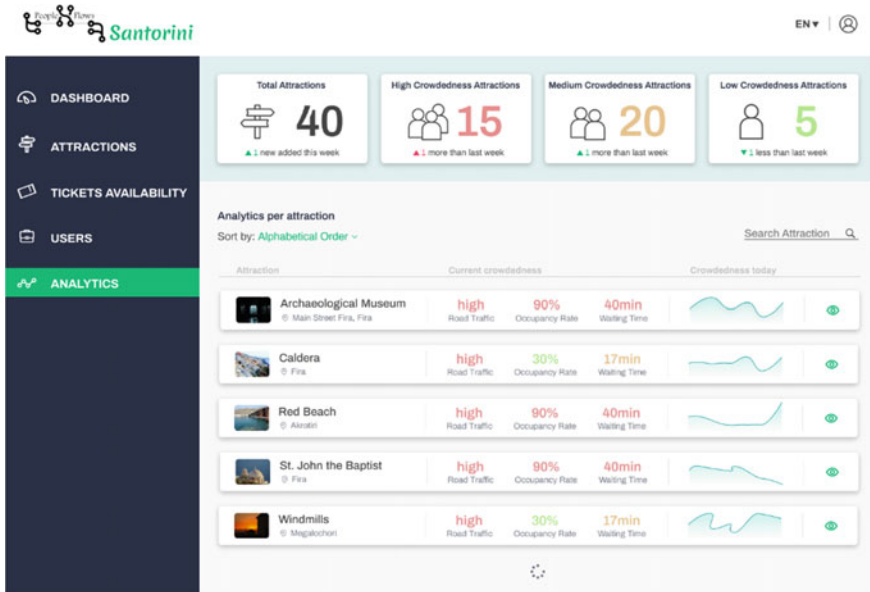
Fig. 7 Destination analytics

3.5 Ticket Issuance

This functionality (Fig. 8) is primarily used by ticket office employees of an attraction for the issuance of tickets to visitors. The user can select the number and type of tickets to be issued together with the date and time of visit. The calendar days and times of visit are color tagged in order to visually inform the user of the expected crowdedness of each available slot. A summary of the selected tickets and the final price is displayed on the right side of the screen. The user can proceed with the money transaction and printing the tickets.

4 Summary and Conclusions

The purpose of this work was to identify effective strategies for dealing with an established, but still not dealt with, issue. In order to tackle overtourism and ever-increasing numbers of tourists, tourism must be developed and managed in a sustainable manner for the benefit of both visitors and local communities. As discussed in Sect. 3, the PeopleFlows platform utilizes big data analysis, machine learning, and computer vision technologies in order to efficiently monitor and timely respond to predicted irregularities. The PeopleFlows approach features a platform for administrators, allowing them to manage ticket availability and monitor flows in their
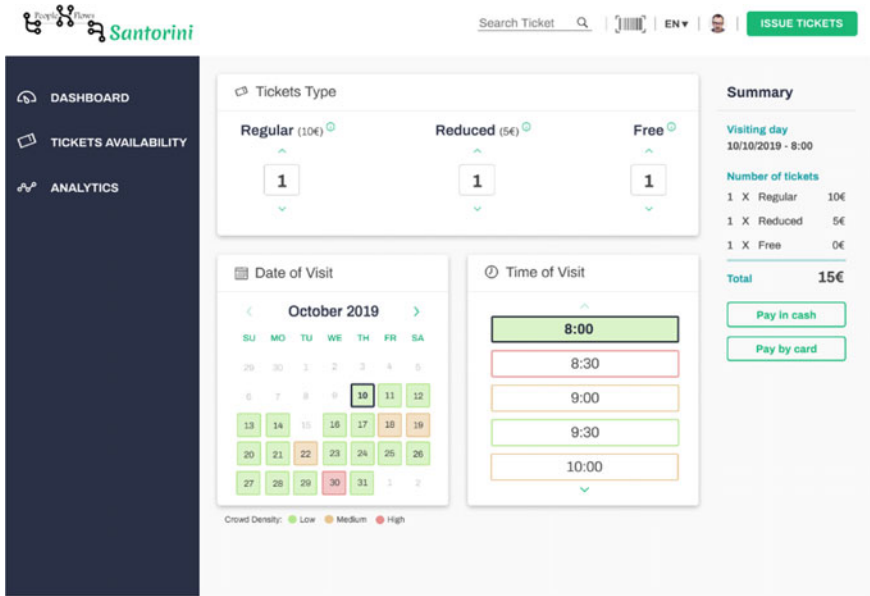
Fig. 8 Ticket issuance

venues. At the same time, an application for policymakers provides statistics for all the sights and attractions in an entire area, thus facilitating planning and decision-making. Additionally, the PeopleFlows ecosystem also features a booking platform for visitors which can guide and make recommendations based on real-time metrics and forecasted projections.

A heuristic evaluation of the PeopleFlows ecosystem has revealed a few weak points that need improvement. Pending further in-situ evaluation which is being prepared in order to investigate and test alternative use-case scenarios that will help identifying whether the proposed system can provide a viable and substantial solution to overtourism.

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Rural Tourism HUBs in University Innovation Models

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Abstract The objective of this work is to propose an innovation model for university institutions in Latin America. The model derives from the concept of fourth-generation universities and can be used in general innovation contexts. The advances in this sense are shown with the creation of a rural tourism hub for the department of Magdalena in Colombia. The methodology used consisted of a concurrent mixed research methodology for the Universidad del Magdalena in Santa Marta, Colombia. As a result of the work, an innovation model is proposed that can be applied to innovation in Latin American universities.

Keywords Territorial development · Hub · University innovation models · Rural tourism · Universities

1 Introduction

The health, education, and infrastructure sectors in numerous parts of the world, as well as in Colombia, have low indicators that have pushed them to the bottom of the rankings. As a result, these areas stand out for their cultural and environmental diversity. The conflict between natural abundance and social poverty, to some extent, is a result of various forms of violence that are part of the social problems of the regions.

In the international arena, the so-called business or third-generation universities have committed themselves to their approach to regional development. Likewise, the fourth-generation universities, from their focus on regional development, have provided great contributions to their community.

Universities have sought to contribute to the resolution of many social issues in their communities, and others have chosen to evolve into universities.

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The goal of this research is to provide an innovation model for universities that will allow them to explore ways to contribute to the holistic development of communities, and so become fourth-generation universities. The proposed innovation paradigm is based on Latin American development models, regional innovation systems (RIS), business universities, smart universities, business-focused universities, the triple helix model, technical hubs, and/or social innovation.

2 The Problem

In the international arena, demographic and technical [1] societal shifts have pushed universities to undergo a mission transformation [2]. Those who were once seen to be independent knowledge producers [3] are now seen as integrated knowledge generators who are a part of a regional innovation system [4]. Where universities play a significant role as a source of knowledge as well as a supporter of funding and collaboration among a region's various entities [5].

Because of the increasing focus of its third mission, where transfer offices, engagement with other entities, and the generation of human capital are crucial [6], the university has become regarded as an integral institution for the development of territory over time.

Colombia offers representative universities in local and regional environments, in departments with abundant biodiversity, climatic variance, and gastronomic and cultural diversity. However, these areas rank last in the country's competitiveness rankings and have a slew of socioeconomic issues that contribute to high rates of multidimensional poverty.

The high rates of illiteracy in Colombia and Latin America, as well as the poor net coverage of secondary and university education, are among the country's most pressing issues. In terms of health, the country has recently experienced high infant mortality and malnutrition rates among children under the age of five. Similarly, in the country, there is a lack of public service coverage, particularly in rural areas, where sewerage coverage is lower than required. On the other hand, there are common criminal organizations that boost the frequency of homicides in both cities and rural areas. Similarly, Colombian and Latin American regions have lower transparency than global indexes.

Surprisingly, the challenges arise in areas with abundant natural and cultural resources, as well as the presence of the country's major universities. However, a lack of development plans and an explicit link between universities and regional

development result in limited innovation, low rates of schooling, and human potential training. As a result, there is a lack of new industry formation, low productivity, and disparities in the healthcare system; it also contributes to violence and corruption. (https://www.gobernaciondelmagdalena.gov.co/plan-de-desarrollo-departamental-magdalena-renace-2020-2023-2/).

The development of university facilities and the consumption of local resources that allow these institutions to operate, according to Ruoppila and Zhao [7], has an impact on the territory in which they are located. Furthermore, according to Florida [8], knowledge transforms places, resulting in global economic importance. However, because of the way institutions are organized, their impact on regional growth is unclear. As a result, it is critical to alter university models of operation; according to Newlands [9], by doing so, universities will promote regional development by transforming them into more innovative and knowledge-generating organizations.

Universities are currently embracing open innovation methods to increase their capacity to participate in regional development, according to Meissner and Shmatko [10]. According to Etzkowitz [11], among the successful examples are the North American colleges Stanford and MIT, which have shown via their programs that knowledge can reshape places. Georgia Tech University [2], for example, pioneered the formation of a knowledge region within its area of incidence.

To comprehend the link between the university and the business sector, it is necessary to realize how the university has conceptualized regional development theory, as well as the evolution of university models based on new administrative ideas or theories. According to Huggins and Prokop [12], a representative example is the network paradigm, which arises from the relationship between the institution and many local actors, fostering regional growth.

According to the authors Guerrero et al. [13], universities in emerging countries bear a greater responsibility for the development of their regions, which is why they are concerned with transforming their model of operation and linkage, to provide stakeholders with a guide, so that education can be used as an elementary tool for regional development.

As a result of its connections with regional players, a fourth-generation University, derived from the so-called third-generation model, contributes to the development of its region.

According to Pawlowski [14], the proposed university innovation model is framed in fourth-generation institutions; it is also founded on theoretical evaluations of predecessor writers and experiences with innovation models in authorized universities throughout the country. The proposed approach aims to improve the university's connection to regional development by gaining a better grasp of the tools that can be used to support regional development.

3   Theories of the University Model

The "Regional Innovation System" concept, often known as RIS, has had an impact and importance in the implementation of regional development in a territory. Because regions have been identified as a competitive focus for companies in the global economy, a focus on regional development has emerged in the enterprises; formal and informal networks have been recognized to maintain trust between companies, to reduce costs; and physical proximity has been identified as an important factor that promotes the exchange of knowledge innovations [15].

The NIS ("National Innovation System") concept underpins the RIS concept, where the NIS and RIS are viewed as institutional infrastructures that support a region's or country's innovation. The RIS concept is primarily derived from the following sources: the general theory of systems and its application in planning systems; emerging regional policies and practical literature in the 1980s; and, finally, the concept of networked regions, which is derived from the theory of industrial districts, environmental research, and innovation systems [16].

Regional development is envisaged in this work as a component that includes human development and supports investment in small and medium-sized businesses to have a long-term impact on the region [14] and to incorporate knowledge into social and economic activities [17]. Based on the concept of Latin American or peripheral capitalism that necessitates a new production structure in which surplus production is shared with society [18].

In 2009, Carayannis and Campbell [19] presented the mode 3 innovation model, which could be highly valuable for colleges. This model incorporates systems theory elements, such as innovation networks [20]. Similarly, in this model, the university is immersed in an innovation ecosystem that emphasizes the inclusion of regional actors, as well as the community's lifestyle, values, and culture; and beneficial concepts to propose an innovation model, which allows us to understand how the university can participate in its sphere of influence.

On the other side, Kitagawa [21] presented the concept of an innovation network, which explains how regional actors might impact innovation generation and hence boost growth. Indeed, a new study has discovered that entities with strong research and development capabilities occupy core positions in innovation networks; hence, regions with universities and research centers will occupy a major position in the innovation network.

Hub a social and technological innovation tool that may be employed in new university innovation models has just been developed. These are small spaces that are technology-based and specialized; they have a strong potential to foster innovation and entrepreneurship [22], as well as meeting spaces, new goods, and community development [23].

An Innovation Hub is primarily a small physical room with laptops and furniture, such as chairs, workstations, and meeting tables that is connected via a wireless network. The London Hub, which was founded in 2005, was one of the first organizations to have the qualities of a technological and social Innovation Hub; it was

followed by the Nairobi iHub in Africa, which was founded in 2010, and is the institution that has widely used the word [24]. Similarly, new variants of the Social Innovation Hub have evolved, founded by technology-related groups with collaborations with international entities and the government [25]; on the other side, there are Living Labs [26] and the firms that require them to advertise their products [27].

The so-called fourth-generation university models, which focus on the development and transformation of their local region, have been disclosed in scientific literature. To bring about these changes, the university must adopt institutional reforms that allow for this approach [14]. Zuti and Lukovics [28] introduced the idea of regional development as the foundation for the fourth-generation university model.

In a global context, Engaged University [29] refers to universities in the United States that have gone to great lengths to actively participate in local community projects. Regional innovation ecosystems, in which universities participate under the notion of technical districts (https://minciencias.gov.co/sites/default/files/upload/paginas/pedcti-bolivar.pdf), have been proposed on a national scale.

Medellin, Colombia, is a city that has begun to promote these districts (www.distritomedellin.org); also, Route N is coordinated in this region, where meetings between the university, the corporation, and the state have been conducted since 2003. Similarly, the CIDER of the University of the Andes has contributed to Colombia for the past forty years by examining regional development [30]. To address regional inequality, it is critical to make appropriate investments in human capital [31].

4 Methodology Used

The research was conducted utilizing a contemporaneous mixed research methodology that included both a qualitative and quantitative approach. This method allows for a better understanding of the proposed innovation model for the Universidad del Magdalena in Santa Marta, Colombia, by combining a collaborative discussion of the two techniques [32]. The mixed method was applied to the topic under investigation since it aimed to build an innovation model for the institution based on the university's efforts to innovate as well as the efforts of other authorized universities in Colombia in the same vein.

The concurrent mixed methodology is defined by two independent data collection phases, with data integration typically taking place in the interpretation phase. This phase is what allows us to obtain the university's innovation model, which allows us to understand how it can contribute to regional development. A systematic examination of the literature was conducted at the start of the research, allowing for the development of a general model of university innovation for involvement as well as other features such as the hub idea, which served as a guide in the qualitative and quantitative study.

5 Proposal for a Hub-Based University Innovation Model

The university innovation model is built on the hub concept (see Fig. 1), which distinguishes it because it enables the institution to collaborate with various actors both inside and beyond the region to contribute to its development.

Other organizations are currently proposing certain characteristics of the university innovation model; for example, in Colombia, the mission of sages, in its work sessions focused on creative and cultural industries, presented the proposal of the creative incubators https://minciencias.gov.co/mision-sabios, which is similar in several ways to the university innovation model.

The proposed model is based on the metaphor of "business" architecture, which refers to a set of internal parts in the university that is interconnected for it to play its function of regional involvement1 [33]. The model is modeled after a human brain, which is made up of two sections.

Strategic leadership, administrative support, involved academics, administrative structure, technology, art/media/design, and sustainability are the first seven elements of a support area. It's worth noting that the seven aspects work together, with no one element standing out above the others [33].

The second section consists of a hub connection area that allows the institution to link with other regional development actors in a hybrid (virtual and physical) manner.
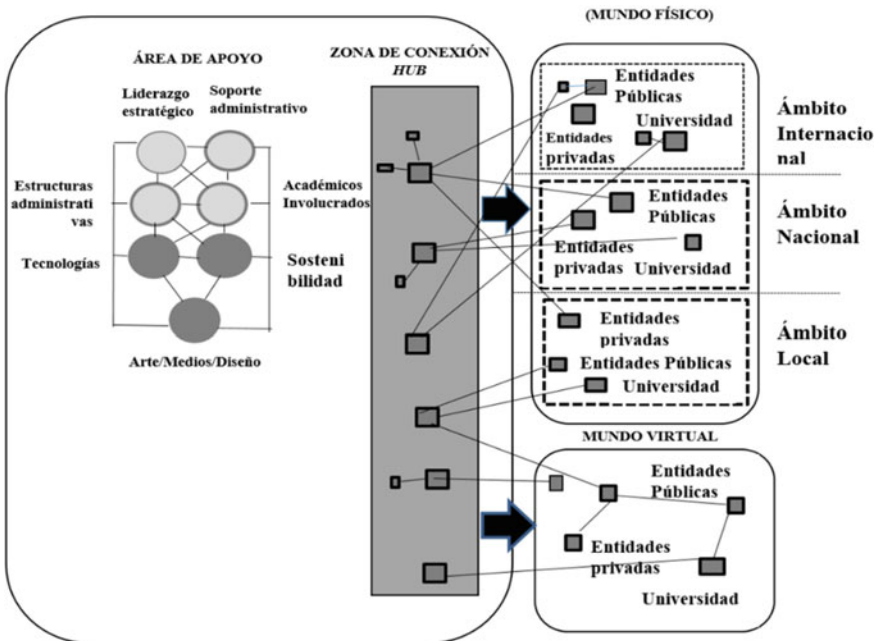

Fig. 1 A Hub-based university innovation model

One feature of the university innovation model that stands out is its goal of achieving interaction between the institution and other actors in the region's innovation system. Numerous writers [34] have proposed methods in which the university engages with various groups involved in regional development, based on models, such as the triple helix or fourth helix, through living labs, business incubation networks, or online, through open innovation platforms.

The concept of the Innovation Hub, with its various approaches, is an important part of the proposed innovation model. The approach to the concept of innovation centers [23], which are locations or social communities that are distinguished by being safe places for ideas to be recognized and carried out, also stands out. Entrepreneurs and/or innovators are given support in the form of market information, techniques, and trends, as well as practical resources and tools; also, these innovation centers serve as a haven where mistakes can be made.

The elements found in the innovation model are similar to those found in the proposal made for Colombia's cultural and creative industries by the mission of wise men (minciencias.gov.co/mission-sabios), in which the need is emphasized to strengthen spaces that promote cultural work, such as cultural houses, creative nurseries, and similar sites; as well as identify and strengthen association networks, and promote the link between the government, industry, and the public sector. These places will constitute a network of nodes that will go beyond the renovation of architectural sites, allowing citizens to integrate, imagine, and be open-minded.

The strategy for creating a network of creative incubators is based on the quadruple helix relationship models for the creative and cultural sectors. This basket network will be made up of nodes, each of which will have three sections or spaces: a creativity laboratory, a cultural or creative enterprise incubator-accelerator, and a public center with a year-round program of distinctive cultural activities.

6   Rural Tourism Hub

The University of Magdalena has approached the concept of an Innovation Hub by establishing laboratories for innovation, such as the herbarium, which houses plants from the "Mutis" botanical expedition, the biological collections center (CBUMAG), an "Aula Viva," which houses a permanent plot of Tropical Dry Forest (BST), and the video-on-demand platform "videosferas.com," which features audiovisual content created by teachers, graduates, and students. There is also a museum network, which includes the Gabriel Garcia Márquez House Museum in Aracataca—Magdalena, the art museum of the San Juan Nepomuceno cloister, and the Campus, which has been converted into a museum. In the year 2020, Magdalena's first and only laboratory was equipped and certified to take Covid samples. Murunmuke, El Banco, Algarrobo, and El Congo are four digital offices located in different parts of the department of Magdalena. (https://www.unimagdalena.edu.co/Publico/acreditacionInstitucional).

The "Aven Hub Magdalena," a rural tourism hub based on the university's innovation paradigm, is a key project in which the university participates. This aims to

promote adventure and environment tourism offered by communities in the department of Magdalena, relying on technology and digital media to ensure that tourism becomes more than just a series of trips and instead becomes a quest for new experiences. Similarly, it is hoped that these Magdalena locations will become smart tourist destinations to improve the quality of the visitor's experience and stay, and to achieve this goal, some of these municipalities will be provided with new and cutting-edge technologies.

7   Conclusions

The proposed innovation paradigm for universities is centered on a commitment to contributing to regional development. This is accomplished by collaboration with various regional actors, as is the case with fourth-generation universities [18]. The suggested innovation model consists of seven linked subsystems with Innovation Hub architectures that enable open invention and the availability of hybrid places that foster creativity.

This approach enables the institution to determine the best organizational structure for itself, as well as how to integrate and contribute to the development of its region. The innovation model is based on characteristics of contemporary innovation models, which are used by a variety of organizations that want to contribute to a region's growth.

The literature was thoroughly examined to discover existing trends that link universities to regional development to create a proposal for an innovation model directed at universities. Similarly, the factors that must be incorporated for the innovation model to be relevant in regional development and its interactions with other players were studied.

Using the business university model [35], it was discovered that various critical elements influence business ties and regional involvement with the university [14, 36, 37]; hence, the work innovation model was proposed.

Similarly, while doing the literature study, concepts such as fractal network architectures [19], hub nodes [38], and social innovation [39] were identified as complements to the university innovation paradigm.

Support for the university's involvement in the region, the hub network that facilitates integration with the region, and the virtual representation of the hub that provides more flexibility and interaction with other international, national, or local players make up the university innovation model.

The proposed innovation paradigm follows recent international theoretical suggestions that incorporate open innovation and virtual collaborative platforms. The proposed innovation model incorporates features that are comparable to those provided by Colombia's wise mission, which supports the formation of creative nurseries, in terms of the business environment.

A university must be able to commit itself to the development of a region to have support subsystems; as a result, a future research project would be beneficial

to investigate the regulations of higher education in Colombia, which may act as a barrier or an obstacle for universities to have a greater possibility of integration with the territory; that is, they are of the fourth generation.

The hub is an important conceptual element in the suggested innovation model for a university because it allows the institution to interact with various players involved in regional development and contribute promptly to the region's development responsibilities. However, in this work, a specific design and structure of the hub are provided, which will serve as a basis for future research into numerous variations of the hub that can be used in universities and other institutions.

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Coordination Mechanism of Stakeholders in Tourism Destinations: A Social Network Analysis Exploration

Yewei Shang, Montserrat Pallares-Barbera, and Francesc Romagosa

Abstract The relationship between stakeholders is intensive and complicated, thus, understanding the relationship between stakeholders is important for the successful management of tourism destinations. To make it viable, this paper applies network analysis and third party in stakeholder theory and explores the interest coordination mechanism of stakeholders by quantitative method. Based on the fieldwork undertaken in the Hangzhou West Lake Heritage Site (World Heritage Site) from June to September in 2018, it systematically investigated the identification, classification and interests of stakeholders. The data collection method comprised an expert panel ($n = 29$) and a stakeholder survey ($n = 274$) in finding the classification and interest of stakeholders in the most scenic spot at the Hangzhou West Lake Heritage Site, China. The results suggest two main findings: each stakeholder has a different kind of interests and these interests are hierarchical; stakeholders play different roles in the relationship network and lead to unbalanced relationships, which one party has a relationship of constraints or dependencies on the other party. Based on the findings and further, a coordination mechanism is proposed by the application of the third party as a coordinator in the social relationship network for destination tourism management.

Keywords Stakeholders · Relationship · Third party · Coordination mechanism

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1   Introduction

Relationships between stakeholders have been an important issue when addressing problems within sustainable tourism management. And generally, stakeholders are accepted as six categories in tourism issues: tourists, industry, local community, government, special interest groups and educational institutions [1]. The complexity of relationships between stakeholders includes cooperation, partnership, and conflict [2]; various studies have attempted to explore and explain the relationships. Some studies have been designed to understand the identification of stakeholders by analytical dimensions [3], others have been attempted to capture attitudes and perceptions held by stakeholders combined with their characteristics and interests to explain the territory within a case study, and the scope and intensity of cooperation [4], attitudes of local people to tourism on heritage sites, the benefits gained and the impact of local identity on heritage tourism [5].

The relationship between stakeholders and heritage tourism is intensive. Even though the study of heritage tourism in China began in the 1990s and experienced a boom in the past decade [6], few studies have explored the interest coordination mechanism among stakeholders in-depth, perhaps due to the complexity of relationships between stakeholders and heritage tourism.

Therefore, Hangzhou West Lake, as a UNESCO World Heritage Site in China, is selected as a case study, to deeply understand the interests of different stakeholders and their attitudes and perceptions in cultural heritage tourism. Because some problems exist in the sustainable development of West Lake heritage tourism, mainly fascinated in four parts: the common phenomenon of overcrowding in the heritage site and West Lake water pollution incident; narrow approach of the decision-making process; Over pursuing economic interests; the inauthenticity of the heritage site.

