The Trade Effects of the US Tariffs on China (2018–2019): Evidence from Dual Margins Perspective

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Abstract. Based on the reality that the US imposed additional tariffs on Chinese products in 2018–2019, this paper probes into the trade effects of the additional tariffs from dual margins perspective, using monthly import data of the US with its 20 top partners in 2017–2019. The results show that the US imports from China have decreased with the imposition of additional tariffs. It is mainly reflected in the decrease of the intensive margin of the tariff-targeted products, that is, the proportion of the US import from China relative to world has decreased. The conclusion is still stable when expanding the sample of the tariff-targeted products and using 2 months lagged tariffs on China. From the perspective of product heterogeneity: the additional tariffs reduce the imports of existing consumer and capital products on the list along the intensive margin, but have no effect on the imports of intermediate products. We also find the US additional tariffs don't increase its imports from the third-party markets on the tariff-targeted products and from China on the non-tariff-targeted products.

Keywords: Tariffs · US's imports · Dual margins · Trade destruction effect · Trade deflection effect

1 Introduction and the Literature Review

While China continues to greater opening-up, the US initiates trade protectionism actions around the world, especially the large-scale tariff war against China. From July 6, 2018 to September 1, 2019, the US has imposed additional tariffs of 15–25% on $34 billion, $16 billion, $200 billion and $300 billion (Part I) worth of Chinese products. China has also taken anti-tariff measures at the same time, imposing additional tariffs of 5–25% on $34 billion, $16 billion, $60 billion and $75 billion (Part I) worth of the US's products. Although China and the US formally signed their phase-one economic and trade agreement on January 15, 2020 through the joint efforts and negotiations of both sides, the phase-two agreement needs long time to confirm. In 2021, the Biden administration took office and said it would reconsider policies toward China during the Trump era, "We are not looking for confrontation, although we know there will be steep, steep competition." In November 2018, President Xi Jinping stated at the APEC CEO Summit that "if we

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take the path of confrontation, no matter cold war, hot war or trade war, there will be no real winners".

The studies of tariff barriers and the margins of trade find that tariff barriers have significantly negative effect on the margins of trade. Debaere and Mostashari [1], based on the Probit model, have proved that the contribution of tariff reduction to the intensive margin during 1989–1999 was significant, that is, exports increase by 0.011% when the tariff decreases by 1%. Tian and Xiao [2] have found that the tariff reduction caused by FTA between China and South Korea increases by 1%, the intensive margin significantly increases by 3.29%, among which the quantity margin increases by 3.355% and the price margin increases by 0.046%, but extensive margin has no any significant change. Wang et al. [3], using the world input-output database, also find that if the tariffs increase by 1%, the intensive margin of China's export will decrease by 0.012% and the extensive margin by 0.013%.

The present papers examine the recent US-China trade friction thoroughly. First of all, before and after the implementation of the US tariff policy of imposing additional tariffs on Chinese products, scholars use previous data to predict the impact of this trade friction on the macroeconomic based on various models. For example, Li and Whalley [4], Bouet and Laborde [5], Li et al. [6], Guo and Chen [7] conduct studies using general equilibrium theory and the GTAP database, while Yan et al. [8], Ni et al. [9] using the input-output table, Fan et al. [10] using the structural model. They all find that the US-China trade disputes harm both China and the US, benefit the third-party markets which have close trade relationship with China or the US, but harm the global economy as a whole.

In addition, some scholars have conducted empirical studies after the implementation of US additional tariffs on China, using actual trade data, including value, price and quantity of import and export among China, the US and third-party markets. Flaaen et al. [11] and Amiti et al. [12] have confirmed that the US additional tariffs on China's products are almost completely transferred to the prices paid by American importers. Moreover, the US additional tariffs improve not only the price of China's tariff-targeted products, but also the price of the non-tariff-targeted complementary. Based on trade gravity model or difference-in difference(DID) model, Amiti et al. [13], Philipp et al. [14], Shen et al. [15] find that the US-China trade friction has trade destruction effects on trade between China and the US, and has trade deflection effects on the third-party markets. Furthermore, from the perspective of enterprises, Felipe [16] finds that US-China trade friction damages companies with export business to China, while benefits ones with export business to the US.

To sum up, although many papers have carried out abundant studies on the US-China trade frictions in 2018–2019, there are still three aspects that can be studied. First, from the perspective of research, there is little literature to analyze the trade effects of US-China trade frictions from the perspective of the margins of trade. But as an important research results of new-new trade theory, dual margins are also of significance to analyze the impact of US-China trade friction on bilateral and multilateral countries. Second, from the perspective of research scope, there are few articles to analyze the size of the trade destruction and deflection effects of additional tariffs imposed by the US on China. Although some papers have analyzed these effects, most of them are aimed at judging

whether the trade destruction and deflection effects are generated based on DID model, not to analyze the size of the trade effects based on trade gravity model. Third, from the perspective of research objects, existing literature focuses on the impact of US-China trade friction on tariff-targeted products, but pays little attention to the non-tariff-targeted products. However, the implementation of the US tariff policy on China will inevitably increase the trade costs of tariff-targeted products and relatively reduce the trade costs of the non-tariff-targeted products, thus causing the US to import more from China's non-tariff-targeted products.