As the relationship between stakeholders could evolve in dynamic situations and the evolutionary path could be bi-directional, network analysis is a prerequisite in discussing the complicated relationships between stakeholders in tourism studies [7]. It can be a tool to describe the structure of links between given entities (namely nodes) and applies quantitative procedures to map and analyse relationships among nodes. It is these overarching patterns of relationships or "ties" that offer insights into the network architecture and its relational data [8]. The network of tourism activity is, therefore, shaped by the stakeholders, (nodes), and interactions, (ties), and shows as a network whereby a web of stakeholders establishes relationships among themselves. It is useful in visualising and simplifying relationships with the purpose of effective collaboration among stakeholders. Furthermore, third parties participate in the role of "sending" and "receiving" who form exchanges, which is an effective coordinator in the relationship network.

2 Literature Review

2.1 The Definition of Stakeholders

The concept of stakeholders is widely known through Freeman's Strategic Management: A Stakeholder Approach, which is defined as a significant component of an organisation's environment [9]. In the tourism industry, stakeholders refer to those groups or individuals who can affect or can be affected by tourism development initiatives [10]. Considering the various stakeholders, it is increasingly important to categorise who should be stakeholders and who are genuine stakeholders. Generally, there are six accepted categories: tourists, industry, local community, government, special interest groups and educational institutions [11, 12], and it can be varied in different tourism contexts (see Fig. 1).

Relationships between stakeholders have been an important issue when addressing problems within tourism management. Although conflict theory has formed the basis of most of the studies of relationships between tourism and other sectors, it may not be the most appropriate framework, since the complexity of relationships between stakeholders includes cooperation, partnership and conflict [13, 14], it studies the identification of stakeholders by analytical dimensions; attitudes and perceptions held by stakeholders combined with their characteristics and interests to explain the territory within a case study, attitudes of local people to tourism on heritage sites, the benefits gained and the impact of local identity on heritage tourism, and the scope and intensity of cooperation. Meanwhile, Mckercher et al. [15] argue that the relationship between stakeholders could evolve in dynamic situations and the evolutionary path could be bi-directional (positive to negative or negative to positive).

Scholar	Classification
Robson J, Robson I (1996)	Tour Operator; Government; Media Organisations; Transport Provider; Employees; Regional Tourist Board; Hotelier; Travel Agents; National Tourist Organisations; Local Business
Markwick (2000)	Tourists; Industry; Local Community; Government; Special Interest Groups and Educational Institutions
Winn (2001, p.135)	Employees; Customers; Shareholders; Communities; Suppliers; Public Interest Groups; Media; Regulators
Ryan (2002)	Employees; Tourism Corporate; Central Government; Tourists; Residents; Agencies; Pressure Groups; Media Organisations
Murphy P, Murphy A (2004)	Customers; Industry; Residents; Government

Fig. 1 The classification of stakeholders

2.2   Stakeholders and Heritage Tourism

The relationship between stakeholders and heritage tourism is intensive. Nana Ato Arthur and Victor Mensah [16] developed the strategy of Elmina Cultural Heritage and Management Programme strategy, which confirms and emphasises the importance of local participation for a sustainable strategy. Since heritage is considered as a dynamic and multi-purpose resource, which can be transformed for a diverse audience, the involvement of various stakeholders is necessary. Successful cultural heritage tourism requires stakeholders have both a realistic perception of the heritage asset and a desire to conserve its core value, its legitimate interests are accepted and its role in promoting cultural tourism is defined [15]. Also, the decision of heritage tourism's management cannot be only from a top-down perspective, which reflects the "expert's view"; it should be reflective of the stakeholders who represent the public's interests [17]. Public policy managers can improve their understanding of potential stakeholders' responses by nurturing different levels of involvement and on-going support [18], so stakeholders' theory can be shown as a democratic behaviour of community participation or public involvement in policy development.

Not all the stakeholders, however, have the same level of knowledge about the protection of heritage tourism; therefore, stakeholders have to be educated on heritage tourism and the distribution of power in the decision-making process should be slightly different by focusing more on the core stakeholders. Different views from multiple stakeholders can also cause complexity and difficulty in stakeholder collaboration and management [19]; cooperation between stakeholders is fundamental to the sustainable tourism industry. This is defined as community-based tourism planning of an inter-organisational, community tourism domain to resolve planning problems of the domain and/or to manage issues related to the planning and development of the domain. This is an incentive strategy for all stakeholders to have the responsibility to manage issues of tourism development within the community; also, it allows the community to have a clear understanding of its perceived tourism impacts and the actual tourism impacts that result from tourism. Aas et al. [20] explore five aspects: channels of stakeholders' communication, heritage income-generating, local community's increase in tourism activities, an assessment of the extent and success of stakeholder collaboration, to promote collaboration between heritage conservation and tourism through stakeholder involvement.

3   The Case Study of Hangzhou West Lake

West Lake, located in Hangzhou, the capital of Zhejiang Province, is one of China's World Heritage Site. It enjoys a reputation as "paradise on earth" in Chinese poetry, and it is well known for its rich cultural landscapes and historical relics [21]. Although the West Lake pattern has achieved success in Hangzhou, there are still some problems in the sustainable development of West Lake heritage tourism. Firstly, there is

the common phenomenon of overcrowding in the heritage site (see Fig. 2); on the one hand, it implies that tourists lack awareness of the necessity to protect heritage tourism, simply motivated by a free ticket, and on the other hand, government lacks the proper strategies to handle the excessive number of tourists. This can also be seen in the West Lake water pollution incident. In February 2013, Hangzhou West Lake Scenic Area became a swamp and West Lake became a sewage pool. A large part of the sewage came from hotels in the scenic area and polluted the wells. The management department explained that due to the rapid development of tourism, the water consumption of the West Lake Scenic Area had exceeded the capability of the sewage system, indicating that local community management could not properly deal with the relationship between sustainable tourism development and a cultural heritage site. Secondly, there is the narrow approach of the decision-making process. Wang and Bramwell [22] consider policy-making for heritage protection and tourism development through the implementation of two schemes called Mei Jiawu and Leifeng Pagoda, finding Hangzhou's local state and mayor to be powerful players in relation to West Lake, particularly when civil society organisations remain weak in China. Key decisions for policy priorities were also made by a fairly restricted and powerful "policy community" of city government individuals. It is inevitable that government, as one of the core stakeholders, is concerned about tourism development, but their main interests was to use the heritage resources to promote the city's image or promote tourism-related economic development. They perceive that the goal of heritage tourism is to help achieve a higher GDP at a local or national level, and many other stakeholders who are involved in heritage tourism such as tourists, local community and tourism retailers have little power in the decision-making process.

Fig. 2 The broken bridge at West Lake heritage site in Hangzhou

Thirdly, local residents tend to pursue their own economic interests, like the infringement of the construction of rural settlements in heritage sites and the deforestation tea incident. Local villagers gradually built houses and illegally invaded green space in order to serve tourists, creating farmhouses, teahouses and small restaurants. In addition, since the rapid development of tourism, the price of tea and tea sales have increased significantly, with some migrant workers carrying out land reclamation and deforestation to make tea bases, even though the degree of deforestation that is taking place is destructive. This shows local residents lack the awareness of sustainable heritage tourism development. Fourthly, the authenticity of the heritage site was changed due to the increasing fame of the Mei Jiawu tourism brand and the possibility of making profits; the indigenous people moved out and rented their houses to outsiders, so most of the teahouses are now run by outside operators [23]. The original lifestyle of local residents was also influenced by an increasingly large number of tourists, which also threatened the rural tourism brand of Mei Jiawu and destroyed the cultural experience of tourists.

4 Methods and Results

4.1 Methodology and Data

Although sustainability is generally a goal or aspiration, many scholars have tried to measure sustainability from a stakeholder's perspective by quantitative ways and put forward a framework or model [10, 24]; and unsustainable problems exist, as shown by the case study, which are caused by the complicated relationships between stakeholders, so the construction of the methodology aims to coordinate stakeholders' relationships to achieve sustainability. The methods of network science can prove highly beneficial in broadening the knowledge of stakeholders by translating the physical interpretations into the language of social science, so this framework relies on the method of network analysis with an application to the field of tourism studies. It emphasises that the understanding of relationships is of essential importance to network analysis. To explore the relationship in depth, the initial step is to consider who the stakeholders are and what really counts [25]. Byrd [26] also states that the identification of stakeholders and the method of involving stakeholders are two main issues that should be considered, based on Donaldson and Preston's three aspects of stakeholder theory, however, the attributes that stakeholders should possess are unclear, Mitchell et al. [27] contribute to the theory of stakeholder identification and salience based on stakeholders possessing one or more of three relationship attributes: power, legitimacy and urgency. Chen and Jia [28] adopt a multi-dimensions' classification method and Mitchel's score-based approach to classify ten stakeholders in Chinese enterprises by three dimensions called active tendency, importance and urgency. It deepens people's understanding of stakeholders and encourages relevant
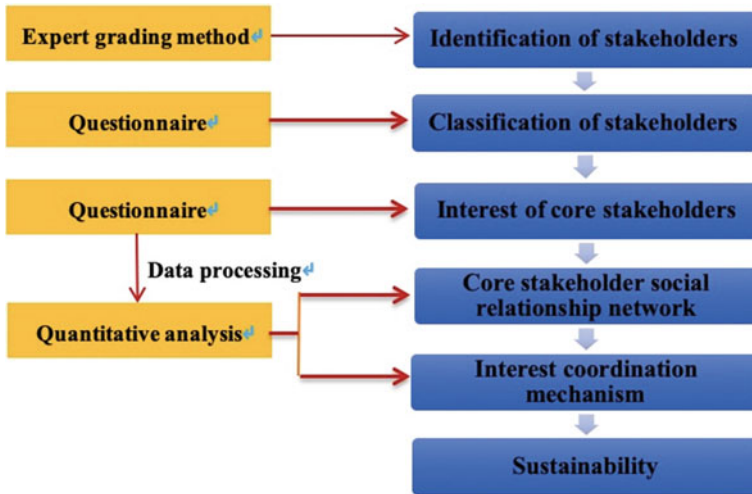
Fig. 3 Framework of resolving conflicts in the protection of World Heritage sites

agencies to use effective measures to manage stakeholders. Based on the literature review, the design of expert grading and a questionnaire is shown in Fig. 3.

The method of expert grading and questionnaire design are considered most appropriate for this framework. The first step is identifying stakeholders by the expert grading method, because it is widely used for consulting, processing and analysing relevant experts' opinions due to experts' rich fieldwork experience, close connections with local stakeholders and familiarity with each stakeholder's interest, which can quickly and effectively identify stakeholders at the West Lake Heritage Site. It is conducted by inviting experts to select the relative stakeholders of the West Lake Heritage Site according to their perceptions and the actual situations, the list of possible stakeholders is provided by Hangzhou Tourism Commission. A questionnaire is used at the second and third stages by using Likert-type questions as attitudinal measurement tools. Specifically, interviewees from the West Lake Heritage Site can show their approval of attitudes towards different stakeholders' involvement in the heritage site by five alternative responses: totally agree, agree, unsure, disagree, and totally disagree. The next step is classifying stakeholders by finding core stakeholders at the West Lake Heritage Site, because some relationships need attention while others do not, which calls for a "normative core", so the set of questions are based on the theory of "Mitchell Scoring" analysis [27] and Chen's three dimensions [28], comprising initiative, importance and urgency to classify stakeholders. There are three main questions, namely:

1. Initiative: Does your organisation actively exert an influence on the West Lake Heritage Site by taking initiatives to undertake tourism development of the scenic spot?

2. Importance: Is your organisation indispensable to the tourism development of the West Lake Heritage Site?
3. Urgency: If the interests of the organisation cannot be met quickly, will it affect the normal operation of the West Lake Heritage Site?

Collecting and analysing interests of core stakeholders, follows, especially focusing on their specific order of interests. Due to the varying importance of stakeholder interest, it is suggested that methods be adopted to solve the prior interests. This method could accurately grasp core stakeholders' primary interests in different situations, which can better balance the interests of stakeholders.

4.2   Data Collection and Analysis

The major data-gathering activities were performed in August 2018; they were designed as a purposive sampling, a type of non-probability sampling that studies a certain domain involving knowledgeable experts. The question posed to relative stakeholders is of the utmost importance for managing stakeholders, so the expert grading method was conducted by inviting 12 experts from Zhejiang University, Hangzhou Normal University, Zhejiang Academy of Tourism Sciences and Tourism College of Zhejiang China, along with 17 experts from the Hangzhou Tourism Commission, Hangzhou West Lake Scenic Spot Management Committee, Hangzhou Shangri-La Hotel and Hangzhou Tourism Association. The stakeholder questionnaire was distributed at the main areas of West Lake Cultural Heritage Site, namely the Broken Bridge, Su Causeway, Mei Jiawu and Leifeng Pagoda. After eliminating those that were incomplete, a total of 300 questionnaires were delivered and 274 effective ones were recalled with a response rate of 91.3%.

As for measuring attitude with Likert-type items in the questionnaire, it is hard to transfer these qualities into a quantitative measure for data analysis. Descriptive statistics are used to describe or summarise quantitative data, which is recommended for interval scale items and a prerequisite for understanding evaluations. It includes the mean for central tendency and standard deviations for variability [29].
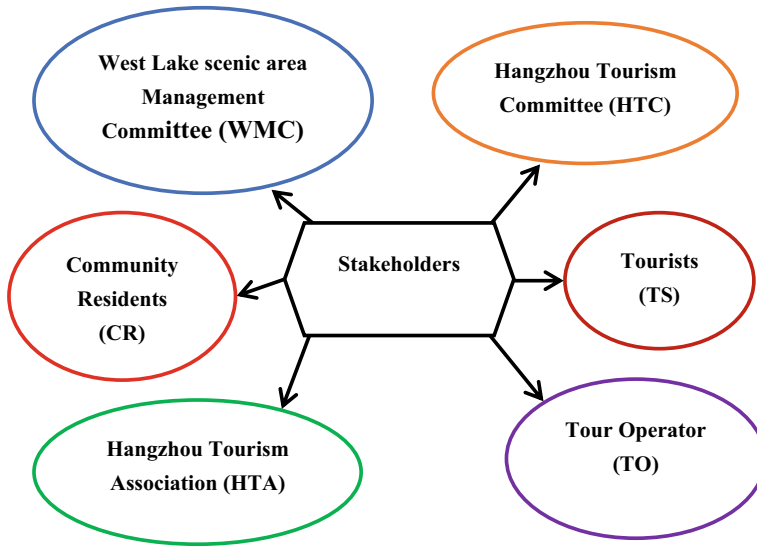
4.3   Results and Findings

The identification of stakeholders is conducted by the expert grading method and the statistical results are shown in Table 1. The high grading rate is a criterion for the choice of stakeholders, since it is highly approved by experts who have rich fieldwork experience and professional knowledge. Considering the West Lake Scenic Area Management Committee, tourism operators and tourists, the grading rate is 100%, indicating that these three stakeholders are recognised by all experts. The community residents' grading rate is 82.8%, owing to the government's policies in

encouraging community residents to move out of their homes. It has not attained 100%, but there are still a large number of indigenous residential settlements in the West Lake Heritage Site such as Mao Jiabu and Mei Jiawu, which work as tour operators to provide support services such as farmhouses or teahouse catering. Hangzhou Tourism Committee and Hangzhou Tourism Association do not have high grading rates, accounting for 75.9% and 58.6%, respectively, which is over 50%. They not only provide theoretical guidance on the development and protection of West Lake Heritage tourism, but also act in the role of supervisor. These two groups are considered to be relative stakeholders by many scholars, Hangzhou Tourism Committee and Hangzhou Tourism Association are also considered as stakeholders. Competitors, special interest groups, volunteers, the media and educational institutions have relatively low grading rates of below 50%, which means they cannot be thought of as relative stakeholders.

Accordingly, six groups are selected as relative stakeholders of the West Lake Heritage Site, including the West Lake Scenic Area Management Committee, tour operators, tourists, community residents, Hangzhou Tourism Committees and the Hangzhou Tourism Association. The basic map of stakeholders in the West Lake

Table 1 Statistical results of expert grading method defined by stakeholders in West Lake heritage sites

Method	Population sampled (Total = 29)	Stakeholders category	Number of identified stakeholders (N)	Grading rate (N/Total) (%)
Expert questionnaire and grading	29 experts from local universities and tourism institutions with years of tourism heritage management experience and academic research	West Lake Scenic Area Management Committee	29	100
		Hangzhou Tourism Association	17	58.6
		Tour Operator	29	100
		Competitor	11	38
		Community Residents	24	82.8
		Media	12	41.4
		Tourist	29	100
		Hangzhou Tourism Committee	22	75.9
		Volunteer	7	28
		Special Interest Groups	10	34.5
		Educational Institutions	5	17.2

Fig. 4 Basic map of stakeholders in West Lake heritage sites

Heritage Site is based on the results of the expert grading method, which is shown in Fig. 4.

The classification of stakeholders considers core stakeholders should possess three attributes: initiative, importance and urgency. Initiative means stakeholder have a positive attitude towards the heritage tourism development; importance means different stakeholders have different impacts on tourism, some stakeholders are indispensable while others are not; urgency calls for immediate attention, these stakeholders are also time-sensitive and their relationship or claim is important or critical to stakeholders. As for Likert-type questions with five alternative responses, the average score of four and five represents agree or totally agree, respectively, so that core stakeholders should have an average score over four. The standard deviation measure, used to quantify the amount of variation or dispersion, can show precisely the variation of results. According to this standard, the West Lake Scenic Area Management Community (WMC), Tourism operator (TO), Community residents (CR) and Tourists (TS) got average score over four at all these three dimensions. Besides, they have a steady performance in relation to these three dimensions according to the low standard deviation, which will be perceived as being core stakeholders. The Hangzhou Tourism Community and the Hangzhou Tourism Association, however, cannot be considered as core stakeholders due to low scores (below 4) in dimensions of importance and urgency, and do not seem to have any clear relationship attributes. Notably, the WMC get a highest average score for initiatives and a low standard deviation. This is consistent with the fact that many participants who are government officials or are in government positions can be generalised as being stakeholders [26], because

Table 2 The average score and standard deviation of stakeholders from "Mitchell Scoring" analysis

Dimension	Statistics	WMC	TO	CR	TS	HTC	HTA
Question 4: Initiative	Average	4.31	4.04	4.12	4.07	4.01	3.85
	Standard deviation	0.467	0.501	0.578	0.523	0.621	0.512
Question 5: Importance	Average	4.18	4.10	4.11	4.26	3.88	3.75
	Standard deviation	0.536	0.489	0.562	0.578	0.498	0.593
Question 6: Urgency	Average	4.02	4.08	4.06	4.14	3.7	3.63
	Standard deviation	0.576	0.498	0.519	0.537	0.587	0.613

those groups of people have the power to regulate the scenic spot and perceive that tourism can have a positive impact on the community.

The results in Table 2 indicate that the interests of all stakeholders are different and have a hierarchical structure. According to rank of interests based on Likert scale, the tour operators' first interest is pursuing high returns (4.01), and its fourth interest is protecting the resources and environment (3.57). Community residents, whose first interest is improving the environmental quality (4.22), have the least interest or initiative (3.91) in participating in the management of the Hangzhou West Lake Heritage Site. Tourists, whose second interest is pursuing a high-quality tourism experience (4.28), care more about the rationality of the price of the tourism products (4.35) and care less about protection of the environment (3.84).

It is important for constructing the social network of coordination mechanism, as stakeholders making decisions, higher level of interest appeal should be considered first, which directly dominates the conflict or harmony of interest relations. The purpose of stratifying each stakeholder's interest structure is to grasp the main factors affecting the social relations among stakeholders and to simplify the social relations among stakeholders through the analysis of these high-level interests. Next, these hierarchical interests will be analysed and discussed, on the one hand, to identify all stakeholders related to individual interests and, on the other hand, to elaborate on the social relations between them.

The classification of stakeholders helps to identify who the core stakeholders are among various stakeholders. This is of central importance because different stakeholders have different aims or interests in the practice of stakeholder analysis. Understanding the interests of each stakeholder is of great significance for sorting out the relationships among stakeholders, resolving conflicts of interest and enhancing cooperation.

According to Table 3, the tour operators' first interest is pursuing high returns (4.01) and its fourth interest is protecting the resources and environment (3.57). This indicates that tour operators primarily care about profits and are less likely to protect resources and take initiatives to benefit local community residents. In contrast, community residents, whose first interest is improving the environmental quality (4.22) and whose second interest is improving their own economic conditions (4.18), have the least interest or initiative (3.91) in participating in the management of the Hangzhou West Lake Heritage Site. This is because the scenic spot is the permanent

residence for communities, their survival needs are to protect the local environment and care for the resident place. As a direct management department, the West Lake Scenic Area Management Community's first interest is to improve local economic conditions (4.22) with the subsequent purpose or responsibility of achieving the prosperity of tourism. This is related to the policy of the local government, because Hangzhou is a relatively developed city in tourism industry, tourism has become a benchmark to examine the performance of the government. The sustainable use of resources (4.15) and the promotion of local harmony (4.15) are the second interests considered by the management department. Since government departments have a responsibility to promote social harmony and stable development of scenic spots. Tourists, whose second interest is pursuing a high-quality tourism experience (4.28), care more about the rationality of the price of the tourism products (4.35) and care less about protection of the environment (3.84). It can be explained that, tourists, as the main consumers of the scenic economy, are directly driving the development of tourism. The good experience of natural scenery, transportation facilities, humanistic feelings and satisfaction with the price of tourism products directly restricts the amount of tourist flow and affects the destination image of the scenic spot [30].

Table 3 Rank of interests of the core stakeholders at the West Lake heritage site

Stakeholders	Rank of interests based on Likert scale[(score)]
Tour operators (TO)	No. 1: High returns[(4.01)]
	No. 2: Long-term survival and sustainable development[(3.88)]
	No. 3: Pursue a good image of West Lake heritage site[(3.79)]
	No. 4: Protect the resources and environment[(3.57)]
	No. 5: Benefit local community residents[(3.33)]
Community residents (CR)	No. 1: Improve environmental quality[(4.22)]
	No. 2: Improve own economic conditions[(4.18)]
	No. 3: Pursue sustainable development[(4.16)]
	No. 4: Want to participate in management[(3.91)]
West Lake scenic area management community (WMC)	No. 1: Improve local economic conditions[(4.2)]
	No. 2: Promote local social harmony[(4.15)]
	No. 3: Pursue sustainable use of resources[(4.15)]
	No. 4: Improve local tax[(4.01)]
Tourists (TS)	No. 1: Focus the rationality of the price of tourism products[(4.35)]
	No. 2: Pursue high-quality tourism experiences[(4.28)]
	No. 3: Focus on safety and environment[(3.89)]
	No. 4: Protect the environment[(3.84)]

In short, the interests of all stakeholders are different and have a hierarchical structure. Higher level of interest appeal is the core factor that stakeholders should first consider when making decisions, which directly dominates the conflict or harmony of interest relations. The purpose of stratifying each stakeholder's interest structure is to grasp the main factors affecting the social relations among stakeholders, and to simplify the social relations among stakeholders through the analysis of these high-level interests. Next, these hierarchical interests will be analysed and discussed, on the one hand, to identify all stakeholders related to individual interests and, on the other hand, to elaborate on the social relations between them.

5 Analysis and Discussion

5.1 The Core Stakeholder Social Relationship Network

The linkage of interests among various stakeholders constitutes a complex social network relationship. Its complexity can be analysed from two perspectives. Each stakeholder has different kinds of interests and these interests are hierarchical in order; stakeholders play different roles in the relationship network and lead to unbalanced relationships, in which one party has a relationship of constraints or dependencies on the other party. These two aspects will be analysed, respectively, as follows.