Therefore, based on reality of 2018–2019 US-China trade friction, this article analyzes the trade destruction and deflection effects of this trade friction with trade gravity model, and researches how intensive and extensive margins play a role in trade effects from the perspectives of dual margins.

2 Modelling Dual Margins of the US Import

2.1 Measuring Dual Margins of the US Import

We calculate the dual margins of the US with its importers based on the definition and formula proposed by Hummels and Klenow [17], making use of the monthly data of the US with its 20 importers in 2017–2019 provided by Uncomtrade database. 20 sample countries or regions are selected considering the completeness of data and the proportion of imports of each importer or region to US total imports.[1] In 2017, the US imports from 20 countries accounted for 79.81% of its total imports, so sample countries are fairly representative.

The import penetration of the US's industry k importing from country i relative to world is denoted as S_{aikt}:

$$S_{\text{aikt}} = \frac{M_{aikt}}{M_{awkt}} = \frac{\sum_{p \in I_{aikt}} m_{aipt}}{\sum_{p \in I_{awkt}} m_{awpt}} \tag{1}$$

$$M_{aikt} = \sum\nolimits_{p \in I^1_{aikt}} m^1_{aipt} + \sum\nolimits_{p \in I^2_{aikt}} m^2_{aipt} + \sum\nolimits_{p \in I^3_{aikt}} m^3_{aipt} \tag{2}$$

$$S_{\text{aikt}} = \frac{\sum_{p \in I^1_{aikt}} m^1_{aipt}}{\sum_{p \in I_{awkt}} m_{awpt}} + \frac{\sum_{p \in I^2_{aikt}} m^2_{aipt}}{\sum_{p \in I_{awkt}} m_{awpt}} + \frac{\sum_{p \in I^3_{aikt}} m^3_{aipt}}{\sum_{p \in I_{awkt}} m_{awpt}} \tag{3}$$

where M_{aikt} (or M_{awkt}) = the US imports from partner i (or world) in industry k and month t, m_{aipt}(or m_{awpt}) = the US imports from partner i (or world) in product p and month t, p(Harmonised System 6-digit level product) is a kind of product in industry k(HS2-digit level product). I^1_{aikt} = the set of China's tariff-targeted products, I^2_{aikt} = the set of China's non-tariff-targeted products, I^3_{aikt} = the set of other products of China which are neither China's tariff-targeted products nor non-tariff-targeted products, so

[1] Including China, Mexico, Canada, Japan, Germany, Korea, United Kingdom, Italy, India, France, Ireland, Switzerland, Brazil, Israel, Singapore, Russia, Spain, Belgium, Colombia, Chile.

there are no products for China, that is, products in this set are imported from other partners except China. Meanwhile, M_{aikt} can be divided into there parts in formula (2): m^1_{aipt} = the US imports from partner i in tariff-targeted product p and month t, m^2_{aipt} = the US imports from partner i in the non-tariff-targeted product p and month t, m^3_{aipt} = the US imports from partner i in other product p and month t. Therefore, in formula (3): $\frac{\sum_{p\in I^1_{aikt}} m^1_{aipt}}{\sum_{p\in I_{awkt}} m_{awpt}}$ = the ratio of the US imports from partner i relative to world in common tariff-targeted product p and month t, $\frac{\sum_{p\in I^2_{aikt}} m^2_{aipt}}{\sum_{p\in I_{awkt}} m_{awpt}}$ = the ratio of the US imports from partner i relative to world in the non-tariff-targeted product p and month t, $\frac{\sum_{p\in I^3_{aikt}} m^3_{aipt}}{\sum_{p\in I_{awkt}} m_{awpt}}$ = the ratio of the US imports from partner i relative to world in other product p and month t, which will be ignored because it isn't the key data we care for.

The ratio of the US imports from partner i relative to world in tariff-targeted product p and month t can be further expressed as follows:

$$\frac{\sum_{p\in I^1_{aikt}} m^1_{aipt}}{\sum_{p\in I_{awkt}} m_{awpt}} = \frac{\sum_{p\in I^1_{aikt}} m^1_{aipt}}{\sum_{p\in I^1_{awkt}} m^1_{awpt}} \times \frac{\sum_{p\in I^1_{awkt}} m^1_{awpt}}{\sum_{p\in I_{awkt}} m_{awpt}} = IM^1_{aikt} \times EM^1_{aikt} \tag{4}$$

IM^1_{aikt}, the intensive margin for the US import from country i in industry k and month t within the set of tariff-targeted products, is the ratio of the US import from partner i relative to world in industry k and month t within the common set of tariff-targeted products. The smaller this indicator is, the smaller the US imports and thus the smaller the depth of the existing tariff-targeted products.