On the one hand, each stakeholder has different kinds of interests and these interests are hierarchical in order. A complicated relationship can exist when different stakeholders share different interest goals or appeals. Regarding tour operators and tourists, for example, tour operators aim to gain high returns from tourists, whereas tourists are sensitive about the rationality of the price. Also, tour operators can provide community residents with job opportunities but the excessive pursuit of high profits could harm sustainability, such as the West Lake water pollution incident. Based on the basic idea of the analytical hierarchy process [31], decision-makers should model and quantify the decision-making process of complex systems, thereby breaking down complex problems into different levels and different influential factors. This paper adopts the Saaty's analytic hierarchy process theory, it first stratifies the interests of each type of stakeholder and distinguishes the first, second, third and fourth interests. The purpose of hierarchical interest claims is to screen out the core interests of stakeholders. In the following analysis of stakeholder relationships, first and second orders of interests are considered as core interests of stakeholders, ignoring other levels of interest.

On the other hand, as a single interest of a stakeholder, not all stakeholders, are related to it. But if there are stakeholders associated with this interest, the mutual relationships of constraints and dependencies could exist between them. This is due to the direction of the flow of interest, because the interests always flow from one party to the other and the other directly interests. For example, the first and second

orders of interests of the tour operator are the pursuit of high profits and long-term survival, which are mainly related to the consumption levels of tourists, of items such as accommodation and tickets. It can be stated that the consumption status of tourists directly determines the core interests of operators. Since tourists constitute a direct constraint on the tourism operators, the core interests of tourism operators (high profits) are strongly dependent on the consumption of tourists. On the other hand, the tour operator has an active influence on tourists, which is reflected in the rationality of the prices of tourism products. The first and second orders of interests of tourists come from tourism products at reasonable prices and of reasonable quality. However, a high-quality travel experience depends more on the value and management of tourist attractions which is not entirely determined by tour operators [32]. Although there are interrelated relations between stakeholders because of certain interests, therefore, the relationships of constraints or dependencies between one party and the other party are not equal, which, in fact, leads to the imbalance of the interest relationship between the two parties.

Based on the above analysis of the relationship between stakeholders, in order to effectively describe this relationship between two stakeholders, the relationship between the two stakeholders is divided into a strong constraint and weak constraint relationship, they are represented by Level A and Level B, respectively. Also, the two stakeholders are connected by arrows, and the direction of the arrow indicates that one party has constraints on the other. For example, according to the relationship of interests between TO and TS analysed above, TO's interest impacts on TS, referred to as Level A, conversely, TS's interest impacts on TO referred to as Level B, as shown in Fig. 5. This is because the core interests of TO mainly depend on the consumption of tourists, and TS constitutes a strong constraint on TO. However, the core interests of TS are the consumer experience and the quality of travel experience, which are not entirely dependent on TO's decision, as analysed above.

Similarly, this can be seen in the relationship of interests between tourists (TS) and the West Lake Scenic Area Management Committee (WMC). The WMC is a government department, and its first and second order of interest is to improve local economic development of the scenic area and promote social harmony. As the most important consumer at tourist attractions, tourists are the main source of income at the scenic spot, which directly drives local economic development. When the interests of tourists are not satisfied, there is a decrease in the consumption power of the scenic spot, and an increase in the number of tourist complaints to scenic spot managers [33]. It can be seen that tourists (TS) have a strong constrained influence on the

**Fig. 5** Interest flow relationship between two stakeholders
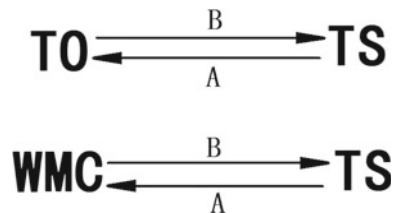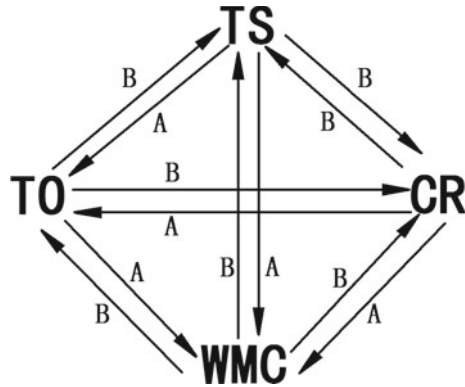
core interests of the WMC, labelled A in Fig. 5. The WMC, as a management and regulation department, provide more services and guidance for tourists [34]. This has a weak influence on the interests of tourists. In the same way, through the analysis of the relationship between two interests of the four core stakeholders, a social network relationship diagram of the stakeholders can be obtained, as shown in Fig. 6.

5.2 Design of Interest Coordination Mechanism of Stakeholders

The design of an internet coordination mechanism for stakeholders is based on the core stakeholder social relationship network. This is constituted by the strong and weak constraint relationship between two stakeholders, namely Level A and Level B, respectively. For simplifying the complicated relationship and effectively managing stakeholders, according to the basic idea of the analytical hierarchy process [31], it is suggested that considering only the strong influences represented as Level A. The interests of all stakeholders are hierarchical and decision-makers should give priority to the highest order of interest. After eliminating the weak influences of Level B, the coordination relationship network is more simple and clear. As long as unsustainable problems exist, the approach is to identify the core stakeholders and consider the determining factors of the relationship between these two stakeholders. An example of the coordination mechanism between TO, TS and WMC follows (see Fig. 7), which is taken from Fig. 6 and can help explain how the coordination mechanism works between stakeholders.

A professional decision-maker, in the coordination relationship network, is necessary to quickly identify the core stakeholders and coordinate the unbalanced constraint relationships between relative stakeholders. As such, the role of a third party (3P) is proposed, as an important and unique role in a central position in the coordination map. The use of a third party as an effective regulatory mechanism has been highly promoted and applied in many industries, there is a suggestion

Fig. 7 Coordination
relationship network
between stakeholders
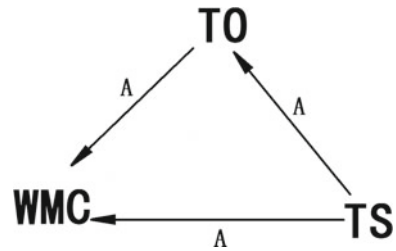
of third-party certification and labelling initiatives to enhance environmentally and
social sustainability [35]. Considering the 3P is important in the coordination map,
it should have multiple functions: it could be a "mentor" such as a local authority or
intermediary body, who can manage and coordinate the industry. It could work as a
"federator", which is of prime importance in uniting enterprises in common action.
It could function as an "umbrella", as with professional associations, since profes-
sional associations are legitimate "representatives" and have the power to normalise
and sanction [36]. As for choosing an appropriate third party, however, this depends
on what the company expects from a third party and whether the third party has the
ability to meet its goals [37].

According to the above analysis, there is a complete map of the coordinating rela-
tionships network (see Fig. 8), which takes TO, TS and the WMC as examples and
proposes a possible co-ordinated solution. Specifically, tourists (TS) directly affect
the interests of tourism operators (TO) and the West Lake Scenic Area Manage-
ment Committee (WMC). TO directly affect the interests of the WMC with a strong
impact of Grade A, so TS is the dominant party in the coordination relationship
network. As previously analysed, the third party (3P) must first consider the interests
of TS, and satisfying TS's interest's needs to be placed in the primary coordination
positions. Secondly, TO has an positive influence on WMC, and its economic status
directly affects the financial revenue and government performance of the Scenic
Area Management Committee. The satisfaction of TO's interests, therefore, should
be placed in the second coordination position.

Fig. 8 Application of third
party in coordination
relationship network map
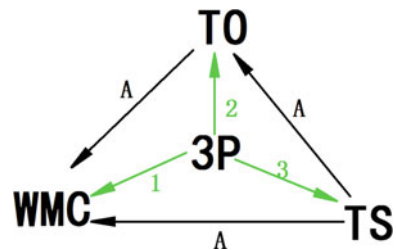
6 Conclusion

Study shows that stakeholders play different roles in the relationship of interests, resulting in the unbalanced relationships of constraints or dependencies. This constitutes a complex relationship of framework. With an aim of resolving the complicated relationships, the interest coordination mechanism is developed based on the stakeholder relationship network and Saaty's analytic hierarchy process theory [31], the core principle for this mechanism is to give priority to the core stakeholder's first or second order of interests when making a decision. Further working out whether the relationship is constraints or dependencies between two stakeholders. The strong constrained relationship is the core solutions for problems-solving.

The methods of network science can prove highly beneficial in broadening the knowledge of stakeholders by translating the physical interpretations into the language of social science. And third parties are applied as a coordinator in a relationship network due to unbalanced relationships and its multiple functions, such as "mentor" and "coordinator". This paper contributes to a better understanding of the mechanism of interest coordination in the tourism context, with an attempt of Saaty's analytic hierarchy process in simplifying relationships and an application of network analysis and third party in the decision-making process of a social relationship network, the whole set of frameworks is practical for the management of stakeholders in heritage protection.

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Perceptions on Climate Change Challenge Among Hoteliers and Travel Agencies in Malaysia

Chuie-Hong Tan, See-Nie Lee, and Sin-Ban Ho

Abstract Tourism is a climate-dependent industry, and many tourism industry players owe their popularity destinations to their pleasant climates during holiday seasons. This study explores the knowledge of the Malaysian hoteliers and travel agencies on the impact of climate change risks. The purpose of the study is to gain an understanding of the perceptions and preparedness of hoteliers and travel agencies in resilience to climate change challenges. The study employs a mixed of close- and open-ended questionnaire survey directed to managers in the hotel industry and travel agencies in Malaysia. The findings show that the selected 100 hoteliers and travel agencies have high awareness of global warming and are willing to take climate actions. Majority of the respondents are willing to work together with local and international projects by offering eco-friendly activities to mitigate climate change. Nevertheless, the respondents are slightly optimistic of the tourism industry under the climate change risks and perceived that the hotels are somewhat ready for the climate crisis. The need of an immediate action to raise awareness of climate change risk and to implement climate change action are recommended to secure the future tourism industry.

Keywords Climate change · Tourism · Hotel · Travel agency

1 Introduction

Many sectors have recognized climate change as a major concern toward social and environmental issue. Tabari [1] found that climate change initiated extreme events,

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such as heat waves [2], the annual wildfire across Indonesia [3], and hurricanes in the USA and the Caribbean [4]. Similar to agriculture, transportation, energy, and insurance, tourism industry is highly sensitive to climate change. Especially, hotel and travel industry influence the natural environment and are susceptible to extreme weather events.

The Intergovernmental Panel on Climate Change [5] has reported that the world mean surface temperature rose at a rate of 1.7 °C per century since 1970. It is estimated that the temperature will increase by 1.1 °C to 3.6 °C in Peninsular Malaysia and 1.0 °C to 3.5 °C in East Malaysia in the next 100 years. Rainfall is also predicted to drop by 8.8% to 18.7% 30 years later [6].

Carey [7] studied the climate change impact on the tourism industry. Temperature rise might cause infrastructure damage, as well as food and water supply disruption in the hotels in the future. Researchers projected that more than 95% of the reef's coral will be dead by 2050 due to high temperatures in the oceans [8].

This paper focuses on the potential impacts of climate change risks on tourism industry. More specifically, it explores the knowledge and perceptions of hoteliers and travel agencies on the impact of climate change challenges on tourism industry. In addition to that, this paper also investigates the preparedness of hoteliers and travel agencies in facing climate change risks.

This study aligns with Malaysia's National Tourism Policy 2020–2030, which outlines six transformation strategies for Malaysian tourism sector, as follows:

(1) Strengthen Governance Capacity
(2) Create Special Tourism Investment Zones
(3) Embrace Smart Tourism
(4) Enhance Demand Sophistication
(5) Practice Sustainable and Responsible Tourism
(6) Upskill Human Capacity.

This research will contribute to advancing transformation strategy 2, 3, and especially 5. Furthermore, this study introduces future scenarios of climate change challenges to gauge preparedness of the hotels and travel industry in Malaysia.

In the following sections, the topics of the weather and climate as motivations for travel and climate change risks on tourism industry are reviewed. Methods, results, and discussion are then presented.

2 Literature Review

Climate change is anticipated as the possible risks toward resources of tourism. Loss of cultural heritage and physical infrastructure, natural habitat destruction and species extinction as well as pollution in air and water quality might occur with the climate change crisis. Study shows that tourism demand varies according with climate indicators, such as heat, precipitation, and storms. Meanwhile tourists possess weather consciousness, climate change sensitivity, and behavioral intention [9]. Other

than that, climate change such as temperature which is one factor that could affect food production, food quality, and availability in many parts of the world, particularly those that are prone to drought and famine. This may affect food ranger tourists on destination choice.

Hence, tourism industry is not immune to observed and possible impacts on future climate change. The link between climate change and tourism sector is expected to be negatively significant. Climate change has unlocked the discussion on whether the tourism industry can sustain and endure the climate challenges [10].

Tourism industries play a significant role in mitigating the climate change crisis. They can reduce the mission of greenhouse gas effects and also assist the locals where tourism businesses serve a main source of income for them. Some hotels are environmentally friendly and take initiatives and practice activities to reduce energy, water, and waste. They implement recycling programs, installing energy efficient lighting, participating linen changing programs, and informing their guests their role plays in protecting the world [11]. Further study is required to explore the link between the tourism and climate change to set a platform to inform the sector on preparation and adaptation to the climate change.

This paper answers to this call and describes on the exploratory research in the tourism industry in Malaysia toward advancing smart tourism and readiness development.

3   Methodology

To investigate the understanding and perceptions of climate change among hoteliers and travel agencies, an explanatory and critical world approach are employed. This research implements the study of Blennow et al. [12] that "knowledge of factors that trigger human response to climate change is crucial for effective climate change policy communication. We conclude that to explain and predict adaptation to climate change, the combination of personal experience and belief must be considered" [13].

In addition, to gauge the preparedness of the hoteliers and travel agencies in handling climate change, imaginary scenarios are created. Researchers have proposed that imagination as a useful method to explore sociocultural and technological characteristics of world challenges. Yeoman and Postma [14] discovered that creative thinking about the upcoming of tourism, such as forming futuristic scenarios, may assist practitioners and academicians in discovering the linkage between the past, existing, and future.

In order to stimulate the reflections about likely futures, the respondents are presented with two imaginary futures before they are requested to rate the probability of these scenarios happening.

3.1   Climate Challenges in Malaysia

There are various activities promoted for tourists traveling to Malaysia such as diving, golf gaming, world class F1 car racing track, cave exploring as well as turtle watching and bird viewing [15]. Besides that, there are many famous theme parks, highlands, beaches, sail and cruise, spas, and national parks available in Malaysia. However, the environmental hazards may pose potential threats to these tourism landscape in the highlands, beaches, flora and faunas, and also cultural infrastructures. In Malaysia, climate change is usually associated with extreme weather (temperature, rainfall, and wind) and seasonality (dry and wet/monsoon season). The tourism trend is affected by these two factors and to some extent influences the perception of tourists to visit Malaysia.

Geographically, Malaysia possesses a total land area of 329,733 km^2 and most coastal regions are low-lying areas less than 0.5 m above the highest tide or are within 100 m inland of the high-water mark which makes them vulnerable in the case of sea level rises. Moreover, most of the tourism destinations in Malaysia are located along coast lines, such as Port Dickson, Malacca, and Penang. Persistent increase of ocean temperatures and extreme weather will jeopardize the beach conditions and hotel infrastructure in the front of the beaches. The hotels will have to insure their premises with higher premiums due to more extreme weather. Other impacts include reduced water supply and food security.

As a consequence, environmental hazards and climate change provides a strong framework for understanding how hoteliers and tourism industries deal with the urgency of preparedness for climate change challenges. Thus, solutions for green business model is designed for the tourism and travel industry in Malaysia.

3.2   Data

Questionnaire survey is designed to measure the perceptions and knowledge on climate change from the targeted respondents. Researchers such as Blennow [12] as well as Kettle and Dow [13] support the survey instrument to quantify perceptions and knowledge on climate change and in order to implement climate action. Data is collected using a convenience sampling survey method. The targeted area includes Melaka (nearby beach), Port Dickson (nearby beach), and Seremban city. The population of the study are all managers or senior executives who work in the hotels and travel agencies. Contacts and addresses were first acquired through websites. Administered survey data was conducted in the organizations to maximize data responses and accuracy. Translation and explanation were given to the respondents who were not well versed with English language.

In the survey questionnaire, the items were retrieved from past studies [16, 17] which touched on perceptions and knowledge of global warming. The survey questions start with the respondents' demography followed by questions covering on the

knowledge and perceptions as well as actions taken on the climate change. Readiness evaluation of the organizations' climate change resilience is gauged through their exposure of two scenarios. Detailed descriptions of the scenarios are designed to guard the respondents. Two open-ended questions were positioned after the close-ended questions to allow the respondents to share their opinions and suggestions in detail on issues raised in the survey questionnaire.

4 Results

In total, 100 survey questionnaires were collected from hotels and travel agencies in Malacca, Port Dickson, and Seremban city. The demography of this study is presented in Table 1. 42% of the respondents are male, while 58% are female. About half (49%) of the respondents are 30 years old and below, approximate one-third (33%) are in the age group 31–40 years old and 18% of the respondents are more than 40 years old. 72% of the respondents work in the hotels that are located in the town area where as 19% of them work in the beach front hotels. There are 9 respondents who work in the travel agencies.

The descriptive findings are presented in Tables 2, 3, 4 and 5. Most of the data collected was in ordinal type as the questions are in 5-point Likert scales ranging from 1 strongly disagree to 5 strongly agree. As the sample size is 100, mean data is valid for exploring the descriptive analysis. Table 2 reports the mean as well as the mode of the responses. The findings reveal that respondents are aware of the climate change issues which have threatened the tourism and hospitality industries. They completely agree that the world temperature is increasing as compared to the past. They strongly believe that they should take actions to safeguard the quality life of future generations.

In Table 3, the results show that the respondents are willing to participate in any activities to reduce the impact of climate change. They perceive that the government should play a role in giving incentives to encourage green campaign initiatives. They are also aware that little is done within the tourism industry in mitigating

Table 1 Characteristics on respondents and organizations	Gender	Male	42 (42%)
		Female	58 (58%)
	Age distribution	30 years old and below	49 (49%)
		31–40 years old	33 (33%)
		41–50 years old	10 (10%)
		Above 50 years old	8 (8%)
	Organization type	Hotels on the beach front	19 (19%)
		Hotels not on the beach front	72 (72%)
		Travel agency	9 (9%)

Table 2 Summary of descriptive statistics on knowledge and perceptions on climate changes

Knowledge and perceptions on climate change	Mean	Mode	Max
Climate change creates a big threat to the sustainability of Malaysia	4.17	4	50
Climate change creates a serious threat to the tourism and hospitality industry in Malaysia	4.17	4	45
Climate change is caused by human activities	4.11	4	50
Climate change hazards and its potentially negative effects are misjudged in the local news	4.11	4	40
Climate change is impacting tourism and tourism infrastructure in my nation now	4.12	4	42
Malaysian tourism and hospitality firms are proactive and ready to reduce their energy and water usage to tackle climate change	3.66	4	30
Our key tourism and hospitality industry agencies completely understand what climate change means	3.72	4	46
The global temperatures have changed compared to the past decade	4.29	5	49
Regional tourism organizations in Malaysia support climate resilience in the industry	3.55	4	36
This current generation has a responsibility to address climate change so that the future generations can enjoy the same quality of life	4.28	5	44
The business models of companies in tourism industry have transformed to address climate change risks	3.73	4	34

Table 3 Summary of descriptive statistics on knowledge, perceptions and action on climate changes

Perceptions, knowledge, and action on climate change	Mean	Mode	Max
Each one of us can reduce the effects of climate change	4	4	50
It should be mandatory to reduce energy usage if it reduces climate change impacts	3.93	4	49
Climate change is bound to happen because of the current modern society	3.91	4	43
Climate change is a natural phenomenon; we cannot do anything about it	2.91	2.3	25
The government should increase the incentives for people who try to reduce climate change	3.91	4	49
I will promote a greener environment and participate in initiatives to reduce climate change	4.06	4	40
Climate change is only because of the pollution from industries	3.38	4	30
Recent global disasters are because of climate change	3.61	4	38
The climate change topic is exaggerated by the media; in fact, it is not that big of a deal	2.45	1	33
There are more important matters than climate change	2.62	1	26
Cutting down trees to build infrastructure is not a bad thing	1.85	1	60

Table 4 Perceptions on the responsibility party to mitigate climate change

Perceptions on the responsibility party to mitigate climate change (rank 1 highest to 8 lowest)	Mean
International Organizations such as the United Nation	3.1
The Country's Government	2.54
Businesses and Industries	3.04
Local Government	2.86
Environmental Organizations such as Worldwide Fund for Nature	3.02
Individuals	2.67
Current Generation	3.19
Future Generations	3.85

Table 5 Preparedness of the hotel sector and the respondents' institution under climate change

	Mean	Mode	Max
Scenario 1: The future for the tourism sector is gloomy under the climate change risk and environmental hazard			
Do you agree that scenario 1 might become reality?	3.86	4	41
Do you agree that the hotel sector is ready for scenario 1?	3.37	3	35
Do you agree that your institution is ready for scenario 1?	3.28	3	37
Scenario 2: The major change in the attitude of individuals and institutions heading to a prosperous green tourism industry			
Do you agree that scenario 2 might become reality?	3.81	4	41
Do you agree that the hotel sector is ready for scenario 2?	3.50	3	38
Do you agree that your institution is ready for scenario 2?	3.27	3	44

the global warming issue. These findings reveal that the respondents acknowledge the responsibility of tourism and travel industry toward global warming crisis. 67 hoteliers and travel agencies are willing to team up with local or international projects to offer of eco-friendly activities to combat climate change.

Table 4 shows that the respondents consider that the responsibility to mitigate climate change should fall on the governments and individuals' shoulder. Environmental organizations should also share the responsibility in tackling the global warming crisis, followed by the businesses and industries. They agree that future generation should not be responsible to handle the climate change problem.

Table 5 reports the result of two scenarios presented to the respondents. Scenario 1 describes a very bleak future with no effective local or global approach to adapt to the global warming crisis and environmental hazard. The hospitality and tourism sector are facing a negative future. Scenario 2 delineates a change in the attitudes of individuals and institutions heading to a green environment future. Respondents perceived scenario 1 as a possible outcome and evaluated this future slightly higher than scenario 2. Respondents are rather optimistic that there will be a change in the

attitude for positive climate action. Regarding of the preparedness of the hotel and travel sector and the respondents' company, the score was 3.0–3.5. This suggests the respondents slightly positive in the preparedness for future climate change and environmental hazard.

In the open-ended questions section, this study found that 36% of the respondents state the reasons for the insufficient climate change action are lack of environmental education and awareness of climate change risk. 28% of the respondents perceive that the lackadaisical attitude of the individuals as well as selfishness and greed of the industry players causes the global warming problem. Nevertheless, 17% of the hoteliers and travel agencies are concerned about high-cost expenditure on new businesses operation with eco-technological equipment. Other respondents blame it on deforestation and increase in transportation volume which cause green-house gas emission due to rapid development.

About 35% of the respondents recommend to employ 3R (Reduce, Reuse, and Recycle) to protect and conserve the environment. Besides that, they propose effort to inculcate more awareness, such as programs, campaigns, and seminars on social media. They highlight the importance of public education involving global warming issues and its sustainability. The respondents even recommend the hotels and travel industries to invest in eco-technology to safe energy and reduce harmful waste to the environment. In addition, some would like to see stricter law penalty to be enforced to violators.

5   Conclusions

This study seeks to understand how the tourism and travel industry players perceive their sector under climate change risk. Their views and perceptions are crucial to develop sustainable business models in the tourism industry in Malaysia. Respondents are aware and concerned to take actions in tackling climate change. Nevertheless, only few of the hoteliers and travel agencies are perceived to adjust their current operations toward climate change challenge. In addition, all respondents come to agree that global warming was resulted by human activities and can be overcome by changing in their attitude. Public awareness and education about climate change crisis are recommended for effective programs and policies for climate action in Malaysia.

This study reflects a further comprehension and implications of the perceived demand of the tourism and hospitality sector. Policymakers can assist tourism sectors to adapt to climate change risk by creating programs and seminars. They can also collaborate with universities to establish awareness campaigns and education. Tourism industry players can build relationships with tourists or clients to find out the appreciated climate action-related activities. Hospitality industry can implement 4.0 technologies in its business to reduce its effect on climate change by increased energy efficiency, recycling and re-use of water, and reduced food waste. The use of

virtual reality can decrease transport and travel and hence reduce the greenhouse gas effect to the environment.

However, there are some limitations in this study. The samples are taken from a specific part of the country. Samples from east coast of Malaysia and East Malaysia are recommended to be included to compare as well as provide comprehensive views and possible ideas. This exploratory study reports tendencies and trends. An in-depth research is suggested to reach a conclusive evidence and confirm the tendencies. Nevertheless, future research could investigate the type of climate action-related activity the tourists would value.

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Applied Economics and Sustainable Development

The Great Resignation: Shifter of the Modern-Day Workweek

Charlotte Situ

Abstract "The Great Resignation" which refers to the surge in resignation rates in April of 2021 is a perplexing and relativity unexplored phenomenon. With many speculating that "the great resignation" will signal a shift in the workplace and worker-employee dynamics, we must understand the factors that attributed to the record-breaking amount of people leaving the workforce. Additionally, this paper will also explore whether the four-day workweek would aid in being more people back into the workforce. Aggregated data, a linear regression model, and a theoretical model were conducted utilizing data from the U.S. Bureau of Labor Statistics (BLS). The data and theoretical model indicate that the increase in resignation rates is primarily due to two factors: decrease in productivity and increase in hours worked during remote working, and increases in government unemployment benefits. Given the factors leading to the great resignation, they support the notion that a four-day workweek would attract more employees to a particular company or the overall labor market.

Keywords The great resignation · Four-day workweek · COVID-19 pandemic · Linear regression model

1 Introduction

From the abrupt closure of offices and businesses across America to the nation-wide movement toward adapting to remote working, the COVID-19 pandemic has undoubtedly altered the way millions of Americans work nationwide. The pandemic-initiated recession was comparatively short and its impact hit unevenly with some companies growing despite many companies shutting down resulting in record job losses reaching 14.7% in April of 2020 [1]. Regardless, the pandemic witnesses an unprecedented nationwide from working at the office to working at home. A 2020

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survey of 229 human resources departments found more than one-half of the companies' surveys had roughly 80% of employees working from home during the early stages of the pandemic [2].

As companies began to urge workers to return to the offices in the spring of 2021, likely due to the emergence of the COVID-19 vaccine, resignation rates across the United States began to spike. According to the U.S. Bureau of Labor Statistics (BLS) in April of 2021 quit rates reached 2.7% of the workforce, making it the highest recorded quit rate in the history of the BLS history (2021). This record-breaking surge in resignation rates also known as "the great resignation" has taken American companies by surprise, especially since many are still vulnerable and recovering from the recession and the aftermath of the COVID-19 pandemic. Due to this phenomenon occurring recently, there currently lacks sufficient scholarly work to explain and explore the impetuses behind this occurrence; however, it has been speculated that "the great resignation" may potentially be due to factors such as decreased worker mental health and an increase in government subsidies and disposable income. Employees who are working from home are more likely to experience negative consequences associated with remote working such as loneliness and isolation. Simple workplace interactions such as shaking hands [3] or having a casual conversation with a coworker are essential for establishing positive employee mental health [4]. Without these simple interactions, it can lead to workplace loneliness can affect employees' behavior, performance, and commitment [5]. Thus, it is reasonable to assume that as workers spend more time isolated from their peers, they are more likely to experience the consequences of workplace loneliness which can decrease their commitment and performance leading to higher resignation rates. Moreover, in response to the substantial job losses during the pandemic, the US government created the Federal Pandemic Unemployment Compensation (FPUC) which increased unemployment subsidies by $600 a week which ended in June of 2020. The increase in employment subsidies was beneficial for many with more than 76% of the unemployed receiving more income with FPUC than their previous wages [6]. Additionally, it is predicted that the increases in unemployment benefits may deter peoples' efforts to search for a job [7, 8]. Thus given that unemployment benefits may be higher than their wages some people may choose to leave the workforce. Furthermore, according to the U.S. Bureau of Economic Analysis (BEA), another factor that has increased disposable personal income (DPI) is increases in wages that occurred after the FPUC program ended (2021). Increases in disposable personal income along with the negative mental health repercussions of working from home may lead individuals to resign from their jobs. As wages increase the income effect sets in and result in individuals increasing their preference for leisure and decreasing their preference for work.

Although many journalistic sources have speculated about the factors inciting the phenomenon known as "the great resignation," there currently lacks scholarly work discussing not only the factors causing "the great resignation" but also its implications and potential responses. This paper's main objective is to explore these unknown factors through utilizing data analysis and a theoretical model to probe the inciters of "the great resignation" and whether implementing a four-day workweek

would remedy the situation. Despite the four-day workweek becoming a popular topic of contention within the academic community, connections between implementing a four-day workweek and increasing workforce participation amid the aftermath of "the great resignation" have been sparse.

In the following sections, this paper will delve into exploring the factoring attributing to "the great resignation" through using a linear regression model to establish a relationship between percentage increases in hours worked by employees and percentage changes in quit rates. Having established the relationship between hours worked by employees and quit levels, a theoretical model can be produced based on the results.

2 Literature Review

2.1 The Great Resignation

Given that the great resignation is a relativity new phenomenon there currently lacks extensive scholarly work exploring this topic. Among the limited amount of scholarly work, a working paper by author Ulrike Malmendier [9] (Edward and Mollie Arnold Professor of Finance at the Haas School of Business and Professor of Economics at the Department of Economics, University of California) explored the connection between modern brain science and the alternation of our economic behavior as a result of pandemic related experiences [8]. Although this paper provides some insight into "The Great Resignation" and its inciters from a neuroscience perspective, it does not touch substantially on potential remedies to the issue and the explanation provided is narrow to one field.

2.2 The Cost of Worker Burnout and Decreased Productivity

The pandemic undoubtedly has brought upon many challenges that we had to overcome. Of those challenges the most daunting being, how people would continue to work while staying safe during COVID? Luckily, modern technology has allowed us to enter into a new mode of working never experienced before on a worldwide scale: working from home. Although bring work home or otherwise referred to as remote working has helped keep people safe physically, the blurring lines between home and the workplace has posed many challenges in terms of employee mental health. Findings from Hayes et al. [10] paper titled "'I'm not Working from Home, I'm Living at Work': Perceived Stress and Work-Related Burnout before and during COVID-19" supported the hypothesis presented in the paper that overall Perceived Stress Score is higher in participants who worked from home in the sample collected post-COVID-19, indicating that COVID-19 and remote working has had a notable effect on the

mental well-being of some employees. Notably, respondents to the survey reported that work-related problems, such as "Maintaining appropriate levels of communication with my team/colleagues" and "Managing my time/Avoiding distractions" were much more frequently identified as stressors and causes of burnout than "Balancing personal/family responsibilities with workload" [10]. Working from home has created negative mental health repercussions for employees such as increased stress and burnout levels, a psychological work-related syndrome that can cause symptoms such as emotional exhaustion, decreased efficiency at work, and cynicism [11].

Given that mental health has become a growing problem in the workplace as a result of the pandemic, the response to this issue from employers and management is crucial. Alarmingly, a recent report published by Modern Health in light of the ongoing "great resignation" found that substantial a gap between employers' perception of their involvement in bettering employees' mental health and employees' perception of employers' involvement. The study found that 87% of employers perceive themselves to be caring about their employee's mental health, despite only 66% of employees sharing the same perception. Additionally, the labor market dynamics begin to shift as it transitions from the deviating layoffs in 2020 to workers voluntarily leaving their jobs in the currently ongoing "great resignation," more power in the labor market is being held by the employees than before. Thus, it has become increasingly noteworthy that in the Modern Health survey conducted on 702 US full-time employees and 513 US full-time employees, 79 and 81% of employees and managers, respectively, responded that they were more likely to stay in a company that offered high-quality mental health support and services. Additionally, the survey also found that after the pandemic, an increasing amount of people are willing to change their job due to mental health concerns as the percentage grows from 28 to 34% [12].

Therefore, given the increase in mental health concerns due to the pandemic and it being potential impetus behind the great resignation, it has become increasingly imperative to acknowledge the costs of employee resignations.

As resignations continue to soar in the post-COVID-19 American labor market, it is imperative to probe the economic consequences of such high turnover rates for companies. As stated in a 2014 report titled The Cost of Brain Drain: Understanding the financial impact of staff turnover published in Oxford Economics, the cost of losing an employee can be summaries into two components: cost of reciting a new employee and the cost of the lost output level obtained by the employee while the new employee builds to the level of productivity their predecessor achieved. Interestingly, the report found that smaller firms were able to replace employees at a much lower cost than comparatively larger firms as the total cost of training new employees to the desired productively level for smaller firms was only £22,629 in comparison with the £26,000 it costs to replace an employee at a firm with 10–49 employees. A potential explanation for the perplexing phenomenon of the increasing employee turnover costs as firm size increases in size, the report hypothesis that the employment needs for smaller firms may be satisfied with lower expenditure in the employee recruiting processes such as less advertisement and fewer barriers between senior management and new employees which facilitated more timely and personal feedback. Thus, given

the findings and hypothesis raised in this report, the high resignation rates seem to pose a substantial threat to large companies as training and recruiting new personnel comes with substantive costs.

2.3 Four-Day Workweek

Decreasing the amount of time people spend at work to increase worker mental health has been a population topic of conversation for politicians and businessmen and women ali2.3 ke. As stated in [13] Gatlin-Keener and Lunsford's report on the experimental four-day workweek in Microsoft Japan, the toxic level of work-related stress and the reality of seven-day workweeks becoming a norm in Japan have led to the creation of the term *karoshi* which refers to death from being overworked. With suicide rates in Japan among the highest in developing countries, worker mental health has become a pressing issue that needs to be addressed. In 2019 Microsoft Japan responded to this issue by initiating an experimental trial for the four-day workweek. In data published by Microsoft Japan, employee productivity improved by 40% overall. The company also reported higher operational efficiency as reducing the four-day workweek experiment helped decrease the company's electricity costs by 23% and printing costs by 58.7%.

On a national scale, a reduction in working days per week can create new jobs. Historically, reductions in working hours are usually the result of an increase in productivity; however, that trend has reversed in the last 20 years in the United States and European Union (Lee et al., 2007). The four-day workweek reduced the amount of time worked by current employees, and it also creates more employment opportunities for the currently unemployed [14].

Furthermore, in a paper published by the University of Connecticut Law Review, author Robert [15] Bird (Professor of Business Law and Eversource Energy Chair in Business Ethics at the University of Connecticut Law School) reported that the four-day workweek is not a novel idea spawned in this century. In the early 1970s, hundreds of companies across America began the conversion to the four-day workweek. Although productivity increases varied from company to company, there was a consensus that a reduction in the number of times people worked per week increased productivity. Additionally, some companies reported that the reduced workweek increased employment. However, although business owners and managers generally reported having positive perceptions of the four-day week as it increased productivity, employees often complained of the fatigue they experience from longer workdays as a result of reduced workweeks. Potentially due to the lack of employee satisfaction of the four-day workweek, the movement failed to gain much traction with companies and academics beyond the 1980s [15].

Thus as indicated by the current literature present, the impact of the four-day workweek model on employee productivity, and employment rates remains a point of contention. This paper aims to identify whether a four-day workweek is a feasible

solution to resolve the "great resignation" and increase employment rates through utilizing a linear regression model and constructing a toy model.

3   Methodology

3.1   Trends in Working Hours a Productivity During the Pandemic

I will firstly present aggregated data for productivity and hours worked in the United States during the period of remote working to establish a foundation for the theoretical model and data analysis. Then I will conduct a linear regression model in order to identify the relationship between productivity and hours worked in the United States from 2019 to August of 2021. Data published by the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis will be utilized. The data utilized will be from the U.S. Bureau of Labor Statistics and the U.S. Bureau of Economic Analysis Job Openings and Labour Turnover report (published monthly), [5] Personal Income and Outlays report (published monthly), and the "Temporary layoffs remain high following the unprecedented urge in early 2020" (published quarterly). The data published in these data sets aims to depict the trends in employment and unemployment trends in America, which the "Temporary layoffs remain high following the unprecedented urge in early 2020" specifically focusing on how these trends have been influenced by the pandemic and the ensuing "Great Resignation."

There are primarily two trends exemplified in the data presented below (1) inverse relationship between productivity and working hours emerges after remote working commenced, (2) overall increase in hours worked. These trends will serve as a stimulus and support the basic theoretical model that will be presented in the following section. In the theoretical model, it is assumed that labor is an inferior good and leisure is a normal good. The theoretical model draws on the labor-leisure model in order to examine the relationship between labor and leisure at each period in time.

The research method utilized was the most effective in establishing a relationship between productivity and hours worked in the United States during the period of remote working since the aggregated data set was effective in illustrating the relationship between the two factors and the linear regression model effectively established a clear relationship between the two variables. Utilizing data analysis to build context for a toy model was a logical choice as, although the toy model was based upon labor-leisure tradeoff, a fundamental economic concept, data analysis was essential to establishing the factors that incited the movements budget line and indifference curve.

3.2 Productivity and Working Hours

Figure 1 shows the progression of the percentage change in labor productivity and hours worked on average by employees in the US business sector each quarter from 2019 Q1 to 2021 Q3. The blue solid line in the graph presented in Fig. 1 represented the percentage change in labor productivity from quarter to quarter and the blue dashed line represented the percentage change in hours worked from quarter to quarter. Overall, hours worked by employees have fluctuated since 2019 Q1 with a sharp decline in the 2020 Q2 which coincided with when many businesses shut down due to COVID-19 and companies had just begun adjusting to remote working. However, as remote working continued through 2020 Q3 to Q4, the percentage change in the hours worked by employees increased while the productivity of workers decreased. Although there was an initial peak in labor productivity in the second quarter of 2020, which coincides with the beginning of remote working, it is immediately followed by a gradual decline in productivity and an increase in percentage change in working hours from sector to sector. The initial increase in productivity is likely a result of a change in factors such as eradicating long commutes; however, as employees spend more time working from home they may begin to experience negative psychological and social repercussions such as loneliness and isolation. In 2011, C-trip, a Chinese travel agency, conducted an experiment in which they allowed certain workers, some determined through a lottery system and others through volunteering, to work from home. Although the experiment found that working from home led to a 13% increase in performance, more than 50% of participates in the volunteer group reported that primarily due to isolation and loneliness they would prefer an in-person working environment [16]. Thus, as indicated by the data presented above, a negative relationship between labor productivity and working hours began to emerge after the pandemic caused many employees to work from home.

3.3 Hours Worked and Resignation Levels

Before the onset of the pandemic, resignation rates in the United States remained relatively constant at 2.3% of the population as shown in Fig. 2. However, resignation rates began to sharply decrease from March 2020 to May 2020 as a result of the increase in layoffs, unemployment rising by 1.5 million in March of 2020, caused by the United States declaring the COVID-19 pandemic a national emergency [17]. Yet, despite the workforce resignation rate returning to 2.3% in December of 2020, resignation rates continued to grow to reach 2.9% of the workforce population by August of 2021. An interesting relationship can be observed between the changes in hours worked and resignation levels, as the increase in working hours begins to increase rapidly since the second quarter of 2020, it is followed by an increase in resignation rates from March to August.
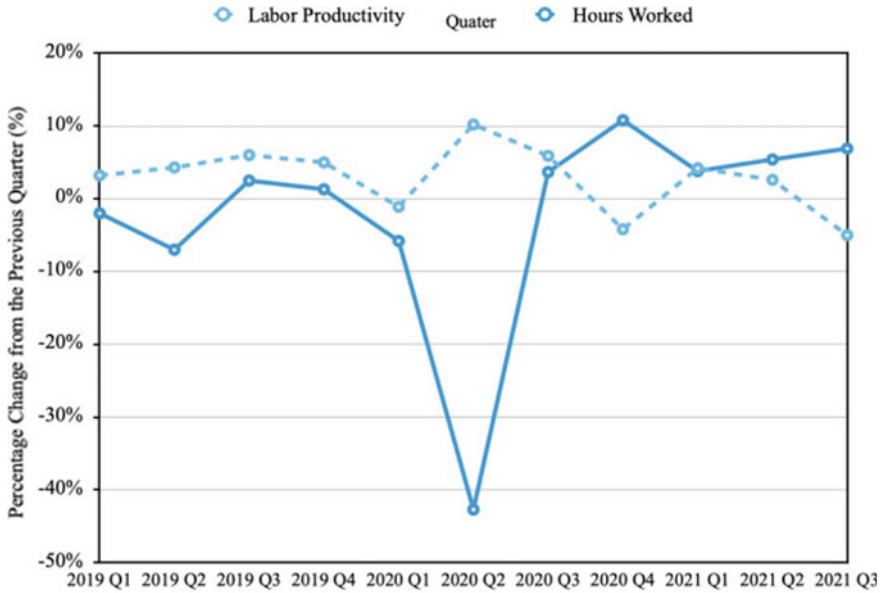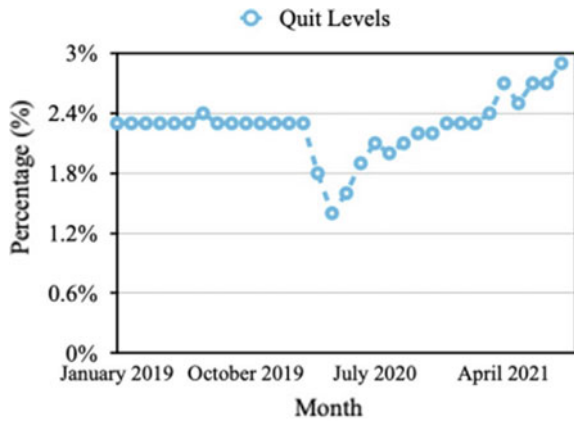
Fig. 1 Productivity and labor percentage changes in the US business sector from 2019 quarter one to 2021 quarter three

Fig. 2 Percentage of the workforce that resigned each month from January 2019 to September 2021

3.4 Theoretical Model

In order to better understand the relationship between these trends and how implementing a four-day workweek would impact these current trends, specifically the increases in resignation rates. A standard microeconomics framework was adopted in order to identify the relationship between longer working hours and resignation

rates in the United States. In this model, it is assumed that wage levels and individuals' preference for leisure remain constant.

In this model, I will first utilize a linear regression to identify a relationship between the hours worked by individuals and resignation rate then I will go onto establish a toy model in order to illustrate the relationship between the variables.

The aim of the linear regression model is to establish the relationship between the change in number of hours worked, independent variable, and fluctuations in resignation rates in the United States, dependent variable. The linear regression equation is

$$Y = 0.00756513x + 0.0225137,$$

in which x represents the percentage in hours worked from the previous quarter and Y represents the percentage of workers quitting in each month in the given quarter. Although there may be other factors that influence an employee's decision to resign, such as shifts in personal priorities or specific personal circumstances, due to the fact that this paper is primarily focusing on the effects of the pandemic and remote working, time spent working will be the only factor taken into consideration in the linear regression equation.

4 Results

The linear regression equation indicates that there is a positive relationship between percentage increases in hours spent working and the percentage of working quitting each month which indicates that as the number of hours workers spend working increase from sector to sector people is more likely to quit. Although this model further illustrated the relationship between these two factors that can be observed in Fig. 3, the data utilized contains limitations. The data regarding the resignation/quit levels is collected monthly; however, the data regarding the percentage change in hours worked is quarterly, and it is only based on the business sector. Thus, although the rendered linear regression model does exemplify a positive relationship between percentage increases in hours spent working and the percentage of working quitting each month, the narrow scope of the data set hinders its applicability to all professions and sectors in America. Therefore, although a positive relationship does exist between the two variables, it is not definitive.

Having established the positive relationship between percentage change in hours worked by employees from sector to sector and the changes in the percentage of the workforce resigning in a given month, a theoretical model based upon the labor-leisure tradeoff principles can be established. In this model, t will represent the time period in which a majority of companies utilized remote working, $t-1$ will represent the time period before the pandemic, $t + 1$ will represent the present (when many

Fig. 3 Aggregated data of the percentage of the workforce that resigned each month and the percentage change in working hours each quarter from January 2019 to September 2021
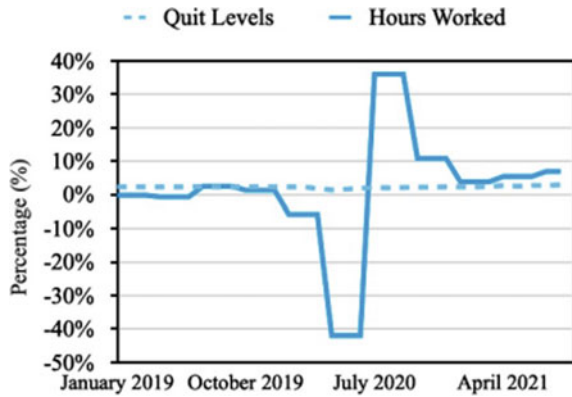
companies have decided to return to in-person working), and $t + 2$ will represent the scenario in which the four-day workweek has been implemented. In this theoretical model, it is assumed that wage and individuals' budget constraints are both factors that are held constant; wage will be denoted with a w. Budget constraint can be expressed as

$$C = wh + V,$$

where C represents the total cost of expenditure on goods, wh represents the sum of labor earnings and V represents the sum of non-labor income. Since there in this model there are only two ways for people to consume time either work to leisure; thus the time in hours each individual has (T) is equivalent to hours they spend working (h) and hours they spend doing leisurely activities (l). Thus the budget constraint can be rewritten as

$$C = w(T - l) + V$$

$$C = (wT + V) - wl.$$

Given that the optimal ratio of work to leisure is achieved when the budget line tangents the indifference curve which implies that marginal rate of substitution is equivalent to the wage,

$$\frac{MU_L}{MU_C} = w$$

Thus, the optimal combination or work-to-leisure ratio can be achieved when

$$\frac{C + V}{T - l} = \frac{MU_L}{MU_C}.$$

Therefore

$$t - 1 = t + 2 = \frac{C + V}{T - l} = \frac{MU_L}{MU_C},$$

$$t + 1 = \frac{C + V}{T - l} > \frac{MU_L}{MU_C} \text{ and,}$$

$$t = \frac{C + V}{T - l} < \frac{MU_L}{MU_C}.$$

In order, to return to equilibrium state that the labor market maintained at $t-1$, a decrease in time allocated to leisure while an increase in time allocated to work must occur. Having previously established the positive relationship between resignation/quit rates and percentage changes in working hours from quarter to quarter, it can be reduced that working hours is a factor that heavily influences peoples' desire for leisure. Thus, as working hours increased during the period of remote working due to a decrease in productivity, employees allocated more time to work than leisure causing an imbalance between marginal rate of substitution of work and leisure to wage. Thus, in order, to return to equilibrium it, resulted in many employees quitting their jobs in order to regain the equilibrium between work and leisure with wage. Therefore, companies would need to increase wages in order maintain the equilibrium between wage and marginal rate of substitution. However, a more cost-efficient method would be to implement a four-day workweek. In addition to the multitude of environmental and cost-saving benefits a four-day workweek, such as reduced energy use [15], a four-day workweek would improve employee mental health and allow productivity levels to be maintained or even improved upon [18] (Fig. 4).

Fig. 4 Work and leisure trade-off
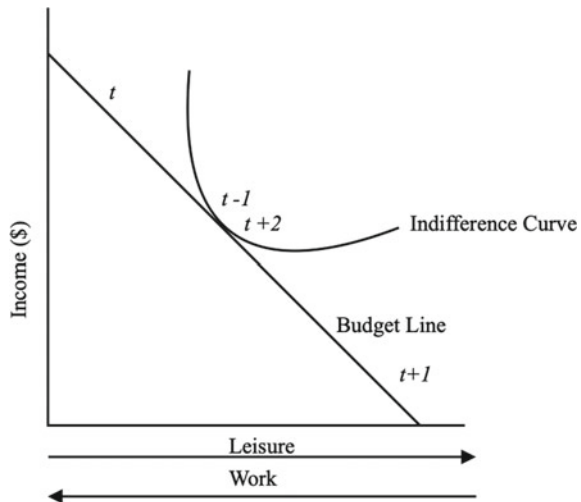
4.1 Income Effect

According to the U.S. Bureau of Economic Analysis, disposable personal income in the United States reach an all-time high in March of 2021 with disposable personal income increase 23.6% from the previous month, which is largely attributed to an increase in government social benefits [5]. However, by November of 2021 growth in disposable personal income has stalled significantly as government social benefits decreased such as decreased payments from unemployment insurance and the Pandemic Unemployment Compensation program. The majority of the 0.4% increase from the previous which occurred in November was due to increases in compensation in the private sector [19]. Thus assuming that the current trend continues and government subsidies continue to diminish, many workers will be returning to the workforce. As the various government subsidies helped people maintain or even increase their consumption costs without working; thus, allowing them to consume more of the normal good, leisure, and less of the interior good, work, which was a contributing factor to the great resignation. Therefore, a four-day workweek would be the superior alternative for businesses looking to hire more workers as it allows the companies to recruit more workers without giving up shares of their revenue to increase wages.