EM^1_{aikt}, the extensive margin for the US import from country i in industry k and month t within the set of tariff-targeted products, is the ratio of US import from world in tariff-targeted products relative to total products, the smaller this index is, the lower the degree of overlap is, which indicates that the US imports fewer tariff-targeted products from country i in month t, so the breadth of product is smaller.

Similarly, the intensive and extensive margins of the US import from country i in industry k and month t within the set of the non-tariff-targeted products (IM^2_{aikt}, IM^2_{aikt}) can be showed as below:

$$IM^2_{aikt} = \frac{\sum_{p\in I^2_{aikt}} m^2_{aipt}}{\sum_{p\in I^2_{awkt}} m^2_{awpt}} \tag{5}$$

$$EM^2_{aikt} = \frac{\sum_{p\in I^2_{awkt}} m^2_{awpt}}{\sum_{p\in I_{awkt}} m_{awpt}} \tag{6}$$

Dual Margins of the US Import on Chinese Tariff-Targeted Products. Figure 1 shows dual margins of the US import from Chinese products on the 200 billion list before and after the US additional tariffs on China's products. First, the intensive margin of the US import on Chinese tariff-targeted products showed an overall upswing and continued growing trend in fluctuation before December 2018, while displaying a downward trend after that. From December 2018 to December 2019, the intensive margin declined by

35.45%, while increased 8.41% for the same period last year. Second, there is no big change for the extensive margin of the US import on Chinese tariff-targeted products before and after the US additional tariffs. Therefore, the US additional tariffs are likely to produce the trade destruction effects on the import of China's tariff-targeted products along the intensive margin. We will further test the trade destruction effects caused by the US additional tariffs based on the DID model in Sect. 3.

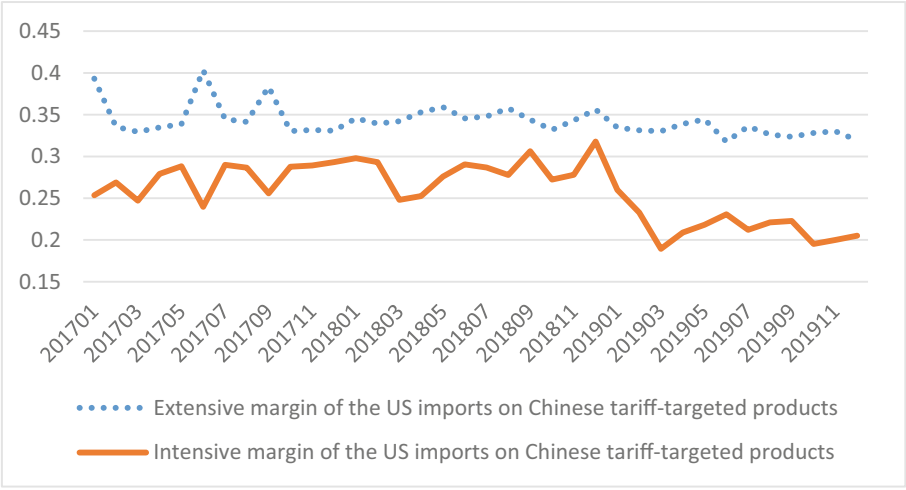


Fig. 1. Dual margins of the US import on Chinese products on the 200 billion list.

Dual Margins of the US Import on Chinese Non-tariff-targeted Products. Figure 2 demonstrates dual margins of the US import from Chinese products not on the 200 billion list before and after the US additional tariffs. However, we find no fluctuation both in the extensive and intensive margins of the US import on Chinese non-tariff-targeted products, which means, the US additional tariffs are unlikely to cause trade deflection effects on the imports of China's non-tariff-targeted products. We will further analyze the trade deflection effects in Sect. 3.

Dual Margins of the US Import from the Third-Party Countries Based on Tariff-Targeted Products. Figure 3 displays dual margins of the US import from third-party countries based on the products on the 200 billion list before and after the US additional tariffs. We use the average dual margins of the US import from its 19 countries (except for China) based on 200 billion list products. However, the extensive and intensive margins of the US import from third-party countries change regularly from year to year with a slight increase, which means, the US additional tariffs are unlikely to cause trade deflection effects on the imports from third-party countries. We will further research the trade deflection effects in Sect. 3.