5 Discussion

Through my research paper, I aimed to discover the factors inciting the phenomenon known as "the great resignation" and whether the four-day workweek would be an effective remedy to this dilemma. Increasing working hours due to decreasing productivity and the increase in disposable personal income as a result of increased wages and government subsidies are the two foremost radices of the increase in resignations America is currently experiencing. Moreover, the data supported theoretical model suggests that a four-day workweek would aid companies in recruiting more workers and recovering from "the great resignation."

The primary purpose of my study is to explore the four-day workweek as a potential solution to "the great resignation"; given my findings, I would advise companies to implement trial programs for the four-day workweek. Although evidence currently suggests that implementing a four-day workweek would be beneficial for companies in the long run in terms of recruitment and productivity, it may not be suitable for all companies depending on various factors such as their field and company culture. I would suggest that further research be conducted on an experimental basis to explore in which specific sectors a four-day workweek would be the most beneficial in terms of recruitment and productivity. Although the data provided points conclusively to the fact that a four-day workweek would be an effective remedy to the decrease in workforce participation, additional in-depth research and studies should be conducted. This paper largely drew on data from the U.S. Bureau of Labor Statistics and the

U.S. Bureau of Economic Analysis; thus, indicating that the data utilized is likely credible.

However, the theoretical model and statistical analysis in this paper remained at a fundamental level, therefore, to arrive at more credible and definitive results, further research needs to be conducted. Specifically, I would suggest a more advanced mathematical model be conducted to model the effects of the four-day workweek, and more large-scale studies should be conducted to determine the real-life implications of the four-day workweek in practice before it can be broadly utilized.

Lastly, throughout my research process, it has become evident that worker mental health and various physiological factors have also attributed to "the great recession." Thus further research into the psychological aspects of this phenomenon is warranted in order to help companies and employees better meet each other's demands and reduce the strain caused by the aftermath of the pandemic and remote working on both parties.

6 Conclusion

The American labor market has been through many challenges since the pandemic begun in early 2020, the most recent challenge American labor market has to undertake is the phenomenon known as "the great resignation" which refers to the time period around August of 2021 when an unprecedented amount of American workers decided to leave the workforce. This paper is centered around identifying the factors that have attributed to "the great resignation" and exploring whether a four-day workweek with reduced working hours would resolve "the great resignation" and increase labor force participation. Results from the data analysis and theoretical model both support the surmise that a four-day workweek would be beneficial to resolving the current worker shortage.

Though a linear regression model, it is firstly established that a positive relationship between percentage increases in working hours between quarters and resignation level exists; thus, it is reasonable to conclude that increased working hours during remote working, due to a decrease in productivity, may be a factor attributing to "the great resignation." Additionally, increases in disposable personal income, as a result of increasing government subsidies and increasing wages, are also an attributing factor to "the great resignation" as people can consume more leisure and less labor since the governmental benefits can allow them to consumer more leisure while still maintain a similar or higher income. However, the amount of income people gain from governmental subsidies, such as unemployment benefits, have been decreasing, yet disposable personal income is still increasing, granted at a slower rate, due to increases in wages. If companies want to attract new employees and not lose portions of their profit to increased wages, a four-day workweek would be a feasible alternative. With high resignation rates, a shift in dynamic is beginning to emerge in the

American labor market, with more autonomy being grated toward workers. Therefore, companies need to embrace solutions that will aid them in retaining more employees while maintaining or even increasing their profits.

The findings from this paper is merely a first step in probing the feasibility of the four-day workweek as a means to meet the demands of the changing labor market. Further research and surveys should be conducted on this topic as "the great resignation" has opened up opportunities for dynamics shifts and restructuring of the norm in the American labor market. The opportunity has arisen to remold and revolutionize the modern-day work culture and company-employee relationship. With further in-depth research regarding the proposition of a four-day workweek in not only the field of economics, but also in the fields of sociology, psychology, and more, we are well on our way redefining the norm of what a workweek looks like.

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Students' Environmental Awareness and Low-Carbon Behavior: Exploring the Differences

Djula Borozan and **Sanja Pfeifer**

Abstract Young people are generally well aware of the importance of transitioning to a low-carbon economy. However, there is a significant gap between awareness of the importance of a low-carbon transition and actual behavior. The main aim of this paper is to explore the relationship between these two dimensions and, accordingly, using the k-means cluster method, create a typology of young people, Croatian university students. In addition, the paper is focused on examining the association between cluster membership and selected demographic variables. The application of the cluster method on the data collected by a survey in 2021 resulted in three significantly different, stable, and meaningful clusters. They differ in the extent to which respondents are aware of the importance of a low-carbon economy and the extent to which they engage in low-carbon behavior. The first cluster includes about 5% of respondents who are quite skeptical but often engaged in low-carbon activities. The second cluster includes trusting respondents who sometimes engage in low-carbon activities. This cluster consists of about 68% of respondents. The last cluster includes skeptical respondents who are mostly opposed (rarely active) to low-carbon behavior. The non-parametric chi-square tests suggest that, unlike the selected demographic variables (e.g., gender, financial situation, previously completed study program, field of education, or household size), there is not enough evidence to confirm the existence of the association between rural/urban living environment and cluster membership.

Keywords Environmental awareness · Low-carbon behavior · k-means cluster analysis · Croatian university students

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1 Introduction

The study of individuals' low-carbon behavior is gaining increasing scientific attention, especially due to the estimate that nearly two-thirds of global carbon emissions are due to household or individual consumption [1]. As a result, transitioning to low-carbon alternatives is seen as important and urgent to reduce overall carbon emissions and achieve net-zero emissions by 2050 [2]. For individuals, the transition to low-carbon behavior practically means lifestyle changes in various areas, such as purchasing, household energy conservation, waste management, or transportation. However, these changes often remain only at the consideration stage, as they are challenging and complex, requiring effort, time, and sometimes significant financial investment.

The variety of predictors that influence low-carbon behavior is increasingly debated by scientists. One stream of this debate emphasizes that awareness of low-carbon behavior can play a critical role in individual behavior and the transition to low-carbon behavior [3]. Varela-Candamio et al. [4] found that raising citizens' awareness of global warming is an effective way to encourage them to adopt low-carbon behaviors. Similarly, Chen and Li [5] confirmed the significant role of low-carbon behavior awareness, knowledge, and personal norms in increasing public and private low-carbon behavior in China.

Environmental awareness and its main components, such as environmental values and attitudes, are frequently cited psychological factors that influence low-carbon behavior [5]. However, empirical studies and conclusive evidence on the relationship between environmental awareness and low-carbon behavior are still in their infancy [6]. The gap between environmental awareness (values/knowledge/attitudes) and actual low-carbon behavior has been increasingly highlighted as an important area of concern [7]. Various explanations for the causal relationship between awareness and behavior, originating in sociodemographic or psychological characteristics of individuals or in factors related to cultural, economic, or other contextual settings, have been extensively explored. On the other hand, the observable differences and typology of individuals in terms of their environmental awareness and low-carbon behavior are largely unexplored.

This study aims to examine the typical profiles of students' low-carbon behaviors based on their environmental awareness and identify the different types of students' low-carbon behaviors based on their level of environmental awareness. Identifying the low-carbon behavior typology of students and examining the differences in sociodemographic factors of each cluster will contribute to a better understanding of the development of sustainable low-carbon consumption and lifestyle in the future.

The remainder of the paper is organized as follows: Sect. 2 provides an overview of previous research and relevant literature. Section 3 outlines methods such as the k-means clustering method and describes the sample and instruments used in this study. The results are presented and discussed in Sect. 4. Finally, Sect. 5 summarizes the main conclusions, limitations, and further implications of this study.

2 Previous Research

2.1 *Low-Carbon Behavior*

Low-carbon behavior is defined as energy-saving behavior. In previous research, low-carbon behavior was often equated with pro-environmental behavior. Although these terms are not synonyms, low-carbon behavior can be considered as the main subcategory of pro-environmental behavior. Barr et al. [8] pointed out that energy conservation comes from habitual behaviors (conserving water, turning off lights regularly), consumer behaviors (buying local or environmentally friendly products), and recycling behaviors (e.g., properly disposing of paper, plastic, or cans). Recent studies define low-carbon behaviors as any type of behavior that reduces energy consumption and carbon dioxide emissions from daily activities, such as living, traveling, and purchasing/shopping [9, 10]. Various behaviors that contribute to energy conservation in daily life include limiting water or space heating, turning off household appliances or lights when leaving a room, monitoring individual energy use, and installing energy-efficient appliances. Another type of daily low-carbon routine relates to waste recycling, such as regularly separating waste in appropriate recycling bins, avoiding excessive paper, plastic, cans, or glass packaging, and reducing the total amount of individual waste disposed of. Individuals can also purchase locally sourced products or those designed and certified as environmentally friendly, reuse products, or buy used products instead of new. Fourth subcategory of an individual's daily routine that contributes to carbon emissions is related to transportation. Choosing public transportation, bicycling, or walking instead of owning a car can be another option for low-carbon behavior.

In developed countries, housing, personal travel, or purchasing behaviors account for 45–55% of total energy use [11]. Similarly, residents of China contribute to nearly 45% [12], while European households contribute up to 65% of total carbon emissions [1]. Therefore, it is particularly important to measure and change individual low-carbon behavior. Scientists are constantly developing new tools that capture either specific or mixed types of low-carbon consumption behaviors (e.g., food waste versus total habitual behaviors, including diet, consumption, transportation, waste disposal, energy conservation). Extensive research on carbon footprint calculation or self-reported carbon behavior is considered a valuable tool for guiding and promoting the transition to low-carbon behavior. The magnitude and extent of individual low-carbon behavior are influenced by various sociodemographic, economic, psychological, cognitive, emotional, situational, or contextual factors. In addition, the interaction between different types of low-carbon behavior can be reinforcing (positive spillover) or suppressive (negative spillover). Klöckner et al. [13] found that individuals who drive electric cars in Norway may feel that they have fulfilled their duty and neglect some other aspects of low-carbon behavior. In contrast, positive spillover effects occur when activities are convenient, effortless, or do not require financial investment [14].

Regarding the impact of sociodemographic factors (such as gender, age, education level, financial status or place of residence, household ownership) on low-carbon behavior, the majority of previous studies advocate that men rather than women, more highly educated, and wealthier individuals have a higher carbon footprint. Younger, more educated, and wealthier individuals have been found to be more concerned about carbon emissions [10]. In addition, women were found to have lower environmental awareness but were more willing to change their behavior [5].

2.2 *Low-Carbon Awareness*

Environmental awareness is defined as an understanding of human impact on the environment [15]. Environmental awareness or low-carbon awareness is considered as a multidimensional construct that includes environmental values, attitudes, and knowledge as the most frequently mentioned components [16–18]. Environmental values can be classified into four categories: biospheric, altruistic, hedonistic, or egoistic [19]. Biospheric and altruistic values are considered conducive to pro-environmental behaviors, while anthropocentric, hedonistic, and egoistic values are associated with emphasizing human needs at the expense of environmental sustainability [19]. Individuals with biocentric values, who consider environmental issues more important than personal comfort, are more likely to exhibit energy-saving behaviors [8]. A similar positive relationship has also been frequently found between environmental knowledge and environmental attitudes. However, empirical evidence on how environmental values, attitudes, or knowledge influence environmental actions is in its infancy [6].

A previous meta-analysis of the psychosocial determinants of pro-environmental behavior showed that environmental awareness has an important but indirect effect on pro-environmental intentions and consequently on pro-environmental behavior [20]. Other researchers pointed out that an increase in environmental knowledge [7], attitudes [21], or values [22] does not necessarily lead to an increase in pro-environmental behavior. Several discrepancies have been found between what people think they should do and what they would actually do. The level of environmental awareness has been frequently found to be higher than behavior. In such a case, high environmental awareness is often overridden by more pressing or desirable individual goals. For example, a person who is aware of the negative impact of owning a car on carbon dioxide emissions may still choose to drive in an urgent situation [23]. Lack of time, lack of skills, or conflicting personal goals, situational and contextual factors, and economic reasons (high initial cost, long payback period) may suppress low-carbon behavior [24].

On the other hand, discrepancies in which individuals exhibit higher levels of actual behavior than awareness are less common but possible. A study from Sweden demonstrates that it is possible to "get clean without getting green" [25]. Another study from China found that residents' awareness was lower compared to their low-carbon behavior "because motivators were stronger than barriers" [16: 1261].

For example, people can be motivated by financial repercussions, incentives, social influences, and recognition [16].

2.3 Environmental Awareness and Behavior Typology

Varela-Candamio et al. [4] found that raising citizens' awareness of global warming is an effective way to encourage them to adopt low-carbon behaviors. Raising awareness can play an important role in individual transition to low-carbon behavior [1] and is worth further investigation. However, existing research on low-carbon behavior rarely examines observable differences between individuals in their awareness and actual (self-reported) low-carbon behavior. Such insight should be valuable to policy-makers, educators, and even business owners who could benefit from a clear understanding of the typology of low-carbon behavior. In contrast to the extensive classifications of consumer behavior, the categorization of individuals according to their environmental awareness and low-carbon behavior is markedly underexplored. A study of adults from Northern Ireland and the Republic of Ireland points to the need to distinguish between different types of low-carbon behavior, as well as differences between different groups of individuals who engage in low-carbon behavior [26]. The result of their study highlights the different shades of green behavior depending on the environmental attitudes of the participants. They also challenge "existing research that treats different types of green behavior as part of the same phenomenon" [26]. Our study takes a slightly different perspective and attempts to identify different groups of participants that need to be treated differently depending on their environmental awareness and behavior. Distinguishing between different groups of individuals is important for developing more effective strategies to promote environmental awareness and low-carbon behavior.

Croatia belongs to the group of countries with modest carbon emissions. However, the pace of carbon reduction has already fallen short of the expected Green Deal targets. In addition, consumption-related emissions in Croatia are decreasing at a slower rate than production-related emissions, so urgent action is needed to change individual lifestyles. Young people are expected to be the pioneers of future carbon behavior. Low-carbon behavior among students can positively impact society as a whole and put pressure on policy-makers, employers, and educational institutions to promote the transition to low-carbon development. However, none of the studies examine how consistently Croatian students demonstrate their low-carbon behavior based on their environmental awareness. Therefore, the goal of this study is to determine if there are identifiable subgroups of students that differ in their environmental awareness and actual behavior patterns.

3 Methodology

3.1 Sample, Data Collection, and Variables

In order to study the attitudes, opinions, and perceptions of Croatian young people, an online, computer-based survey research method was used. Participants were 361 students of the Josip Juraj Strossmayer in Osijek, Croatia. The data were gathered during March and April 2021. The respondents were introduced with the purpose of the study and the protection of GDPR data. Their participation in the research was voluntary. The questionnaire consisted of four parts. Besides part one, which aimed to provide the basic information on the sample demography, in parts two-four, the respondents were asked to share their attitudes, opinions, and perceptions on: (i) opportunities and benefits brought by low-carbon transition and the efforts taken by stakeholders in this process; (ii) their low-carbon life behavior, level of low-carbon awareness, barriers, and incentives they perceive to exists; and (iii) their planned behavior concerning low-carbon. One should note that the questionnaire was pretested on a small sample of respondents to check its appropriateness for an online survey. Only small linguistic corrections were made in the questionnaire.

This paper is focused on the questions belonging to the second part, particularly the questions used to design two constructs—the low-carbon awareness and actual behavior. The former was measured using median of scales adapted from [15]. Measurement construct used to assess the latter was developed for this study. They included twelve items, which covered four categories commonly recognized in the literature as the most important—recycle activities, purchasing green products, energy efficiency and conservation, and transportation [17]. All items included in this construct used the Likert five-scale ranging from 1 (never) over 3 (occasionally) to 5 (always).

3.2 Method

People are not equal; they behave and react to stimuli differently. Therefore, it is useful to make a typology of people, i.e., cluster similar individuals into groups that differ from individuals in other groups. To that end, it is preferable to use the k-means clustering method. Its algorithm iterative estimates the cluster means and assigns each case or object, which is a young person in our case, to the cluster (group) for which its distance to the cluster mean is the smallest. In that way, the object in the same cluster is homogeneous as much as possible and different from the object of other clusters as possible. The clusters are different from each other and do not overlap, meaning no case belong to more than one cluster. By clustering, certain details are lost; however, a simplification is achieved that may be useful from a policy perspective.

K-means clustering procedure is particularly appropriate when the sample size is moderate and the number of clusters, denoted by the term *k*, is known in advance. Because of its flexibility, comprehensiveness, and effectiveness, it is the most widely used clustering algorithm [27]. There are two types of clustering techniques—hierarchical and partitioning, and the *k*-mean clustering is a partitioning algorithm. Indeed, it grouped cases into pre-defined clusters, which is the critical issue [28]. The algorithm starts with the selection of k cases as initial cluster centers and then calculates the distance between each cluster center and each case. The case is then assigned to the nearest cluster and the averages of all clusters are updated. The process is repeated until the criterion function converged, i.e., until updated cluster means do not change much between successive steps. The means of clusters that are calculated then are assigned to the cases to their permanent clusters. For a more information on k-means clustering, see [27, 28].

This paper uses standardized variables to ensure that they contribute equally to the distance or similarity between cases and squared Euclidean Distance for the divergence measure between units. It applies firstly a hierarchical cluster analysis to estimate starting values for the k-means algorithm. Moreover, it uses a one-way analysis of variance (ANOVA) and post-hoc Bonferroni test to check whether the means are spastically significantly different from each other. Finally, it uses crosstabs and performs chi-square test to examine whether three is a statistically significant association between cluster membership and sociodemographic variables. IBM SPSS version 23 was used to perform all analyses.

4 Results with Discussion

4.1 Descriptive Statistics

Demographics of respondents, which are shown in Table 1, reveal the diversity of the sample. It imposes the need to use clustering method to make a typology of students based on their level of low-carbon awareness and behavior. The majority of the respondents are women (56.2%). They live in urban area (54.3%), house (75.3%) with a family that counts two to four members. The majority of them perceives their financial situation as good (49.6%) and has studied social sciences (74.2%).

According to the median score related to the low-carbon awareness and actual behavior constructs, the respondents are mostly aware of low-carbon issues (the median grade 4), but behave only sometimes in a low-carbon way (the median grade 3). Evidently, the low-carbon awareness—behavior gap exists, and one-way ANOVA confirmed that actual behavior of the respondents is significantly different for at least one of the estimated low-carbon awareness level ($F_{38,322} = 2.848$; $p<0.001$). One should note that the Cronbach alpha suggests that internal consistency of both constructs (0.728 and 0.723, respectively) is acceptable. The Kendall's tau-b and

Table 1 Sample characteristics

Demographic characteristic		Frequency	Percentage
Gender	Male	158	43.8
	Female	203	56.2
Field of education	Natural sciences	39	11.1
	Technical sciences	86	23.8
	Social sciences	164	45.4
	Biotechnical sciences	53	14.7
	Humanities	4	0.01
	Interdisciplinary science	4	0.01
Place of residence	Rural	165	45.7
	Urban	196	54.3
Flat/house	Flat	89	24.7
	House	272	75.3
Number of family members	One or two members	4	1.1
	Two to four members	246	68.1
	More than 5 members	111	30.7
Financial situation	Very bad	1	0.3
	Bad	13	3.6
	Average	126	34.9
	Good	179	49.6
	Very good	42	11.6

Spearman's rho statistics indicate the positive, statistically significant, association between them (0.256 and 0.290; $p < 0.05$).

To explore the profile among young people, cluster analysis is performed.

4.2   Cluster Analysis

Hair et al. [29] suggested to compute a number of different cluster solutions and then decide among the alternative solutions based on practical judgment or theoretical foundations. The dendrogram of the hierarchical cluster analysis suggested a solution between three and five clusters. Consequently, k-means clustering was performed for three, four, and five clusters. After analyzing the cluster centers, the solution with three clusters turned out to be the solution that provides not only the statistically significantly different and stable clusters, but also meaningful clusters.

Table 2 shows the number of iterations (four) and the changes in the cluster centers at each stage before the process converges and there are no changes in the cluster centers.

Table 2 Iteration history

Iteration	Change in cluster centers		
	1	2	3
1	1.945	1.974	2.030
2	0.063	0.295	0.028
3	0.022	0.079	0.031
4	0.000	0.000	0.000

Note Convergence achieved due to no or small change in cluster centers. The maximum absolute coordinate change for any center is 0.000. The current iteration is 4. The minimum distance between initial centers is 3.606

The F-values from the ANOVA tests for low-carbon awareness and actual behavior (281.635 and 105.093, $p < 0.001$, respectively) suggest that both variables are significant in explaining the model, but at the same time that the awareness plays more important role in forming the clusters.

The Bonferroni test is employed to unveil whether the clusters differ significantly on the cluster variables, which were used to derive the typology. After a careful examination of Table 3 in the appendix, we confirmed that we have three statistically significantly different and stable clusters. Final solution is presented in Fig. 1.

The first cluster includes trusting respondents who sometimes engage in low-carbon activities. This cluster consists of 246 young people, which is about 68% of respondents and is labeled adaptive. It is the most populated cluster. The second cluster includes 39 young people, i.e., about 5% of respondents who are quite skeptical but often engaged in low-carbon activities. It is labeled dutiful. This cluster has the fewest members. The last cluster, labeled skeptic, includes 76 (21.1%) skeptical respondents who are mostly opposed (rarely active) to low-carbon behavior.

Table 3 Results of Bonferroni post-hoc test

Dependent variable cluster			Mean difference	Std. error	Sig.
Zscore (low-carbon awareness)	1	2	2.004	0.108	0.000
		3	1.464	0.082	0.000
	2	1	−2.004	0.108	0.000
		3	−0.540	0.123	0.000
	3	1	−1.464	0.082	0.000
		2	0.540	0.123	0.000
Zscore (actual behavior)	1	2	−0.443	0.137	0.004
		3	1.392	0.104	0.000
	2	1	0.443	0.137	0.004
		3	1.835	0.157	0.000
	3	1	−1.392	0.104	0.000
		2	−1.835	0.157	0.000
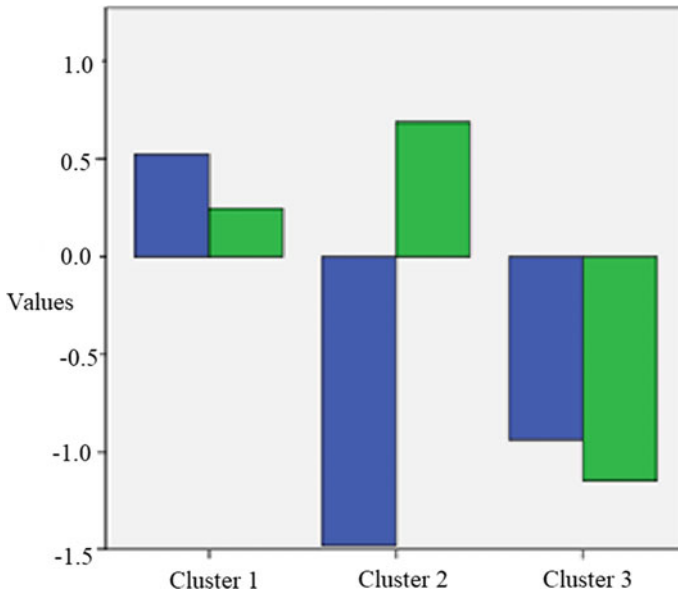
Fig. 1 Final solution. *Note* Blue/green columns represent awareness/actual behavior levels

Although the previous studies did not pay much attention to the typology of people according to low-carbon awareness and actual behavior, several one revealed the existence of the adaptive people [17]. However, opposite results can be found in the literature as well. For example, [16] revealed that the level of low-carbon behavior of the citizens of Tianjin (China) was higher than their awareness. As explained by the authors, this was due to the stronger influence of motivators than barriers.

To profile the clusters in detail, we checked whether there is a statistically significant association with the selected demographic variables: gender, field of education, place of residents, flat/house, family members, and financial situation. Table 4 reports the chi-square test statistics.

Members of Cluster 1 ("adaptive") show a statistically significant association with all tested sociodemographic variables except the place of residents, which turned out to be insignificant across all clusters. The members of Cluster 1 are more likely women than men who live in urban area, house, with a family that has 2–4 members. The adaptive members are more likely to perceive their financial situation as a very good (grade 4) and they study social sciences.

Members of Cluster 2 ("dutiful") also are more likely to study social sciences and live in a house. But, they asses more likely their financial situation as a good or very good. This cluster includes more men than women, who live in rural area; but these associations are insignificant. There is also an insignificant association between cluster membership and the number of family members.

Table 4 Results of chi-square tests

	Cluster 1 adaptive (N = 246)	Cluster 2 dutiful (N = 39)	Cluster 3 skeptic (N = 76)	Sample
Gender	χ2(1) = 9.366 p < 0.01	χ2(1) = 0.026 p = 0.973	χ2(1) = 0.053 p = 8.19	χ2(1) = 5.509 p < 0.05
Field of education	χ2(5) = 221.448 p < 0.01	χ2(4) = 14.974 p < 0.01	χ2(3) = 25.200 p < 0.01	χ2(5) = 312.640 p < 0.01
Place of resident	χ2(1) = 2.341 p = 0.125	χ2(1) = 0.541 p = 0.423	χ2(1) = 1.895 p = 0.169	χ2(1) = 2.682 p = 0.103
Flat/house	χ2(1) = 199.122 p < 0.01	χ2(1) = 18.692 p < 0.01	χ2(1) = 10.0 p < 0.01	χ2(1) = 310.676 p < 0.01
Family members	χ2(2) = 158.512 p < 0.01	χ2(1) = 1.256 p = 0.262	χ2(1) = 21.053 p < 0.01	χ2(2) = 244.427 p < 0.01
Financial situation	χ2(4) = 262.089 p < 0.01	χ2(3) = 10.128 p < 0.05	χ2(3) = 33.158 p < 0.01	χ2(4) = 329.457 p < 0.01

Members of Cluster 3 ("skeptic") are more men who assess their financial situation more likely as good. They more likely live in urban areas, house, and their family number counts two to four members.

As observed by several authors (e.g., [30, 31], the relationship between low-carbon awareness and behavior is very important for low-carbon development. It impacts the pace and the quality of the low-carbon transition. As such, it demands jointly action of different actors in order to improve low-carbon awareness and promote low-carbon behavior. Although the members of Cluster 1 show the higher level of awareness (median grade 4) than in other clusters, carefully planned and coordinated activities need to be continuously improved.

5 Conclusion

Raising environmental awareness has been frequently used as the starting point to encourage individuals' behavior changes and to adopt low-carbon lifestyles. However, heterogeneity of the low-carbon behaviors, as well as individual dispositions that may lead to the different types of congruence between what students are aware of and what they actually do, has been underrepresented in the research.

This study is the first attempt to examine consistency (or lack of it) in regard to environmental awareness and actual low-carbon behavior among Croatian university students. Several types of inconsistent behaviors have been detected. For example, findings indicate that there are students whose level of environmental awareness is higher than actual behavior (adaptive), those whose level of awareness is lower than actual behavior (dutiful), and those whose level of awareness and actual behavior are modest. Adaptive cluster is the most populated and majority of the students demonstrate flexibility in the sense that their behavior is not always consistent with their

environmental awareness. Their high awareness does not always translate into low-carbon behavior for variety of reasons. Those students might be faced with the barriers that inhibit them to act according to their awareness of the problem, or they have false sense that some aspects of their conduct compensate other aspects. For example, because they use bikes as low-carbon transportation vehicle, they care less about saving home energy. In addition, adaptive students may inhibit low-carbon behavior due to the barriers (lack of time, effort, money). Different incentives might be appropriate (from increasing actionable skills, to alleviating the barriers to low-carbon behaviors). Dutiful students are those whose low-carbon behavior is higher than their environmental awareness. They seem to respond more to the environmental regulations, laws, reward policies, or cost savings than to their internal values. Although they have highest low-carbon behavior, raising their awareness may have the long-lasting effect on their low-carbon behavior. Cluster of skeptical students are least populated by students who rarely engage in low-carbon behavior and have relatively low level of environmental awareness. Those students are candidates to benefit most from the awareness-raising campaigns initiated by policy-makers, educational institutions, or other types of stakeholders. Several studies already indicate that awareness can be raised by the visual aids and photographs of the environmental problems as well as through exposure to the positive role models and trainings in the pro-environmental daily routines. However, additional studies are necessary.

The sociodemographic profiles of the clusters have few significant distinguishing characteristics. For example, women and wealthier individuals are more adaptive to change, which is consistent with the majority of previous research.

It should be noted that the results are based on a sample of university students at one of the largest Croatian universities and are, therefore, not generalizable. In addition, one of the limitations of the study is taking integral measure of low-carbon behavior rather than exploring potential differences between four components of low-carbon behavior. In addition, the clustering was based on two variables. Since low-carbon behavior is a multidimensional and complex phenomenon, further studies should pay more attention to other psychological variables when profiling specific clusters. In addition, it seems worthwhile to further investigate the determinants of environmental awareness (visual images, contact with role models, environmental workshops). Another possible avenue for further study could be to pay more attention to the effect of reducing barriers and inhibitions (lack of skills, opportunities, time) or to the factors that promote the transition to low-carbon behavior (cost savings, social recognition, financial incentives).

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Implication of Social Programs on Subjective Economic Well-Being: A Perspective on the Case of Junin, Peru

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Abstract Social programs emerge as a response of a government seeking to improve the welfare of its population living in extreme poverty; knowing the perception of beneficiaries will prove the efficiency of their application. In this article, we test the impact of social programs on the subjective economic well-being of families in the Junin region of Peru. The data were extracted from the results of the ENAHO (National Household Survey) between the years 2012 and 2019. For the empirical strategy, we used a binary choice model, specifically a logistic regression. The findings show that the "Juntos" and "Pension 65" social programs do not generate a positive impact on the subjective economic well-being of beneficiary families, making this analysis an outlier to what theory adduces. The management of public policies in the Peruvian case lacks information that does not allow us to know exactly what the needs and demands of the population are, or these are ignored by policymakers.

Keywords Subjective well-being · Social programs · State policies

1 Introduction

Social programs are aimed at segmented sectors according to their needs, whose objective is to reduce the problems of monetary inequality and opportunities, in other words, to improve the welfare of the beneficiaries. However, the effect of these programs on the welfare of the beneficiary population goes far beyond measuring it through socioeconomic indicators such as gross domestic product, poverty rate, GDP per capita, and HDI, since welfare encompasses a very broad concept. Therefore, the subjective perception of the beneficiaries must be considered to verify the real efficiency of a social program applied to a specific population living in poverty [1].

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Poverty is a major problem and has social, economic, and political consequences. The concept is quite broad, since it not only implies low-income level (objective indicator) but is also related to low quality of life, social class, labor position, access to basic household services (sanitation, electricity, drinking water), education, health, among many other aspects that relate to the satisfaction of needs of individuals, in other words, the state of well-being or more subjective indicators [1].

In Peru, according to [9], the population identified as living in monetary poverty in 2019 was 20.2%, maintaining a level close to that of 2018, where it reached 20.5%, that is, around 6.4 million inhabitants were living in poverty. Likewise, according to [5], the monetary poverty between 2009 and 2015 decreased nationwide; however, poverty in the rural region is still worrying, with a higher level concentrated in the jungle region and highland region. In accordance with this, the way of measuring monetary poverty in Peru includes families whose spending per person is deficient and unsatisfactory to be able to acquire a set of basic food products and other services (home, clothing, academic training, etc.).

As for the years not considered, which comprise between 2020 and 2022, they were not taken into consideration because, in 2020 and 2021, there was an unexpected change in the time series due to the COVID-19, as a consequence of higher unemployment, quarantines, social isolation, border closure, among others, that increased poverty, according to [12], mentions that in the year 2020, monetary poverty increased ten percentage points compared to 2019, concluding that there was a 10-year setback. This deviates us from the main objective of our research, to identify the effect of social programs on the subjective economic well-being of Junin (2012–2019); and as for the year 2022, there is no annual data for the date of study (first quarter 2022).

There has been a decrease in the level of monetary poverty in Peru in recent years. However, the percentage difference by department remains the same. The regions located in the center and south are the regions with the highest level of poverty and suggest a worrisome socioeconomic issue. Because of this, in the National Household Survey [ENAHO] 2018–2019, grouped the twenty-five national departments according to their level of monetary poverty, in the case of the first group, the percentage exceeds the national average with a minimum of 34.4% and a maximum of 39.4%; on the other hand, the region that maintains the lowest percentage of monetary poverty is Ica between 1.3% and 3.9% which belongs to the fifth group [9].

According to the information, which shows that in 2019, within group three of the departments grouped according to their level of monetary poverty is the region of Junin, with an average between 21.9% and 25.3%. For the years 2007–2016, Junin was in group four, that is, it belonged to a group that presented lower percentages of monetary poverty that were between 14% and 18.1%, which shows that the poverty numbers in Junin have increased, that is why the main objective is to prevent the Junin region and the other departments from having percentages like those of groups one and two [9].

Focusing on the association between social programs and welfare, [22] analyzed the importance of the different social policies implemented in Bolivia through social programs, where they found that the conditional transfer plans did make it possible to reduce poverty and improve social welfare. Similarly, [2] in his objective to know

the impact of a Mexican social program because, despite the large amounts of money spent annually by the Mexican government on social programs, it is not possible to know the real impact beyond just the growth indicators, so he considered that it was important to measure the effects in depth. Based on the above, the author determined that the "Prepa Sí" program (education), which was implemented in Mexico City, did contribute to student welfare.

In this sense, after analyzing the implications of social programs, which indicate that subjective well-being can be studied through the perception or assessment of people's well-being, this paper hypothesizes that social planning can increase the subjective well-being of the population in the Junin region.

Therefore, the main objective of this research will be to demonstrate the effectiveness of social programs on the subjective well-being of families in Junin, as well as to recognize the indicators that can be used to measure subjective well-being and to identify which of the social programs studied has the best effect on the subjective well-being of families in Junin.

2 Literature Review

2.1 Welfare Economics

According to [4], welfare economics is a sub-discipline that is based on measuring and quantifying the benefits and costs of the various alternatives that exist for the efficient allocation of scarce resources, as well as investigating the structural bases of economic and social policy. Cost–benefit analysis determines whether the welfare of a given population has improved or not. However, there is no globally accepted criterion for interpreting welfare, since certain actions may improve the welfare of some and harm that of others.

Therefore, to measure well-being, it is necessary to make the sum of improvements in the perception of well-being.

A positive variation in an individual's income will not necessarily produce a significant change in subjective well-being. For example, an increase in GDP will not automatically increase people's income, since GDP is a broader concept (Pigou, 2005, as cited in [19]).

2.2 Subjective Well-Being

For [3], the concept encompasses a global analysis of the different aspects of an individual's life, understood as an integrated judgment of the individual, but this perception is per period, there is no way to determine which moment is the most

appropriate; however, cognitive and affective components can be included as part of scales for measuring the quality of life.

In addition to that, in accordance to [28], subjective well-being is a multifaceted term that encompasses the different perceptions that individuals determine about the reality in which they live, the experiences that occur to them and the decisions they make about their lives. Within this, cognitive elements are manifested as a result lead to the creation of the individual's own judgments in which emotions and impressions intervene. Moreover, [24] mentions that subjective well-being is "an option to the traditions of imputation and presumption of well-being", this will be based on knowing everyone's perception of one's well-being, and the person must include the concept of well-being, since the fact of encompassing the affective, hedonic, and cognitive experience domains. On the other hand, [18] define it as how a person evaluates in what way satisfied he/she is with his/her life.

In part, well-being does depend on income, but absolute income by itself does not determine subjective well-being. As stated by [18], the increase in the satisfaction that derives from the increase in absolute income happens partly offset when all people in the same reference group perceive an increase in income in the same proportion.

2.3 Determinants of Subjective Well-Being

For Diener, Suh, Lucas and Smith (1999) cited by [8] detail that could include life satisfaction as one of its determinants (desire to change one's life, satisfaction with current life, with the past, with the future, and with how others see our life) and the domains of satisfaction would be work, family, leisure, health, and income.

This subjective well-being encompasses two highly related aspects, the cognitive-emotional analysis and the global analysis, and involves how a person identifies each component of his or her life that influences well-being [8]. Meanwhile, [3] mentions that it is composed of the subjective character, which is defined as the individual's own experience, the global dimension which is an assessment of the state of his or her life, and the inclusion of positive dimensions due to its nature.

In this context, for the analysis of this study, the focus of the determinants of subjective well-being will be related to socioeconomic circumstances. These are the perception of the standard of living and the perception of income behavior, which in turn are measured under five indicators: (1) perceives that he/she lives well with his/her income, (2) perceives that during the last year the standard of living of his/her household improved, (3) perceives that during the last year the standard of living of his/her community improved, (4) perceives that he/she manages to save, and (5) perceives that his/her income is stable.

2.4 Social Programs

According to [27], social programs are an intervention of the state in search of efficiency in the economy, based on the way income is distributed, because no matter how much efficiency there is in the Pareto sense, income distribution may continue to be uneven in society, leaving a certain group with very limited resources. Therefore, the state intervenes by creating these programs to redistribute income to eliminate economic inequality.

Furthermore, [21] mentions that they are plans created from the perspective of the state to reduce poverty. Since their implementation in 1990 in Peru, social programs consisted of two approaches: (a) aimed at fostering labor resources for the eradication of indigence in the long and medium term and (b) aimed at alleviating poverty in the short term by addressing the highest priority that the poorest population requires [5].

The main function of social programs is to grant goods and services with the sole purpose of satisfying the most basic needs of a population in a situation of vulnerable poverty, and they also aim to boost the economic value of the subsidized individuals so that from that they can promote their productive competencies and thus improve their socioeconomic performance [21].

National Program of Direct Support to the Poorest—Juntos
According to [20] the Peruvian cash transfer program Programa Nacional de Apoyo Directo a los Más Pobres Juntos, initiated in September 2005, is one of the social policies born as a response to the fight against the increase of monetary poverty in Peru, whose main objective is to reduce generational extreme poverty and provide social protection to those Peruvian citizens who cannot access social services such as national health service and/or education service. The purpose of the program is to reduce the consumption probabilities of the families belonging to the program, considering the valuation of their fundamental rights. Likewise, it had as antecedents the international programs that with the same objective and purposes are applied for programs under the name of Opportunities in Mexico and Bolsa Familia in Brazil.

In accordance with [15], the program offers social protection, i.e., benefits such as health, education, nutrition, and equality. Thus, using cash transfers, it encourages the most economically vulnerable families to increase their consumption and investment in human capital in the short term, since in the long term what it seeks is that these transfers or incentives end up eradicating the problem of generational poverty in Peru. Demographically, the Juntos program prioritizes the rural area of the country because it is the population of households that suffer the most from poverty and extreme poverty.

Pension 65
As it points out [16], is a social program of monetary subsidies, it was created in October 2011 and is aimed at adults over 65 years old who have a quality of life in a situation of extreme poverty and their fundamental basic human rights are defended. Its primary function is to look after the economic situation of affiliated older adults belonging to different rural and urban demographic areas. To estimate the

Table 1 Household surveyed nationwide

Year	2012	2013	2014	2015	2016	2017	2018	2019	Total
Total	26,456	31,69	31,69	33,43	38,296	36,996	39,82	36,994	275,372

Note Taken from "Microdatos: Consulta por Encuesta", by Instituto Nacional de Estadística e Informática

correct number of older adults in need of the program, it makes use of the Household Targeting System and identifies the older adults who are most vulnerable physically, economically, and emotionally.

As stated by [14], among the primary purposes of the program, the contribution of making the beneficiaries in extreme poverty feel economically secure stands out, as well as the promotion of physical, psychological, and emotional well-being. In addition, the cooperation and contribution of older adults are encouraged.

3 Methodology

3.1 Data

The ENAHO for the periods 2012–2019 is taken as a reference, which is a data collection program associated with the level of well-being of the population, which makes it possible to monitor the quality-of-life indexes in Peru. According to [11], "it is a survey of law that is executed nationwide, throughout the year".

The total number of households surveyed using the updated methodology of the ENAHO at the national level is distributed yearly and is seen in Table 1.

Likewise, an analysis of the number of households that responded to the subjective well-being dimensions is given in Table 2.

The data sample represents the Junin region, using filtered data from the ENAHO for the periods 2012–2019. The data are filtered from the Ubigeo that corresponds to the department of Junin (120,000). Thus, the number of households surveyed is given in Table 3, which corresponds to the periods 2012–2019.

From which a further filter is made to determine the people who have access to the social programs "Juntos" or "Pension 65", the new final sample is 881 beneficiaries for Pension 65 and 1249 for Juntos, making a total of 2130.

3.2 Standardization

The independent variables will be both social programs, which are found in the ENAHO format, these are strategies or planning that the state puts forward to mitigate the lack or to intensify important capabilities of a segment of the population [30].

Table 2 Dwellings surveyed according to dimensions

No. of households responding	Perception of income	Perception of household standard of living	Perception of the standard of living in your community	Savings	Estimated income
2012	23,819	23,822	23,821	23,822	23,825
2013	28,518	28,518	28,518	28,517	28,518
2014	28,826	28,826	28,826	28,826	28,826
2015	30,415	30,416	30,416	30,416	30,417
2016	33,345	33,345	33,345	33,345	33,345
2017	31,871	31,873	31,873	31,873	31,872
2018	33,941	33,942	33,942	33,942	33,942
2019	31,807	31,806	31,806	31,807	31,807

Note Taken from "Microdatos: Consulta por Encuesta", by Instituto Nacional de Estadística e Informática

Table 3 Households surveyed, Junin

Year	2012	2013	2014	2015	2016	2017	2018	2019	Total
Homes surveyed—Junin	1122	1349	1343	1511	1551	1537	1567	1571	11,551

Note Taken from "Microdatos: Consulta por Encuesta", by INEI

National Program to Help the Poorest—(Juntos) and National Solidarity Assistance Program—(Pensión 65).

The items considered are regarding the receipt of social programs of direct economic support to the poorest and the period of access to the program, including the present.

Within the research, a selection of variables formulated in the ENAHO was made to evaluate the impact of the subjective well-being generated by the two social programs. In this order, the questions considered were the perception of the standard of living, in which the changes or evolutions in the quality of life that the beneficiaries went through are analyzed and the perception of the behavior of income, in which the evolution of the financial situation and income over the years is analyzed (Table 4)

Between the years 2012 and 2019, filtering the data according to the five sub-dimensions, a single dichotomous variable (well-being) was generated which contains the sum of the five sub-dimensions; if the family perceives 2 or more of the dimensions = 1; 1 or less = 0. In a general way, the variables were filtered by cluster number, housing selection number, and Ubigeo code for the Junin region.

Table 4 Criteria for assessing the impact of subjective well-being

ENAHO input questions	Indicators
Dimension: perception of living standards	
37. With your household income, do you estimate that you live? – Very good – Good – Bad – Very bad	1. You perceive that you are living well on your income: Value 1: "Very good" or "Good". Value 0: otherwise
33.2 In the last year, has the standard of living of your household? – Improved – It is the same – Worsened	2. Do you perceive that during the last year your household's standard of living improved: Value 1: "improved" Value 0: otherwise
33.1. In the last year, has the standard of living in your community? – Improved – It is the same – Worsened	3. Do you perceive that during the last year the standard of living in your community improved: Value 1: yes: "improved" Value 0: otherwise
Dimension: perception of income behavior	
32. In the current financial situation of your household – Do you save money? – Do you barely manage to balance your income and expenses? – Are you forced to spend your savings? – Are you forced into debt?	4. You perceive that you are able to save money: Takes the value 1 if the input question was answered "manages to save money" and takes the value 0 otherwise
38A. Is your household income…? – Too unstable? – More or less stable? – Stable?	5. You perceive that your income is stable Value 1: "stable" Value 0: otherwise

3.3 Development of the Binary Choice Model

To analyze the impact of social programs on subjective well-being in Junin, a binary choice model was used, specifically a Logit model, so we proceeded to convert the variables to dichotomous variables, placing 1 and 0 depending on the favorable results we need to achieve, we performed the regression for the dichotomous variable well-being (subjective well-being) and analyzed whether it is related to access to the "Juntos" and "Pension 65" social programs.

3.4 Components

Mentioned by [26], the binary logistic regression technique or better known as the Logit model is applied if the dependent variable is dichotomous, as it will represent access to social programs (value 1 if accessing the social program and value 0 if not accessing it); the technique also has advantages of robustness, for instance, in the presence of assumptions of normality, and the analysis of results is coincidental to that of linear regression. On the other hand, the Probit model provides the dependence of a group of independent variables on the ordinal response, that is, it analyzes which determinants influence the level of satisfaction of a scale, which is of auxiliary or complementary use to the Logit model. Likewise, [23] mentioned that it is characterized by being nonlinear, in terms of the probability and magnitude of change of the results of the independent variables, also depending on the levels of all these.

Given the dependent variable y:

$$y_i = \alpha + \beta x_i + \varepsilon_i$$

where i is the observation, x is a vector of the variables predicting the model, and finally ε is the model error term.

We proceed to divide y into k ordinal categories.

$$y_i = m, \quad \text{if } \tau_{m-1} \leq y \leq \tau_m \text{ to } m = 1 \text{ to } k$$

where the cutoff points τ_1 to τ_{k-1} are estimated. We assume that $\tau_0 = -\infty$ y $\tau_k = \infty$.

3.5 Dimension Scores

To comply with the dichotomy of the model, we proceed:

Variable y_1 is the perception that a person lives well on their income, where "Very good" and "Good" will take the value of 1 and 0 otherwise. Variable y_2 is the perception that the standard of living of a household improved, where "Improved" will take the value of 1 and 0 otherwise. Variable y_3 is the perception that the standard of living in your locality improved, where "Improved" will take the value of 1 and 0 in the opposite case.

The variable y_4 is the perception where a person manages to save money, where "Manages to save" money will take the value of 1 and 0 otherwise. Moreover, the variable y_5 is the perception whose income is unstable or stable, and "stable" will take the value of 1 and 0 otherwise.

4 Results

In the first regression, the likelihood ratio (**LR**) of the analysis of variance is 180.67 and has a probability of 0.000, which means that the whole model is significant, since it is less than 0.05, making the variables Juntos and Pension 65 together help explain the variable "Welfare"; the Pseudo R2, which varies in a nonlinear way, is 0.0115, which means that there is a good global adjustment. With respect to the z coefficient, the values are greater than 1.96, implying a greater relevance of the variables. Both variables are significant.

Regarding the marginal results of the variables Juntos and Pension 65, we proceed to multiply the coefficients with the density function, for Juntos it is 0.0431, which results in 0.005; for Pension 65 it is 0.0368, which results in 0.007, the interpretation is that when a family accesses the Juntos and Pension 65 programs, and the subjective well-being does not increase or decrease.

The odds ratio is added to the regression, which serves to analyze the influence of the regressor variables on the regressed variable. The odds ratio should not be close to one or equal to one because there would be no relationship between the variables. If it is greater than one, there is a positive dependence, and if it is less, there is an inverse relationship. For the first regression, the odds ratios are less than one, i.e., there is an inverse relationship between greater access to a social program (Juntos and Pension 65) and how subjective well-being is perceived.