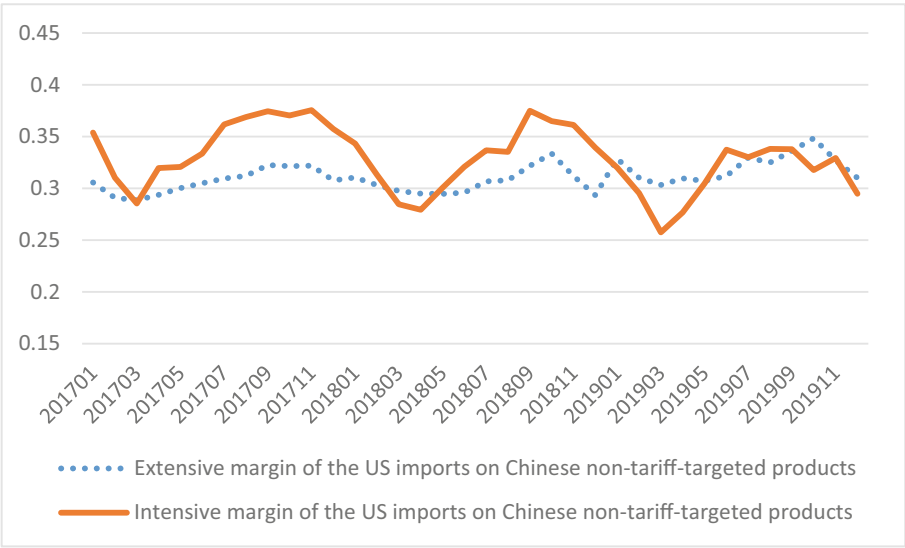
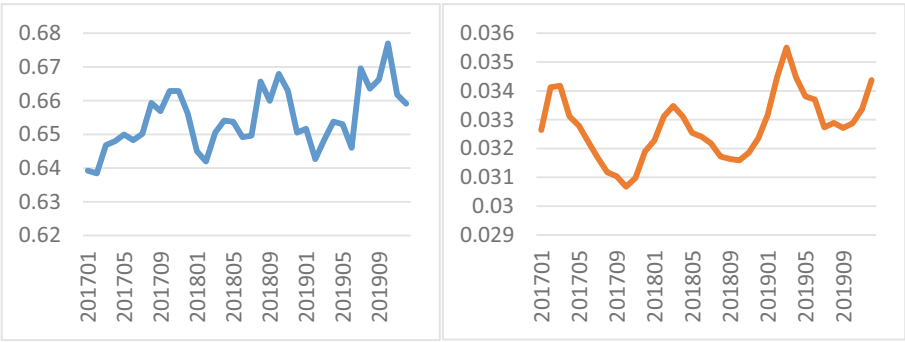


Fig. 2. Dual margins of the US import on Chinese products not on the 200 billion list.



(a) Extensive margin (b) Intensive margin

Fig. 3. Dual margins of the US import from third-party countries based on the 200 billion list products.

2.2 Research Design and Model Specifications

Following the analysis of China's dual margins and ternary margins from James and Eric [18], Wei and Guo [19], we set up a gravity model to study the margins of the US combined with the situation of additional tariffs imposed by the US on China.

$$ln\,Mckt = \alpha + \beta 1 ln\,tariffckt + \beta 2\,ln\,GDPct + \beta 3\,ln\,REREct + \gamma_k + \gamma_t + \varepsilon ckt \quad (7)$$

$$ln\,Mjkt = \alpha + \beta 1\,ln\,tariffckt + \beta 2\,ln\,tariff\,\text{third}jkt + \beta 3\,ln\,GDPjt + \beta 4\,ln\,RERjt + \beta 5FTAjt + \beta 6\text{lang}j + \beta 7\,ln\,disj + \gamma_j + \gamma_k + \gamma_t + \varepsilon jkt \quad (8)$$

M_{ckt} (or M_{jkt}) in the above equations stands for dual margins of the US import from China (or country j) in industry k and month t. $Tariff_{ckt}$ (or $tariffthird_{jkt}$) refers to the average tariffs imposed by the US on China (or country j) in industry k and month t. GDP_{ct} (or GDP_{jt}) represents the relative economic scale between China (or country j) and the US in month t, RER_{ct} (or RER_{jt}) represents the real exchange rate between China (or country j) and the US in month t. FTA_{jt} indicates whether country j has Free Trade Agreement with the US, $lang_j$ indicates country j has the same language with the US, dis_j indicates the distance between country j and the US. $\alpha, \beta_1, \cdots, \beta_7$ are the parameters to be estimated, γ_k is industry fixed effects, γ_t denotes month fixed effects, γ_j indicates third-party country fixed effects, ε_{ckt} and ε_{jkt} are the error terms.