5 Discussion of Results

The subjective well-being variable included five sub-dimensions that allowed us to evaluate the personal perception of each person in the Junin region. It was expected that the implementation of social programs would reflect a positive perception in all areas, however, being a region within group three with monetary poverty, it is not one of the target groups where more emphasis was placed at the time of applying the social programs; therefore, the number of beneficiaries of the programs is lower than in other departments. Therefore, the implementation of the programs did not reflect either satisfaction or dissatisfaction of subjective well-being in the beneficiaries of Junin, in other words, the effect was null.

If we look at a national study, being a user of Pension 65 has a greater impact as time goes by, that is, for each additional 10 months in the program, satisfaction with household income increases. However, the same is not true for the Juntos program, since an additional month in the program does not contribute to increasing the probability of perception of improvement in all indicators that comprise subjective well-being, except for income stability [17]. Our results show that while it is true that the variables explain the model, that is, they are significant, both the "Juntos"

social program and "Pension 65" have a null effect (by the magnitude of the probability according to the Logit model) on subjective well-being in Junin between 2012 and 2019.

As for how to measure subjective well-being, according to [7], to effectively measure human well-being, a range of subjective indicators must be considered that reflect all aspects of a person's life and that in effect lead to well-being, which are constructed through surveys that reveal the individual perception of well-being that each person has. Taking this into consideration, in this study we determined in the best possible way the appropriate indicators that allowed us to identify exactly what is the perception of a family's standard of living and income level. Unlike the "Life Satisfaction Scale" created in 1985 by Diener, which only allows to evaluate life in a general way considering personal standards and includes more an affective balance between positive and negative emotions that a person experiences in a certain period [6]. Or also the measure of the "Emic Scale" that allows identifying the achievement of needs proposed by a person, which includes factors such as feeling good, good place to live, status and home, which would allow evaluating more the perception with the standard of living that the person has, nevertheless, not corresponding to the trend of their income [6].

Regarding the effect generated by both programs on beneficiaries, after obtaining the results that would help us understand which of the two programs had a better effect on subjective well-being according to the indicators taken for the analysis, it was obtained between the "Juntos" program and "Pension 65", that the program that maintains a slightly more positive effect on subjective well-being is the "Pension 65" program because on the one hand, verifying the z coefficient, this is greater than that of "Juntos" in absolute terms. On the other hand, in terms of their marginal effects, the effect of the "Pension 65" program is slightly larger than that of the "Juntos" program. However, together the two programs did not reflect either satisfaction or dissatisfaction in subjective well-being. If we compare the results with what was found in the nationwide study by [17], where his results show a positive effect in a greater magnitude for "Pension 65" users, whose benefit from the perception of the beneficiaries represents an important change in their lives. It should be emphasized that in the cities of rural areas, there is the largest number of beneficiaries of social programs, in fact they are around 60 percent and through a targeting mechanism are derived to the same. Although our result shows an almost null effect on subjective well-being, since much depends on the number of beneficiaries for the effect to be total, Junin only represents four percent of the number of "Pension 65" and "Juntos users". To validate this, national results where there is a positive effect, because the coefficients in the regression are positive, being from the Juntos program (0.32) and Pension 65 (0.11), i.e., social programs do increase the subjective economic well-being of the population.

6 Conclusions

This scientific research has described and analyzed the dimensions of subjective well-being of families in Junin 2012–2019, based on current theory. Different empirical theories suggest that the term well-being should not be based only on economic or objective well-being, since the term encompasses more general well-being [25].

Through quantitative methodologies in order to obtain generalizable results for the population of Junin, by means of available data, impacts on the variable related to economic satisfaction were identified, this being a variable that contributes to the study of subjective well-being, it should be emphasized that it is not the only one, and in the same way that these conclusions are subject to discussion and could be complemented with studies using qualitative techniques, for example.

Two social programs (Juntos and Pension 65) were evaluated. The specification of the model showed empirical evidence of the existence of the monotonicity property ("more is better"), so the following conclusions were obtained.

We found evidence of the existence of a significant effect of accessing social programs of cash transfers (Pension 65 and Juntos); however, subjective well-being in the Junin region between 2012 and 2019 does not increase or decrease.

On the other hand, the measurement of subjective well-being will be efficient if the levels of happiness are well established, which will allow the identification of groups with serious problems, the monitoring of this trend and the interpretation and analysis of why some people are happy and others are not. In this sense, over time it will be possible to identify what matters to people and to what extent [13].

In summary, it has been shown that the general hypothesis which mentions that the programs have a positive effect on subjective well-being in the families of Junin between 2012 and 2019 are rejected. Therefore, there are still dissatisfactions due to factors that should be identified in more in-depth studies.

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The Significance of Environmental Accounting in Promoting Supply-Side Structural Reform

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Abstract In recent years, the Chinese government has repeatedly emphasized that the relationship between the environment and the economy should be properly handled in the supply-side structural reform. The environmental accounting information of enterprises can reflect the environmental protection activities of enterprises in the past, so its importance has been increased in the current social and economic environment. The steel industry is one of the 16 heavy-polluting industries announced by the Ministry of Environmental Protection, and environmentalists from all walks of life have been paying close attention to the environmental activities of the steel industry. And the steel industry is a pillar industry for the development of China's national economy, and it is also the focus of the supply-side structural reform. This paper aims to explore the significance of environmental accounting information disclosure to the supply-side structural reform. By quantifying and scoring the environmental accounting information disclosure of three typical iron and steel enterprises, and calculating the height value of the iron and steel industry structure in the corresponding year. And the correlation analysis of the above two values can be concluded that there is a high correlation between the two. Through further theoretical and empirical analysis, it can be concluded that environmental accounting plays an important role in promoting the supply-side structural reform. Including helping enterprise managers and the government to better understand the environmental protection situation of enterprises, and urging enterprises to eliminate outdated production capacity. In order to improve the level of environmental accounting practice, efforts should also be made from three aspects: establishing a more complete environmental accounting information disclosure system, broadening the environmental accounting information disclosure channels, and strengthening the supervision of environmental accounting information disclosure.

Keywords Environmental accounting information · Supply side · Reform

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1   Introduction

1.1   *Background*

At present, enterprises have increased obligations of social responsibility, especially environmental information disclosure. In terms of legislation, new environmental accounting information disclosure laws and guidance are introduced. At the same time, in the supply-side structural reforms, higher requirements for the quality of environmental accounting information also have been put forward by the government and the public.

The steel industry is an important basic industry for the development of the national economy and has developed rapidly since the reform and opening up. However, the contradictions caused by the low-quality development of China's steel industry in the past have become increasingly prominent. Since the 1990s, China's steel industry has experienced three large-scale excess capacities, each of which has attracted great attention from the Chinese government and all sectors of society. Besides, since General Secretary Xi Jinping first formally proposed supply-side structural reform in November 2015, the steel industry has always been the focus of reform. In 2016, the State Council issued the "Opinions on Dissolving Overcapacity in the Iron and Steel Industry and Realizing Development from Difficulties." In 2017, the National Development and Reform Commission and the Ministry of Industry and Information Technology jointly issued the "Notice on the Use of Price Means to Promote the Supply-side Structural Reform of the Iron and Steel Industry." In 2020, the National Development and Reform Commission issued the "Notice on Doing a Good Job in Resolving Overcapacity in Key Areas 2020," etc. During this period, the structural reform of my country's iron and steel industry has achieved outstanding results, but with the further development of the social economy, this type of traditional enterprise has been put forward with higher requirements.

Eliminating excess low-end production capacity, reducing the impact of heavily polluting enterprises on the environment, and curbing the deteriorating natural environment in China are all goals of supply-side structural reforms. Environmental accounting can comprehensively reflect the impact of business activities on the ecological environment. Also, it can urge enterprises to rationally use environmental resources to improve the environmental benefits of the entire society. It is an important means to further deepen the supply-side structural reform in the future.

1.2   *Related Research*

Néfissa and Jilani [1] analyzed based on stakeholder theory and believed that environmental accounting information is an important factor affecting investor decision-making, and there is a mutual promotion between environmental performance and

economic and financial performance. Besides, this point was fully proved by Liu's analysis of 28 evaluation indicators of 34 Chinese listed thermal energy companies.

Starcevic et al. [2] studied several Croatian-listed manufacturing companies, analyzed the way they reported environmental information, and the proportion of it in the financial reports of these companies in 2017, and made extensive use of methods to test hypotheses. Also, it summarizes the limitations of the study and proposes that the application of EA in the future should focus on manufacturing enterprises.

Guan et al. [3] classified the existing accounting information disclosure of Chinese listed companies, puts forward a new quality evaluation method, analyzed the feasibility of this method through case analysis, and finally put forward policy suggestions for listed companies and the government, respectively.

Boyd and Banzhaf [4] argue that there should be a unified definition of units of account in environmental accounting and use specific examples to illustrate the definition of ecological units of account and the goals of defining these units of account. It is believed that the unification of accounting units in this aspect can provide a framework for the measurement of the environmental performance of the government, protected areas, and environmental markets.

Nayyef and Solnaki [5] proposed that accounting should provide managers with sufficient information on environmental costs and other relevant information to ensure that managers have a sufficient and reliable basis for decision-making and prevent managers from making incorrect decisions due to lack of information. Incorrect decision-making contributes to the deterioration of environmental conditions.

Li [6] demonstrated the externality of enterprise environmental accounting, the autonomy of disclosure, the "arbitrariness" of audit, and the abnormality of information form, and discussed the reliability problems expected to be solved at present. Finally, four solutions to this problem were put forward, and the importance of promoting relevant legal construction in solving this problem was emphasized.

Xu et al. [7] analyzed the relevant theories and definition concepts of environmental accounting, interpreted the international laws and relevant policies of various countries on environmental accounting, commented on domestic and foreign environmental accounting theories, and put forward four suggestions, such as establishing an environmental accounting industry accounting standards and improving the environmental responsibility audit accountability system.

Liu et al. [8] analyzed the reasons for the development of Japanese corporate environmental accounting information reports and studied the framework and characteristics of Japan's "Environmental Accounting Guidelines 2005." Finally, it fully considers the reference significance of Japan's "Environmental Accounting Guidelines 2005" in my country and advises on the reform of relevant systems in China.

Lin et al. [9] put forward the framework of enterprise environmental accounting under the concept of sustainable development and analyzed the dilemma of enterprises implementing environmental accounting. Finally, four countermeasures are put forward to strengthen environmental protection awareness and theoretical guidance,

improve the environmental accounting legal system, actively learn from the mature environmental accounting mechanism, and improve the environmental accounting supervision and disclosure mechanism.

Jiang [10] took a steel company as the research object. He made a comparative analysis of its annual reports and social responsibility reports in recent three years and studied its environmental protection projects. Research shows that the main problems of accounting information disclosure include lack of effective supervision of disclosed content, strong randomness of disclosed content, and too one-sided disclosure.

Liu et al. [11] used the calculation model of Moore's structural change value and industrial structure upgrade height value to calculate the upgrading of the metal mining industry structure before and after China's supply-side structural reform. Through the calculation of the degree of upgrading, it is found that the height value of the industrial structure has been increasing year by year after the reform, and the industrial structure has experienced a state of evolution from the primary stage to the advanced stage. Finally, based on the calculation results, policy recommendations are put forward.

1.3 Objective

This paper aims to study the significance of environmental accounting in promoting the supply-side structural reforms, analyze its value and its specific role in the improvement of the supply-side structural reform, and analyze the problems of existing environmental accounting information disclosure system through quantitative data. Then, this paper puts forward methods to solve these problems and discusses how to better promote the supply-side structural reform.

1.4 Innovation

The innovations of this paper include content innovation and method innovation. First, this paper links the relationship between the industrial structure reform at the macroeconomic level and environmental accounting and conducts an empirical analysis on whether the latter has a positive effect on the development of the former. Second, the scoring standard for measuring the quality of corporate environmental accounting information disclosure is innovative. With reference to the disclosure requirements put forward in the "Order No. 24 of the Ministry of Ecology and Environment" issued on November 21, 2021, the original evaluation mechanism has been improved.

2 Data

This paper aims to explore the role of environmental accounting information disclosure in the supply-side structural reform. Therefore, this paper quantifies the level of disclosure quality and reform and selects the score of environmental accounting information disclosure quality as the independent variable and the height of industrial structure upgrading as the dependent variable.

2.1 Concept Definition

From the perspective of national economic development, the height of the industrial structure, as a measure of labor productivity, represents the substantial progress of national economic development. For industry, the improvement of the index represents the improvement of industrial production technology and production efficiency and is the performance of the overall development of the industry.

Deegan and Gordon [12] proposed that experts and scholars can evaluate and determine the quality of corporate environmental accounting information disclosure by counting the number of sentences in corporate disclosure annual reports or other environmental accounting reports when conducting analysis and research. Based on this theory, a set of scoring criteria will be designed.

2.2 Scoring and Calculation Method

This article draws on the scoring criteria of Cho [14] and Guan [15] on environmental information disclosure-related research, as well as the legal disclosure of corporate environmental information issued by the Ministry of Ecology and Environment of China on December 11, 2021, management measures, combined the characteristics of iron and steel enterprises in information disclosure, established a relatively perfect evaluation system for accounting information disclosure, and list many factors involved in the evaluation. Although it is still not specific enough, it has extremely important guiding significance for the follow-up evaluation. Based on this, the following scoring criteria are adopted in this paper: 0 points are assigned when there is no disclosed information, 1 point is assigned when the simple text description is expressed, and 2 points are assigned when the quantitative data information is expressed. 3 points are assigned when data information is expressed. The specific content is shown in Table 1. The values should be considered that 0 points are assigned when there is no disclosure information, 1 point is assigned when expressing simple text descriptions, 2 points are assigned when expressing quantitative data information, and 3 points are assigned when expressing precise data and information. The specific content is shown in Table 1.

Table 1 Environmental accounting information disclosure quality scoring standard

Disclosure item	
Environmental management	Environmental protection concept, policy, goal
	Environmental management organizational structure
	Emergency plan for environmental emergencies
	Heavy pollution weather emergency response
	Ecological environment administrative license
	Environmental protection tax
	Environmental pollution liability insurance
	Environmental credit evaluation
Pollutant Control	Exhaust management
	Waste water Management
	Solid waste management
	Reduce consumption and save energy
Environmental supervision	Environmental honors and awards
	Environmental litigation and penalties
	Environmental self-monitoring program
	Environmental education training and publicity
Environmental performance	Environmental specific performance
	Environmental investment

This article selected three steel companies, Ansteel, Baosteel, and Shougang as samples. Angang is one of the oldest and most patented steel companies in China. Baosteel is the largest and most modern steel joint enterprise in China. Shougang is one of the largest steel companies in China. In summary, the above three companies are representative and typical.

By consulting the annual financial reports and social responsibility report disclosed from 2016 to 2021 [13], and referring to the projects in Table 1, the disclosure of their environmental accounting information is based on the scores in Table 1, and then the scores in Table 1 are scored. Calculating the sum of various scores, the

quality scores of the three companies' environmental accounting information disclosure (hereinafter referred to as EAIDS) in the past six years have been obtained. The average EAIDS of the above three companies each year is used as an indicator of the quality of accounting information disclosure of Chinese steel companies that year. For example, in 2021, Ansteel's EAIDS is 30, Baosteel Co., Ltd. is 28, and the first steel is 33. It can be calculated through calculation. The average value of these three data is 30.33, then 30.33 is the indicator of the quality of disclosure quality of Chinese steel companies in 2021.

This paper draws on Liu Wei's idea of considering labor productivity to calculate the height value of industrial structure upgrading, which is used to measure the degree of industrial structure upgrading. The calculation formula is shown in Eq. (1)

$$H_t = \sum_{i=1}^{2} q_{it} \times \text{LP}_{it} \tag{1}$$

where H_t is the height value of industrial structure upgrading in year t, the larger the value, the higher the degree of industrial structure upgrading; q_{it} is the proportion of industry i in the total industry; LP_{it} is the labor productivity of industry i in year t, and the calculation formula is shown in Eq. (2).

$$\text{LP}_{it} = \frac{V_{it}}{L_{it}} \tag{2}$$

where V_{it} is the main business income of industry i in year t; L_{it} is the number of workers employed by industry i in year t.

Combined with the research object of this paper, H_t is the industrial structure upgrade value of the ferrous metal smelting and rolling processing industry in the t year; q_{it} is the proportion of the ferrous metal smelting and rolling processing industry i in the total industry; LP_{it} is the ferrous metal smelting and rolling process in the t year. Labor productivity in the processing industry i.

The cumulative value of the average number of workers employed and main business income in Table 2 are all derived from the 2016 to 2021 China Statistical Yearbook. The proportion of the ferrous metal smelting and rolling processing industry in the industry is obtained by dividing the main business income of the ferrous metal smelting and rolling processing industry by the main business income of the ferrous metal mining industry.

The calculation results of H_t in the ferrous metal smelting and rolling processing industry from 2016 to 2021 are shown in Table 2.

Table 2 Calculation results of H_t in ferrous metal smelting and rolling processing industry from 2016 to 2021

Industry type	Index	2021	2020	2019	2018	2017	2016
Ferrous metal smelting and rolling industry	The cumulative value of the average number of workers (ten thousand people)	204.9	210	–	228.1	293.34	325.68
Ferrous metal smelting and rolling industry	Main business income (100 million yuan)	96,662.3	72,776.9	–	64,006.5	67,429.6	63,174.3
	The proportion of the industry	0.94	0.95	–	0.95	0.92	0.90
Ferrous metal mining industry	Main business income (100 million yuan)	102,583	76,728	–	67,282.8	73,152.8	69,811.9
Ferrous metal smelting and rolling industry	H_t	444.53	328.71	–	266.94	211.88	

3 Correlation Analysis Results

Based on the above data, Table 3 was sorted out. Taking EAIDS as the independent variable and H as the dependent variable, it was entered into SPSS software for correlation analysis, and the results were shown in Table 4.

In the process of correlation analysis, the method used in this paper is the PEARSON analysis method. It can be seen from Table 4 that there are two *s in the upper right corner of the correlation coefficient, and the significance level is less than 0.01. From this, it can be analyzed that the industrial structure upgrades height value has a highly positive correlation with the environmental accounting information disclosure score.

Table 3 Data of EAIDS and H from 2016 to 2021

Year	EAIDS	H
2016	11.67	175.53
2017	13.67	211.89
2018	15.33	266.94
2019	20	
2020	24	328.71
2021	30.33	444.53

Table 4 Data correlation analysis table of EAIDS and H in 2016–2021

		EAIDS	*H*
EAIDS	Pearson correlation	1	0.981**
	Sig. (2-tailed)		0.003
	N	6	5
H	Pearson correlation	0.981**	1
	Sig. (2-tailed)	0.003	
	N	5	5

** Correlation is significant at the 0.01 level (2-tailed)

4 Discussion

Based on the above data, Table 3 was sorted out. Taking EAIDS as the independent variable and *H* as the dependent variable, it was entered into SPSS software for correlation analysis, and the results were shown in Table 4.

4.1 Positive Effects of Environmental Accounting Information on Supply-Side Structural Reforms

From a macro perspective, through the environmental accounting information disclosed by enterprises, governments and other public power organizations can understand the performance of corporate social responsibility. By understanding whether the environmental pollution of the enterprise is developing in a positive direction, it can largely understand whether the enterprise's industrial structure is optimized. For example, in terms of pollutants in the scoring items, it has a relatively intuitive reflection on the management of wastewater management, exhaust gas management, solid waste management, and consumption reduction. From the perspective of the scoring situation, from 2017 to 2021, the overall score of pollutant prevention and control is on the rise, from 20 points in 2017 to 35 points in 2021. The H value has also risen in the past five years, from 211.89 in 2017 to 444.53 in 2021. At the same time, the utilization rate of steel production capacity has also increased from 73% in 2017 to 79.2% in 2021. (Data source: China National Statistics Bureau).

In the process of improving environmental accounting information, it is beneficial for enterprises to form an effective cognition and control of their own environmental risks, which is conducive to the improvement of corporate internal control. For example, the intuitive information reflection of emergency plans for environmental emergencies, environmental pollution liability insurance, etc., can help enterprise managers to take measures more effectively to reduce risks.

Besides, the government can also have a more comprehensive, timely and more intuitive understanding of the problems in the supply-side structural reform through

various environmental accounting information of the enterprise. And make companies upgrade more efficiently. For example, through the quantification of environmental accounting measurement, the pollution discharge and consumption reduction and energy and saving situation of enterprises have become more intuitive. The government's changes in various data can be more likely to find out whether the company's production capacity structure and environmental performance are developing in a positive direction.

4.2 Suggestion

It can be seen from statistical data that EAIDS in enterprises with heavy pollution weather, ecological environmental administrative licenses, environmental protection tax, environmental pollution liability insurance, and environmental protection credit evaluation is almost 0. If more positive changes are needed in the area of promoting support-side structural reforms by environmental accounting, the actions below should be taken.

Building a more robust disclosure system. First of all, a more sound environmental accounting information disclosure system should be established. China has not made a clear explanation of the relevant definition of environmental accounting, and in China's accounting standards, it has not incorporated the principles of confirmation, measurement, records, and reports of environmental accounting. Therefore, when most of the listed companies in the heavy pollution industry are accounting for environmental accounting, they mainly rely on existing regulations and their own work experience to make judgments. In this case, enterprises have relatively large autonomy, which indirectly allows enterprises to avoid complete information disclosure through various means, and the quality of disclosure is not high. In contrast, Japan has attached great importance to the development of environmental accounting since the 1990s. The current "Environmental Accounting Guidelines" in Japan consists of three parts: "Environmental Accounting Standards 2002 Edition," "Questions and Answers," and "Case Editor," which enables enterprises to carry out environmental accounting practice. However, China only mentioned some general requirements in relevant environmental protection laws and regulations, which led to the disclosure of channels and content for enterprises. Many companies choose not to disclose the environmental accounting information that is not good for enterprises at that time. For example, Baosteel Co., Ltd. has not disclosed environmental lawsuits and punishment information on its own from 2016 to 2020. Therefore, the Chinese government should learn from countries with relatively mature relevant systems and, in combination with their national conditions and basic economic and social status quo, formulate a guiding and mandatory upper-level law, supplemented by specific and operable lower-level laws and unified guidance, to steadily promote the policy in practice, improve the implementation level of local governments and reduce local governments' misunderstanding of the policy.

Broaden information disclosure channels. In addition to disclosure in the annual report and social responsibility report, the company shall also increase independent disclosure reports for environmental protection and make timely disclosure through the enterprise's official website and investment platform. Because there is little quantifiable information in the reports disclosed by the enterprise, the enterprise should also set up a separate chapter in the environmental protection report to disclose the monetized environmental data information. In addition, since there are still differences in monetization methods, to enhance comparability, the measurement standards and basis should be specified through unified guidelines in the future. Also, a clear explanation should be made in the appendix, which is convenient for information users to compare with the data of the same period of the previous year. If the company has serious environmental pollution accidents in that year, it should also disclose a special report on environmental pollution accidents. The report should include the investigation report on the cause of the pollution accident, the solution to the pollution accident, the capital investment in the accident, the effect of solving the pollution accident, and the summary of the enterprise's experience in the accident.

Strengthen the supervision. The "Ministry of Ecology and Environment Order No. 24" issued by the Ministry of Ecology and Environment of China on November 21, 2021, has stipulated that the annual environmental information disclosure report of enterprises should include ecological environment administrative licensing, environmental protection tax, environmental pollution liability insurance, environmental credit evaluation, and other information. However, by consulting the disclosures made by several listed companies, it can be found that the current information disclosure initiative of listed companies is not high, and the disclosure of annual reports and other important matters is extremely limited, not to mention the above environment-related information. Even though the new law has made more detailed provisions for such information disclosure, a large number of enterprises still do not disclose it. The reason is that the implementation of policies and laws is not enough, and there is a lack of corresponding regulatory measures and legal measures. In the latest measures for the administration of legal disclosure of enterprise environmental information, the chapter on "supervision and management" is relatively general, without a detailed description of the supervision methods of environmental information disclosure. In addition, the severity of punishment is relatively light. The most severe punishment method is "order correction, circulate a notice of criticism, and impose a fine of more than 10,000 yuan but less than 100,000 yuan." On the official website of the Chinese government, there are few cases of punishment for incomplete disclosure of environmental information. It can be seen that the supervision of the government and relevant departments is not enough.

5 Conclusions

The improvement of the quality of environmental accounting information has a positive role in promoting supply-side structural reforms. Regardless of environmental

accounting or supply-side structural reforms, China, they are exploring, promoting, and developing. They have an important role in the improvement of China's ecological environment and the optimization and upgrading of its economic structure. It is expected that China's environmental accounting information disclosure system will be more perfect in the future, and the advancement of supply-side structural reforms will be deeper.

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Management Perspective of "Green Strategies" Research—Scientometric Analysis

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Abstract This study provides insight into research on green strategy in the disciplines of management, business, and economics. The dataset of 544 bibliographic references was extracted from the Web of Science database. The main findings of the study indicate that the research on green strategies related to the management perspective is continuously increasing; however, the growth is not yet exponential and further research is needed. In terms of collaboration between authors, institutions, and countries, the results show that the development of research networks between different authors, institutions, or countries is still in its infancy. Analysis of the co-occurrence of keywords shows the evolution of research interests from more general to more focus. Green innovation is one of the emerging hotspots in the research field. The analysis of document co-citations sheds light on the major specialties in green strategies research. The main contribution of this study is in concisely summarizing the intellectual base (most cited articles) and research frontiers (citing articles), and providing insights useful to researchers, practitioners, and policymakers.

Keywords Environmental management · Green strategy · Management discipline · CiteSpace · Scientometric analysis

1 Introduction

Carbon emissions have been frequently recognized as one of the major cause of environmental degradation. Production-related carbon emissions account for up to one-third of total carbon emissions. Not surprisingly, an increasing number of stakeholders, such as governments, local communities, industry or trade associations, and especially consumers, are expressing concern about companies' environmental performance. As a result, the governments have applied regulatory and legislative pressure to prevent or control long-term environmental degradation. More and more companies, such as multinational corporations and companies in the construction

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sector, to name a few [1], are already required to actively and effectively implement "green" or "environmental management" strategies to meet the regulatory frameworks of their respective markets. Increasingly, companies view environmental issues as a strategic imperative to reduce the cost of scarce natural resources or as a strategic opportunity to gain competitive advantage [2]. Accordingly, academic research on how contemporary businesses become green (or carbon neutral) has been recognized as important to stainable development.

Green or environmental issues have been considered from different perspectives. Currently, the number of publications dealing with environmental protection, resource conservation, carbon reduction, clean production, recycling, or waste management seems to be growing exponentially and gaining interdisciplinary attention. Addressing the management, business, and economic contribution to environmental management may be the most urgent task to enable companies and other stakeholders to better understand these issues and more effectively implement green or environmental management strategies at the company level [3].

Green strategies have not only been frequently called for, but they have also been difficult to define, pursue, and implement. The proverbial phrase that "going green" is easier said than done is true in both academic and practical senses. Improving the management capacity of companies to successfully develop green strategies and effectively implement them is increasingly recognized as important to the future viability of any business. Despite the expansion of environment-related literature, there are relatively few studies that are focused on the management perspective of green strategy research. This study attempts to uncover the progress of management insights emerging from green strategy research. The purpose of the study is to examine the current state of green strategy research and to assess the patterns of collaboration, intellectual base, and emerging themes of green strategy research using the increasingly popular data-driven scientometric analysis. The concise summary of the most active authors, collaboration patterns, research fronts, and emerging hotspots of green strategies research is primarily intended for researchers, practitioners, and policymakers who can benefit from a better understanding of the diversification of the topics studied and their development trends or interrelationships.

The remainder of the paper is organized as follows: Sect. 2 provides an overview of the meaning and definitions of "green" and "environmental management" strategies. Section 3 outlines the scientometric approach and describes the protocol for retrieving and analyzing the dataset of bibliographic records. The results are presented and discussed in Sect. 4. Section 5 summarizes the main conclusions, limitations, and further research implications of the study.

2 Previous Research

2.1 Environmental Management

The increased environmental consciousness of governments, consumers, and local communities is an open call for designing and implement better environmental management strategies. Reducing the company's negative impact or increasing its positive impact on the environment is becoming a strategic priority for more and more companies. In part, this strategic priority is driven by government regulations, customer safety concerns, local community environmental concerns, and in part by sound business decisions. As a result, over the past few decades, the literature on environmental management or green strategies has gradually expanded.

The first mentions of the environmental management date back to Welles' analysis of environmental management strategies amid multinational corporations [1]. One study stated that the focus of environmental management should be to "prevent negative environmental impacts and improve environmental performance by institutionalizing various environmental programs and practices, such as establishing environmentally related performance measures and developing green technologies, processes, and products" [4]. Porter [5] made an important conceptual contribution to this field by suggesting that environmental management should be used to provide sustainable competitive advantages to firms. Pettula [6] suggested that avoiding environmental risks/crises, reducing costs, and achieving differentiation by exceeding environmental and industry regulations and standards are the three main approaches to corporate environmental management strategies.

Previous literature reviews of environmental management strategies offer at least two major typologies or taxonomies of environmental management strategies [3]. One critical review of corporate responses to the natural environment found that typical responses can be categorized along the stages of "Non-Compliance, Compliance, Compliance Plus, Commercial and Environmental Excellence, Leading Edge" [7]. Another study found that the maturity level of a company's environmental management strategy can be categorized as at the stage of beginners, fire fighters, concerned citizens, pragmatists, and proactivist [8]. However, the typologies and taxonomies of the environmental management strategies are still perceived as conceptually underdeveloped and empirically under-researched [9].

2.2 Green Strategies

The terms "green strategy" or "environmental management strategies" are frequently used interchangeably in the existing literature. Green strategies have been intensively discussed from the perspective of different disciplines and fields, which is why the term has a different meaning in chemistry or medicine than in business or management research. For example, in business, green strategies mean "aligning

a company's environmental performance with stakeholder expectations as well as constituting a significant new source of competitive advantage such as lower costs and expanded market share" [4]. Olson suggested three guiding principles of green strategic positioning include creating green culture and awareness among managers and employees, integrating green decision-making in initiatives and transformation across the entire company (from operating, technology, marketing, green product and services, green processes and facilities, green performance rewards, green technology information, and other supporting infrastructure) [10].

Despite the increasing attention and popularity of the trend to make everything greener, there is relatively little research that consolidates the current state of research on green strategies from a management perspective and provides insights. The ability of managers to effectively design, integrate, or coordinate green strategies appears to be critical to a sustainable future. However, practitioners or policymakers studying how to effectively implement, coordinate, or promote green strategies are also very interested in new insights from academia. Previous researches have been already making the systematic literature overviews of the carbon emissions [11], green human resource management [12], green marketing [13], green innovation [14], green technology [15], or green business models [16]. Although each of these literature reviews is closely connected to the company level strategies, the entirety of strategic perspective appears to be neglected. Therefore, consolidating, summarizing, and visualizing the research field of green strategies could be useful to understand the contribution of the management literature to the urgent green transformation.

3 Methodology

3.1 Data Collection

Recently, scientometric analysis has become a popular approach for visualizing, analyzing, and synthesizing the evolutionary pathways of a particular field of study. Apparently, it has not been used to analyze progress in the green or environmental management strategies. To this end, the data collection, scientometric instrument selection, metrics, analysis, and visualization techniques are briefly explained.

The data collection is based on the Thomas Reuters bibliographic database Web of Science (All selections), which is recognized as a reliable source of bibliographic data for the respected journal articles [11, 17]. The time period for retrieving the articles was "1955–2022." To focus the search on the most relevant publications, the retrieval of articles was based on the following criteria: Topic = "green* strategy*" or "environmental strategy*"; and Document type = Article; and Language = English; and WoS subject category = Business, Management; Economics, Business Finance, Operations Research, Management Science. Although the inclusion of subject categories as part of the retrieval strategy could exclude influential articles from other disciplines, it was chosen to ensure that records were collected from a management

- **1. Dataset selection**
  - Topic: "green* strateg*" or "environment strateg*" and
  - Document type: Article; and
  - Language: English
  - Refine: WoS subject categories: Business, Management, Economics, Business Finance, Operations Research, Management Science
  - 573 records retrieved

- **2. CiteSpace settings**
  - Importing full records with citing references as plain text in CiteSpace sofware (package 5.8.R3(64bit)
  - Timespan: 1973-2022; # of years per slice=1
  - Node types: Author; Institution; Country; Keyword; Reference
  - 544 records qualified

- **3. CiteSpace tools and metrics**
  - Collaboration networks analysis - centrality and burstness
  - Keyword co-occurrence analysis - centrality and burstness
  - Document co-citation - cluster analysis

Fig. 1 Research design

perspective and were primarily relevant to the management discipline. A total of 573 records were selected. After filtering the dataset for duplicates or invalid records, the remaining 544 records qualified for further analysis. The research design is shown in Fig. 1.

3.2 Scientometric Techniques, Visualization, and Analytical Metrics

The collaboration analysis was used to identify the most productive authors, institutions, and countries in the green, and environmental management strategy field. The analysis of the keyword co-occurrence is used to analyze the development trends in research. Co-citation analysis is defined as the frequency with which two items of earlier literature are cited together in later literature [18, 19]. Document co-citation is used to gain insight into the knowledge domains of the green strategy field, emerging trends and the most cited, novel, or influential references.

The analysis and visualization are based on CiteSpace (package 5.8.R3. 64bit). CiteSpace is an open-access software and is frequently used in sustainability, carbon emissions, and other expanding green research areas [11, 17]. The analysis was based on the default settings and the time span of the analysis was set as "1973–2022, # of years per slice = 1." Nodes and links are the main building blocks of scientometric visualizations. Links indicate the relationship (frequency, co-occurrence, co-citation)

between two nodes, calculated based on the number of articles in which the keywords or references appeared simultaneously. The thicker the links, the stronger the relationship between the nodes. In the collaboration network analysis, the nodes represent either authors, institutions, or countries. In the co-occurrence analysis, the nodes stand for keywords. In the co-citation analysis, references are used as the node type. The size of the node reflects the frequency or citation history of the node, depending on the type of analysis and visualization.

Structural metrics available in CiteSpace that are primarily used for co-citation analysis include betweenness centrality, modularity, and silhouette metrics. Betweenness centrality (BC) measures the extent to which a node is the shortest path between two other nodes [18]. Nodes with a BC value greater than 0.1 denote articles that may lead to breakthrough discoveries [20] and initiate important evolutionary turning points in a research area. Nodes with high betweenness centrality are indicated by the purple outline of the node [19]. The modularity score measures the extent to which a network can be divided into independent clusters. A modularity score ranges from 0 to 1, and a score above 0.7 ($Q \geq 0.7$) indicates clear boundaries between clusters and a well-structured network [18]. The silhouette values estimate the uncertainty in describing the true nature of a cluster. It ranges from -1 to 1. The value of 1 represents the perfect separation of clusters. The silhouette values between 0.5 and 0.7 are considered reasonably reliable, while the silhouette value between 0.7 and 0.9 indicates high reliability and homogeneity of the cluster [18].

Temporal and hybrid metrics include identifying the duration and strength of citation bursts and the novelty (or sigma) score. Citation bursts refer to sudden changes in the number of citations in a given time period. They are useful for identifying emerging trends in a research area. The strength of citation bursts indicates references that have a significant impact on the research area. The duration of citation bursts is useful for understanding changes in researched topics over time and current hotspots in the research area [21]. When citation bursts are detected, it is indicated by a red outline above the node. The novelty score (sigma) measures whether the scientific publication is likely to represent a new idea and is calculated by combining the BC and citation bursts scores [21].

4 Results with Discussion

The first relevant contribution to green or environmental management strategies can be traced back to 1973 [1]. As shown in Fig. 2, the number of publications and citations in the field of green strategies research is still in the early stages of development, with less than 100 publications per year. However, the number of publications and citations is gradually and steadily increasing.

At least three phases of development in green strategy research can be identified. The period from 1973 to 2009 appears static and marks the beginnings of green strategy research. In 2010 to 2018, the number of publications per year began to

Fig. 2 Distribution of
publications and citations
from 1973 to 2022
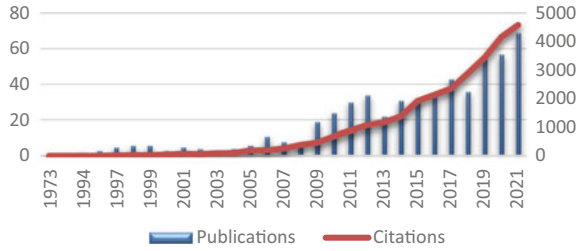
grow gradually (no more than 50 publications per year). Only recently, from 2019
to 2021, has the growth of publications accelerated.

4.1 Collaboration Network

The author's collaboration network included 488 nodes and 252 collaboration links,
indicating underdeveloped collaborations among green strategy research authors.
Sanjay Sharma is the only collaborator who received citation bursts between 1995
and 2005. The top 6 authors with 3–5 collaborations were as follows Concepción
Garcés Ayerbe (University of Zaragoza), Antonio Rueda Manzanares (University
of Granada), Juan Alberto Aragon-Correa (University of Granada), Sanjay Sharma
(Faculty of Commerce, Halifax), Frank Figge (ESCP Business School, Paris). The
analysis of collaboration patterns confirmed that collaboration between institutions is
still modest. Only three institutions were detected in the citation bursts: the University
of Granada, Hong Kong Polytech University and Xiamen University. The analysis
of the cooperation network at the country level is shown in Fig. 3.

The U.S., Spain, China, England, Canada, and Australia contribute the most to
the total output, as you can see from the size of the nodes. However, eight nodes are
outlined in red, indicating a sudden surge of interest in the green strategy in these
countries. Analysis of citation bursts shows that the U.S., Canada, and Australia
record citation bursts beginning between 1994 and 1998. England and Spain record

Fig. 3 A visualization of the country collaboration network

citation bursts between 2000 and 2007, while citation bursts beginning between 2010 and 2017 indicate the increasing importance of the Netherlands, Canada, China, and Pakistan in the research field. The strong influence on green strategy research is also confirmed by the high centrality scores (indicated by the purple border around the node). England (BC = 0.25); USA (BC = 0.23), France (BC = 0.11), Canada and China (BC = 0.1) establish themselves as the most influential countries in green strategy research.

Not surprisingly, the pattern of collaboration is underdeveloped given the infancy stage of the research field. In general, the authors, institutions, and countries that are currently prominent provide the breeding ground for future collaborations. It is worth noting that collaboration patterns could reflect the number of research institutions, the availability of research funding, and the strategic priority of greening for a particular institution or country. Thus, given the regulatory pressures, especially in countries facing large carbon emissions, it is reasonable to expect that collaborations will increase greatly in the future.

4.2   Keyword Network Analysis and Citation Burst

After analyzing the coincidence of keywords, the management perspective of green strategy research evolves around the search for conceptual or theoretical frameworks (such as the resource-based view of the firm), gaining competitive advantage through sustainable development, corporate social responsibility, exploring the determinants of green strategies or their impact on environmental, financial, or overall business performance. Looking at the centrality of the keywords (see Table 1), it can be seen that model, green strategy, impact, performance, or environmental management play the most influential and important role, which is not surprising given the stage of development of the research.

As noticeable in Table 1, environmental management and innovation have seen the largest increase in citations, as indicated by the strength of the citation bursts. However, considering the onset of the citation bursts, the occurring keywords can be divided into three main categories. The first category includes the keywords that were particularly frequently cited from 2005 to 2008, such as environmental management, natural environment, corporate strategy, commitment. These keywords mark the increased attention being paid to the relationship between corporate strategy and the natural environment. From 2011, academic attention has been drawn to the more specific subsystems of corporate strategies in terms of industry, stakeholder pressure, corporate operations, or other corporate systems. Finally, as of 2019, the proactive design of environmental strategy and, in particular, innovations related to the diversified strategic green initiatives (from organization green awareness and culture to the green business model, supply chain management, reporting, and rewarding systems) are the latest hotspots of green strategy research.

Table 1 Top keywords (by centrality, strength, and duration of citation bursts)

Keyword	Centrality	Keyword	Strength of bursts	Duration of bursts
Model	0.15	Environmental management	6.49	2005–2013
Performance	0.14	Natural environment	4.84	2007–2012
Green	0.12	Corporate strategy	3.12	2007–2011
Impact	0.1	Commitment	3.35	2008–2013
Strategy	0.1	Technology	3.4	2011–2012
Environmental management	0.1	Operation	3.21	2012–2014
Management	0.08	System	2.83	2012–2015
Sustainability	0.08	Corporate	4.84	2013–2016
Environmental strategy	0.07	Pressure	2.98	2015–2019
Corporate social responsibility	0.07	Perspective	3.02	2017–2018
Firm	0.07	Moderating role	4.83	2018–2022
Perspective	0.07	Proactive environmental strategy	3.51	2019–2022
Sustainable development	0.07	Green innovation	3.54	2020–2022
Determinant	0.06	Innovation	6.15	2021–2022

4.3 Document Co-citation Analysis

The document co-citation network consists of references cited by the 544 biblio-graphic records in the dataset. Each node represents a cited document and the links between them indicate the co-citation relationship between two articles. The size of the node represents the frequency of co-citations of that article. Cluster analysis tools are used to divide the research area into distinct and meaningful research subtopics or specialties. CiteSpace found a total of 16 meaningful clusters of co-cited refer-ences. According to the modularity score ($M = 0.89$) and the silhouette index ($S = 0.94$), the partitioning of the network and the homogeneity of the clusters are reli-able and indicate well-structured clusters with clear boundaries between them. The visualization of the clusters' timeline shows the progress of the research topics over time. In addition, the impact and influence or dynamics of each cluster are shown by the larger nodes with red or purple borders. As shown in Fig. 4, the research topics such as #1 (inspiring employees) and #10 (analyzing green human resource manage-ment) were developed recently and reflect the shift of research in green strategy to promoting employee or manager engagement for changes in company operations or

behaviors. Cluster #17 (green patents) reflects the interest in green businesses and patents as the most radical form of protecting differentiation from competitors or the growth of patent-based technologies important to green manufacturing. Second, clusters #6 (fostering green management decisions), #3 (managing carbon aspiration), and #12 (life cycle assessment) reflect a shift in research toward measuring and documenting corporate carbon emissions, while cluster #8 indicates a shift toward broader value chains and monitoring the impact of reducing carbon emissions not only through corporate operations but also through corporate purchasing. Third, several clusters focus on identifying the conceptual or theoretical framework, particularly the resource-based or stakeholder view of the firm (#0), or on introducing more specific strategic issues such as low carbon as a risk and cost reduction strategy (#2), while others focus on analyzing the competitive advantages of differentiation through greening products or on corporate-level strategies. Moreover, the causal relationships between the predictors and the effects of green strategies in terms of industry, company size, and national context have been the distinctive features of green strategy research since the field's inception. Finally, it is worth noting that several clusters (#0; #1; #2; #3; #5; #6; #7) have a larger number of nodes outlined in red or purple, indicating influential, dynamic, novel, and important research findings emerging from the co-cited references in the aforementioned clusters. In contrast, several topics have not yet achieved citation bursts or high influence in this area (#12, #13) and could indicate a gap in the research worthy of further exploration.

Clustering the research field is useful to identify the intellectual base (cited articles) as well as the research fronts (citing articles) [21]. Table 2 provides information
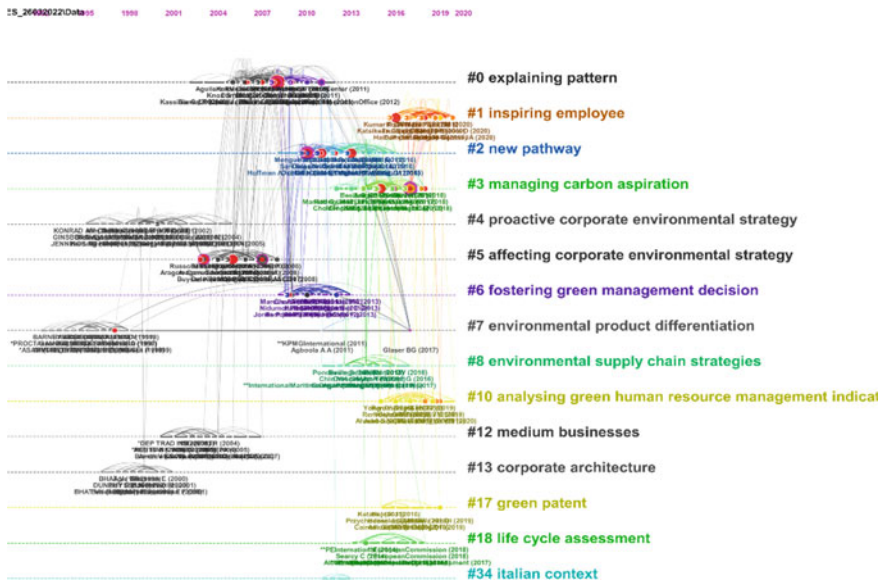
Fig. 4 Timeline view of the clusters in the document co-citation network

about the size of the clusters and metrics that support the homogeneity and reliability of the true nature of the clusters. In addition, Table 2 shows the most frequently cited or important documents and the most active citers of the cited documents. Identifying the intellectual base and research fronts allows the research field to move forward and can be of particular benefit to the research community. Clustering the research field is useful to identify the intellectual base (cited articles) as well as the research fronts (citing articles) [21]. Table 2 provides information about the size of the clusters and metrics that support the homogeneity and reliability of the true nature of the clusters. In addition, Table 2 shows the most frequently cited or important documents and the most active citers of the cited documents. Identifying the intellectual base and research fronts allows the research field to move forward and can be of particular benefit to the research community.

5 Conclusion

This study uncovers the structure of the important and distinctive subtopic of the green strategy research that attracts increased attention of management discipline. Western countries seem to play a leading role in terms of influence on the management perspective of green strategies research, which is not surprising given their total carbon emissions and national targets for reducing it. Although it is still at an early stage of development, a few identifiable subtopics are already visible. In particular, the cluster analysis results show that green strategies are closely related to green innovation, green patents, green human resource management, and new carbon aspiration, to name a few.

However, the results primarily show the management perspective of green management research. Although this limitation was necessary to maintain focus, this approach may miss relevant research from other databases or differently refined datasets. Therefore, further study could include a multi-perspective or multi-discipline approach. Alternatively, further research could be even more focused and examine the contribution of the most prestigious management journals on the green strategy to assess the contribution of high impact factor publications to the structure and development of green strategies from the operational to the corporate level. In addition, it would be interesting to broaden the search string to include all interchangeable terms that map green issues, such as sustainable business strategy, pro-environmental strategy, or eco-efficient strategy.

Table 2 The major clusters of co-cited references

C#	Size	Silhouette	Average year	Label (LLR)	Intellectual base Most important cited documents (by freq, BC; sigma)	Research fronts The most active citing document
0	101	0.89	2007	Explaining pattern	Aragon-Correa et al. (2008), Murillo-Luna et al. (2008), Ambec (2008), Gonzalez-Benito (2006), Clarkson et al. (2011)	de Burgos-Jimenez (2013)
1	90	0.909	2018	Inspiring employee	Hair (2016), Yang (2019), Roscoe (2019), Dumont (2017), Latan (2017)	Shafaei (2020)
2	81	0.93	2012	New pathway	Darnall, (2010), Cronin (2011), Dixon-Fowler (2013), Sarkis (2010), Chan (2012), Delmas (2011); Hart (2011), Torgusa, (2012)	Griffin (2017)
3	61	0.946	2015	Managing carbon aspiration	Leonidou (2017), Alt (2015), Aragon-Correa et al. (2016)	Yang (2019)
4	59	0.993	1999	Proactive corporate environmental strategy	Sharma (2000), Christmann (2000), Bansal (2000), Cordano (2000)	Aragon-Correa, JA (2003)
5	51	0.927	2005	Affecting corporate environmental strategy	Aragon-Correa et al. (2007), Sharma (2005), Bansal (2005), Buysee (2003)	Fraj-Andres (2009)
6	47	0.938	2010	Fostering green management decision	Berrone (2009), Nidumolu (2009), Hahn (2010)	Martinez (2014)
7	41	0.998	1996	Environmental product differentiation	Hart (1997), Glaser (2017)	Reinhardt (1998)

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