We will use model (7) to analyze the trade destruction effects of the US import from China based on tariff-targeted products, and the parameter β_1 in it measures the impact of additional tariffs on dual margins of the US import from Chinese tariff-targeted products, a negative value of which implies that additional tariffs decrease the US imports from Chinese tariff-targeted products. Then, we use model (8) to test the trade deflection effects of the US import from the third-party country based on same tariff-targeted products, and a positive value of the parameter β_1 implies that additional tariffs increase the US imports from partner's tariff-targeted products. Furthermore, we use model (7) to analyze the trade deflection effects of the US import from China based on the non-tariff-targeted products, and a positive value of the parameter β_1 implies that additional tariffs increase the US imports from China's non-tariff-targeted products.

Data and Variables. The dependent variables: dual margins (M_{ckt}, M_{jkt}), including intensive margin (EM) and extensive margin(IM). Using the form of ln(EM + 1) and ln(IM + 1) in the above models.

The core explanatory variable: average import tariffs of the US imposing on China ($tariff_{ckt}$). We get the monthly average import tariffs of the US imposing on China in industry k with geometric average method, by adding the US additional tariffs on the US annual import tariffs of HS8-digit products from USITC. Using the form of ln($tariff_{ckt}$ + 1) in the above models. There may be expectation effect and lagged effect of additional tariffs. From the announcement to the implementation of the US levy of tariffs on Chinese products, some firms in China may reduce exports to the US in case that such unexpected tariffs will be imposed formally, thus producing expectation effect. Furthermore, due to the long duration of trade orders, some firms might still export to their importers even after the implementation of additional tariffs, thus producing lagged effect. Considering the above two effects of additional tariffs, this paper selects contemporaneous tariffs instead of lagging tariffs for the regression analysis.

The control variables: (1) Average import tariffs of the US imposing on third markets ($tariffthird_{jkt}$). We get the monthly average import tariffs of the US imposing on partner j in industry k with geometric average method. Using the form of ln($tariffthird_{jkt}$ + 1) in models. (2) Economic scale (GDP). In order to measure the economic scale of the

US and China, this paper uses relative GDP as the proxy variable of economic scale, that is, the ratio of China's GDP to America's GDP. Using the form of ln(GDP + 1) in models. (3) Real exchange rate (RER). We use the definition of RER in Choorikkad, et al. [20], that is, $RER_{ct} = (ER_{ct}/CPI_{ct})/(ER_{at}/CPI_{at})$, where ER_{ct} (or ER_{at}) denotes nominal exchange rates of China (or the US) in month t, measured as number of units of local currency per US dollars. CPI_{ct} (or CPI_{at}) refers to consumer price index of China (or the US) in month t. (4) Free Trade Agreement (FTA_j). If Country j signs FTA with the US, FTA_j is 1, otherwise, it is 0. (5) Common language ($Lang_j$). If country j and the US have a common language, $Lang_j$ takes 1, otherwise it takes 0. (6) Geographic distance (DIS_j). we choose the weighted distance of capitals of the US and country j. Using the form of $\ln(dis_j + 1)$ in models.

Import values in current US dollars, are obtained from Uncomtrade database, the import tariffs of the US are gained from the United States Trade Representative and the United States International Trade Commission, International Monetary Fund provides data on GDP, the Bank for International Settlements offers data on exchange rate and CPI, World Bank provides information on FTA, CEPII database has data on Common language and Geographic distance.

Descriptive Statistics. In order to analyze the trade destruction and deflection effects of the US additional tariffs on Chinese products, we use the data presented in Table 1.

Among the below three data sets, we first find the mean of intensive margin (expressed in logarithmic terms) is less than the mean of extensive margin (expressed in logarithmic terms), showing that the US import growth is driven by extensive margin. Besides, although the standard deviations of intensive and extensive margins are small, the maximum of them is much larger than corresponding minimum, showing that dual margins vary in different industries. Second, the mean of US import tariffs on China is about three times those on third-party countries. It means that the US tariff policy has greatly increased its import tariffs on China. Third, as for other control variables, the mean of relative GDP of China (relative to the US) is 0.494, while 0.082 of third-party country, indicating that the GDP scale of the third-party countries selected in this paper is far smaller than that of the US and China. Besides, there is a large gap between the maximum and minimum of real exchange rates of the third-party countries (relative to the US), indicating that the currencies of some countries are higher than the value of the US dollar, while some countries are lower. Moreover, the standard deviation of real exchange rates is large, indicating that the real exchange rates of different countries are relatively different. Meanwhile, the average value of FTA is 0.349, indicating that 34.9% third-party countries have signed FTA with the US. In addition, 56.9% third-party countries share a common language with US.

3 Trade Destruction Effects of the US Additional Tariffs on Chinese Products

The US imports of $200 billion worth products from China showed an overall upward trend in fluctuation before 2019, while a downward trend after 2019. To be specific, the

Table 1. Descriptive statistics

China's tariff-targeted products					
Variable	Observation	Mean	Standard deviation	Minimum	Maximum
lnEM	2,528	0.430	0.234	0.000	0.693
lnIM	2,528	0.181	0.133	0.000	0.693
lntariff	2,528	0.073	0.075	0.000	0.491
lnGDP	2,528	0.494	0.023	0.444	0.527
lnRER	2,528	1.994	0.026	1.931	2.032
China's non-tariff-targeted products					
Variable	Observation	Mean	Standard deviation	Minimum	Maximum
lnEM	2,161	0.312	0.253	0.000	0.693
lnIM	2,161	0.271	0.210	0.000	0.693
lntariff	2,161	0.062	0.062	0.000	0.303
lnGDP	2,161	0.494	0.023	0.445	0.527
lnRER	2,161	1.994	0.025	1.931	2.032
Tariff-targeted products of third-party countries					
Variable	Observation	Mean	Standard deviation	Minimum	Maximum
lnEM	40,819	0.323	0.207	0.000	0.693
lnIM	40,819	0.048	0.080	0.000	0.693
lntariff	40,819	0.075	0.075	0.000	0.491
lntariffthird	40,819	0.027	0.042	0.000	0.360
lnGDP	40,819	0.082	0.056	0.013	0.228
lnRER	38,920	2.089	2.052	0.526	7.122
FTA	40,819	0.349	0.477	0.000	1.000
lang	40,819	0.569	0.495	0.000	1.000
lndis	40,819	8.873	0.496	7.640	9.624

imports increase 26.66% from January 2017 to December 2018, but decrease 43.53% from December 2018 to December 2019. The quantity of products covered by the $200 billion list from China had little change before 2019, but declined in 2019, specially, the quantity falls from 2195 in December 2018 to 2062 in December 2019. Based on the empirical model, this section further analyzes trade destruction effects of the additional tariffs.

3.1 Econometric Baseline Results

The econometric model (7) is used to analyze the trade destruction effects of the additional tariffs based on the $200 billion list products imposed by the US on China. It is

first checked whether fixed effect model (FE) or random effect model (RE) is suitable according to the results of Hausman tests before regression.

The regression coefficient of tariff in column (1) of Table 2 is significantly negative, but not significant in column (2), which shows that trade destruction effects of additional tariffs are reflected in the intensive margin (that is, the proportion of the US imports from China relative to world based on existing tariff-targeted products declines.), rather than the extensive margin (showing the change of product types). Specifically, if the US import tariffs on China increase by 1%, the intensive margin of the tariff-targeted products imported by US from China reduces 0.216%. The regression coefficient of GDP is significantly positive, which is consistent with the promotion effect of GDP on trade growth in the trade gravity model, that is, if China's economic scale (relative to the US) increases by 1%, the proportion of US imports from China to its imports from globe based on existing tariff-targeted products increases by 0.213%, while the proportion of product types imported from China increases by 0.141%. The exchange rate has a positive impact on the intensive margin, indicating that the rise of China's real exchange rate (relative to US), which means the appreciation of the US dollar, encourages American importers to purchase more products.

3.2 Robustness Tests

Effects Over Time. Because of long duration of international trade, the impact of tariffs on trade in the current period may not be reflected. So we choose 2 months lagged values of US import tariffs on China and the regression results are shown in columns (3)–(4) of Table 2. First, the influence of core explanatory variable and control variables on the dependent variables in terms of the coefficient direction and significance is consistent with the benchmark regression results. Specifically, the trade destruction effects on China are still reflected in the intensive margin using 2 months lagged tariffs as a core explanatory variable, that is, if the US import tariffs on China increase by 1%, the proportion of the existing tariff-targeted products imported by US from China reduces by 0.208%. In addition, the rise of China's economic scale relative to US's promotes US to expand imports from China along the intensive margin and extensive margin. What's more, the greater China's real exchange rate (relative to US) is, the more products the US imports from China along the intensive margin.

Expanding the Sample of the Tariff-targeted Products: $250 Billion List. The analysis in Benchmark regression is based on $200 billion list, ignoring the impact of $34 and $16 billion list. Therefore, we use an expanded list sample, namely $250 billion list sample, for the robustness test. The regression results are shown in the columns (5)–(6) of Table 2. The results show that the trade destruction effects of additional tariffs are still reflected in the intensive margin; The impact of China's economic scale and real exchange rate on the US imports is also consistent with the results of benchmark regression. Therefore, the conclusions of this paper are robust.

3.3 Heterogeneity Analysis

Intermediate, Consumer and Capital Products. More than 40% products in the $200 billion list are intermediate products, about 30% are capital products, and about 20% are

Table 2. Trade destruction effects of the US additional tariffs on China: Full sample

	Econometric baseline results		Robustness tests: effects over time		Robustness tests: $250 billion list	
	IM	EM	IM	EM	IM	EM
	(1)	(2)	(3)	(4)	(5)	(6)
lntariff	−0.216***	−0.060	−0.208***	−0.058	−0.207***	0.040
	(-5.904)	(−1.594)	(−5.713)	(−1.553)	(−5.805)	(0.831)
lnGDP	0.213***	0.141*	0.263***	0.119*	0.208***	−0.215
	(4.269)	(1.951)	(5.272)	(1.896)	(4.235)	(−1.283)
lnRER	0.234***	0.073	0.136***	0.048	0.224***	−0.105
	(4.707)	(1.605)	(3.321)	(1.232)	(4.564)	(−0.385)
_cons	−0.375***	0.220*	−0.209**	0.279***	−0.356***	0.764
	(−3.615)	(1.899)	(−2.447)	(2.836)	(−3.485)	(1.425)
Model	RE	RE	RE	RE	RE	FE
N	2523	2523	2370	2370	2560	2560
R^2						0.027

(Note: (i) Robust standard errors in parentheses. (ii) ***, ** and * denote significant at the 1%, 5% and 10% levels, respectively.)

consumer products, which shows that the action of US additional tariffs is aimed at the intermediate products from China. Therefore, according to BEC classification criteria of Uncomtrade, we classify import products into intermediate, consumer and capital products, excluding the products without clear classification under three categories of 321, 51 and 7.

The results in columns (1)–(6) of Table 3 first show that US additional tariffs on China have trade destruction effects on the import of consumer capital products on the list along the intensive margin, that is, if the import tariffs on China increase by 1%, the proportion of the existing consumer and capital products on the list reduces by 0.252% and 0.229% respectively. Second, the destruction effects of additional tariffs on consumer products are greater than those on capital products, probably because the import demand of consumer products mainly comes from end consumers compared with capital products, and the demand of capital products is more easily regulated by country. Additional tariffs have no impact on the import of the intermediate products accounting for 40% on the list products. The reason may be that most of intermediate products are parts and components whose technical content is not easy to identify compared with capital products, so it is not easy to enhance import restrictions on them. Third, the extensive margins of these products have not been affected by the increase of additional tariffs. One reason may be that American importers are unwilling to expand exports owing to high cost of expanding trade channels at the product level. Another reason may be that it takes time to find other countries or markets with supply capacity due to the long process of international trade. Forth, GDP also promotes the trade growth of these

products along the intensive margin, and the rise of China's exchange rate against US improves the intensive margin of consumer and capital products on the list.

Table 3. Estimated results of intermediate, consumer and capital products

	Intermediate products		Consumer products		Capital products	
	IM	EM	IM	EM	IM	EM
	(1)	(2)	(3)	(4)	(5)	(6)
lntariff	−0.018	−0.063	−0.252***	−0.040	−0.229***	0.048
	(−0.247)	(−1.478)	(−6.375)	(−1.593)	(−4.469)	(1.449)
lnGDP	−0.665***	0.116	0.245**	−0.011	0.438***	−0.302
	(−2.695)	(1.282)	(2.254)	(−0.104)	(3.239)	(−1.361)
lnRER	−0.006	0.084	0.295***	−0.049	0.391***	−0.066
	(−0.013)	(1.461)	(3.896)	(−0.729)	(2.594)	(−0.530)
_cons	0.500	0.228	−0.458***	0.608***	−0.697**	0.781***
	(0.521)	(1.534)	(−2.631)	(3.613)	(−2.034)	(4.129)
Model	FE	RE	RE	RE	RE	FE
N	2171	2171	1516	1516	352	352
R^2	0.135					0.123

(Note: (i) Robust standard errors in parentheses. (ii) ***, ** and * denote significant at the 1%, 5% and 10% levels, respectively.)

Further Sources of Heterogeneity: The Different Tech-intensive Products. Following the Lall's classification criteria [21], we classify import products into high tech-intensive, medium tech-intensive, low tech-intensive, labor-intensive and resource-intensive manufactures and primary goods, ignoring last two products in the later analysis.

From the regression results in Table 4, firstly, it can be seen that the additional tariffs have no effect on the import of high-tech products on the list, but have trade destruction effects on medium-tech and low-tech products. The reason is that, due to the weak substitutability of high tech-intensive products, it is more difficult for US to find substitutes or importers compared with medium and low high tech-intensive products in a short time. Secondly, the trade destruction effects of additional tariffs on low tech-intensive products are greater than those on medium tech-intensive products: The imports of low tech-intensive products decrease along the intensive and extensive margins, while imports of medium tech-intensive products decrease only along the intensive margin. To be specific, US import tariffs on China increase by 1%, the intensive margin of medium tech-intensive products which the US imports from China decrease by 0.232%, and intensive margin and extensive margins of low tech-intensive products decrease by 0.259% and 0.032% respectively. Thirdly, GDP also promotes the trade growth of these products along the intensive margin. In addition, the rise of China's exchange rate against the US expands the import of low and medium tech-intensive products from China.

Table 4. Estimated results of high, medium and low tech-intensive products

	High tech-intensive products		Medium tech-intensive products		Low tech-intensive products	
	IM	EM	IM	EM	IM	EM
	(3)	(4)	(5)	(6)	(7)	(8)
lntariff	−0.127	−0.003	−0.232***	0.004	−0.259***	−0.032*
	(−0.681)	(−0.203)	(−4.668)	(0.111)	(−5.412)	(−1.853)
lnGDP	0.535**	−0.026	0.395***	0.084	0.325***	0.015
	(2.067)	(−1.063)	(4.679)	(0.901)	(5.961)	(0.367)
lnRER	−0.076	−0.063	0.337***	0.127*	0.339***	0.025
	(−0.295)	(−0.833)	(3.744)	(1.668)	(6.528)	(1.129)
_cons	0.139	0.483**	−0.670***	0.195	−0.561***	0.509***
	(0.337)	(2.501)	(−3.400)	(0.924)	(−5.074)	(7.881)
Model	RE	RE	RE	RE	RE	RE
N	196	196	739	739	1216	1216
R^2						

(Note: (i) Robust standard errors in parentheses. (ii) ***, ** and * denote significant at the 1%, 5% and 10% levels, respectively).

4 Trade Deflection Effects of the US Additional Tariffs on Chinese Products

4.1 The US Imports of Tariff-Targeted Products Shifting from China to Third-Party Countries

The results from estimation of model (8) with industry, time and country fixed effects, using contemporaneous tariffs and 3, 6 or 9 months lagged tariffs, show that the additional tariffs imposed by the US on China have no significant impact on the intensive margin and extensive margins of the US import from third-party countries based on tariff-targeted products. It shows that US imports don't transfer from China to third-party countries owing to the additional tariffs. The reason is that the implementation of the US trade protectionism policy is also a threat to third-party countries. The US may impose tariffs on third-party countries when it sends a signal of trade protectionism to the world, so the entry costs of new products from third-party countries increase, which will hinder the US imports from third-party countries on tariff-targeted products to a certain extent.

4.2 The US Imports Shifting from China's Tariff-Targeted Products to the Non-tariff-Targeted Products

The results from estimation of model (7) based on the non-tariff-targeted products, using contemporaneous tariffs and 3, 6 or 9 months lagged tariffs, show that the US additional

tariffs have no significant impact on the intensive margin and extensive margins of China's non-tariff-targeted products. It shows that US imports don't transfer from China's tariff-targeted products to its non-tariff-targeted products owing to the additional tariffs. In theory, however, the additional tariffs imposing on China's tariff-targeted products will relatively reduce the trade costs of China's non-tariff-targeted products, and then increase the imports of these products. The reason for the inconsistency may be the "chilling effect" (Vandenbussche and Zanardi [22]). When the US imposes tariffs on China's tariff-targeted products, the non-tariff-targeted products may also be subject to tariffs. Indeed, from July 2018 to September 2019, the US imposed tariffs on Chinese products four times, and the scale of tariff-targeted products and the types of products involved gradually increased, which led to less China's exports to the US on the non-tariff-targeted products. Therefore, on the whole, there is no change in US imports from China on the non-tariff-targeted products.

5 Conclusion

Although the signing of the phase-one economic and trade agreement between China and the US on January 15, 2020 suspends the sustained and tense economic and trade situation, the US-China trade frictions are not over, and even more tense with the impact of the COVID-19 epidemic. Based on the trade gravity model, this paper researches how intensive and extensive margins play a role in trade effects of the additional tariffs which US imposes on China from the perspective of dual margins, using the monthly data of US importing from its 20 partners from January 2017 to August 2019. The conclusions are as follows:

First, the US additional tariffs on Chinese products have a trade destruction effect on China along the intensive margin, which shows that if the US import tariffs on China increase by 1%, the intensive margin of the tariff-targeted products imported by the US from China reduces 0.216%. This conclusion is still stable when expanding the product sample and using 2 months lagged US import tariffs on China.

Second, from the perspective of product heterogeneity: the additional tariffs have trade destruction effects on the import of existing consumer and capital products on the list along the intensive margin, but have no effect on the import of intermediate products. Specifically, if the US import tariffs on China increase by 1%, the proportion of the existing consumer and capital products on the list reduces by 0.252% and 0.229% respectively. In addition, the additional tariffs have no effect on the import of high tech-intensive products on the list, but have a trade destruction effect on medium and low tech-intensive products. To be specific, US import tariffs on China increase by 1%, the intensive margin of medium tech-intensive products which the US imports from China decreases by 0.232%, and intensive and extensive margins of low tech-intensive products decrease by 0.259% and 0.032% respectively.

Thirdly, from neither the intensive margin nor the extensive margin, the US imports shift from China's tariff-targeted products, to the tariff-targeted products of third-party countries and to China's non-tariff-targeted products owing to the additional tariffs imposed by the US on China.

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