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The Impact of U.S. Trade Policy Uncertainty on the Trade Margins of China's Export to the U.S.

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Abstract: Since the subprime crisis, the U.S. has begun to adjust its international trade policies due to the worldwide economic slowdown, leaving its trading partners facing great uncertainty in trade policy. In this study, we developed a panel model to empirically analyze the impact of U.S. trade policy uncertainty on the extensive margin, intensive margin, price margin, and quantity margin of Chinese exports of U.S. goods. We found that U.S. trade policy uncertainty is also a trade barrier for China's export trade. The extensive margin, intensive margin, price margin, and quantity margin of Chinese exports to the U.S. are all adversely connected with U.S. trade policy uncertainty. The increase in U.S. trade policy uncertainty significantly inhibits the increase in the extensive margin, intensive margin, and quantity margin of China's exports to America, and the degree of inhibition of the quantity margin is five times that of the extensive margin. Increased U.S. trade policy uncertainty also restrains the increase in the price margin of Chinese exports to America, but this is not statistically significant. In this study, we emphasize the significant impact that U.S. trade policy uncertainty has had on the trade margins of Chinese exports of goods to America. To stabilize China's exports to the United States, China should increase support for export enterprises' technological R&D and innovation, expand bilateral or multilateral free trade agreements with other countries, and so on.

Keywords: trade policy uncertainty; Sino–U.S. exports; trade margins

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1. Introduction

After China's accession to the World Trade Organization in 2001, the scale of China's foreign exports has developed rapidly, and exports have become a very important driving force for China's rapid economic growth. In particular, the United States, as the world's largest developed country, has naturally become a very important destination for Chinese goods and has long been ranked China's largest export destination. In addition, China has also been the largest source country for U.S. imports in recent years, according to the Ministry of Commerce of the People's Republic of China website: in 2017, U.S. imports from China, Mexico, Canada, and Japan were worth USD 505.60 billion, USD 314.05 billion, USD 229.98 billion, and USD 136.54 billion, respectively, accounting for 21.6 percent, 13.4 percent, 12.8 percent, and 5.8 percent of the total U.S. imports. In 2018, U.S. imports from China, Mexico, Canada, and Japan were worth USD 539.50 billion, USD 346.53 billion, USD 318.48 billion, and USD 142.60 billion, respectively, accounting for 21.2 percent, 13.6 percent, 12.5 percent, and 5.6 percent of the total U.S. imports. In 2019, U.S. imports from China, Mexico, Canada, and Japan were worth USD 452.24 billion, USD 358.13 billion, USD 319.74 billion, and USD 143.64 billion, respectively, accounting for 18.1 percent, 14.3 percent, 12.8 percent, and 5.8 percent of the total U.S. imports.

Trade policy uncertainty refers to the possibility of changes in a country's trade policy, mainly including the possibility of the non-renewal of tariff preference programs, temporary trade bans, economic sanctions, intellectual property disputes, anti-dumping measures, and so on. Since the establishment of the World Trade Organization, countries worldwide have been conducting international trade under the framework of the multilateral rules

of the World Trade Organization, and the level of trade policy uncertainty has greatly decreased. Since the subprime crisis, being affected by the worldwide economic downturn, some countries began to adjust their international trade policies, significantly increasing the trade policy uncertainty faced by trading partner countries. According to the Global Trade Alert website, in recent years, the U.S. has been among the top countries in the world in terms of the number of interventions that have been implemented and that are harmful to trade development.

The slow growth of the U.S. economy in recent years, especially the serious hollowing out of the manufacturing sector and the decline in the international competitiveness of traditional manufacturing industries, has led to the rise of protectionist forces in the United States. In particular, Trump's "America First" unilateralism and trade frictions against China during his presidency dramatically increased the level of trade policy uncertainty facing China's exports to the United States. The U.S. Trade Policy Uncertainty Index, compiled by Scott R. Baker, Nick Bloom, and Steven J. Davis [1], shows that since Trump launched trade frictions against major trading partners in 2017, the U.S. Trade Policy Uncertainty Index has climbed rapidly and is much higher than the U.S. Trade Policy Uncertainty Index under the Obama administration. The huge level of trade policy uncertainty once cast a huge shadow over the prospect of Sino–U.S. trade, and although the trade tensions between China and the U.S. have since eased, China's export trade to the U.S. will still face huge levels of trade uncertainty under the influence of uncertain events such as the continued global spread of the new Coronavirus epidemic, the significant decline in the US dollar, the unclear policy orientation of the U.S. Biden administration towards China, and the reshaping of the U.S. supply chain.

Osnago et al. argued that trade policy uncertainty is also an obstacle for world trade [2]. China is the world's largest developing country and the largest exporter of goods. Is U.S. trade policy uncertainty also an obstacle for China's exports to the United States? What is the specific impact on the structure of China's export growth (trade margins) to the United States? Is this impact consistent across different broad product categories? How should China respond? The resolution of these questions will not only help us to understand the impact of U.S. trade policy uncertainty on the growth structure of China's exports to the America, but will also facilitate measures that China can take to properly respond to various uncertainties in U.S. trade policy toward China. Therefore, in this study, we developed a panel regression model to answer these questions by using data from the CEPII database, the WDI database, and the U.S. Trade Policy Uncertainty Index for the period 2001–2019, with the trade margins of 21 major categories of Chinese exports to the United States as dependent variables.

The contributions of this study are mainly reflected in the following respects: First, the existing studies mainly focus on the impact of trade policy uncertainty on export flows, and most of the studies regarding trade margins only include the extensive margin and the intensive margin. Less of the literature focuses on the impact of U.S. trade policy uncertainty on the price margin and quantity margin of China's exports to the U.S. In this study, we systematically examined the impact of U.S. trade policy uncertainty on the extensive margin, the intensive margin, the price margin, and the quantity margin of China's exports to the U.S. The results of this study further enrich and expand research into the trade effects of trade policy uncertainty. Second, we conducted this study from the perspective of trade margins, revealing the impact of U.S. trade policy uncertainty on the growth structure of China's exports to the U.S., which has a certain policy reference significance for our accurate understanding of the impact of external economic policy uncertainty on exporting countries and other reasonable responses.

The rest of the research is organized as follows: A review of the relevant literature regarding trade margins, trade policy uncertainty, and Sino–U.S. exports is presented in Section 2. The theoretical framework is provided in Section 3. The trade margin decomposition framework, empirical methodology, variable selection, and data sources are introduced

in Section 4. The results and discussion are analyzed in Section 5. Section 6 contains the conclusion and policy recommendations.

2. Literature Review

Both classical and neo-classical trade theories focus on the theory of comparative advantage, arguing that one country's export growth is due to the growth of the intensive margin, which is the only way to cause export trade growth. Neo-trade theory argues that economies of scale and product diversification lead to export growth, with the core idea that export product diversification makes the extensive margin an important way of achieving export growth. When the new neo-trade theory was born with the study of firm heterogeneity, the trade growth theory developed to a new level, which integrated the views of the previous theories and argued that export trade could grow along both the extensive margin and the intensive margin [3]. Hummels and Klenow split the binary margin into ternary margins, namely the extensive margin, quantity margin, and price margin, establishing the groundwork for other researchers to investigate the ternary margins [4].

Various researchers have researched export trade growth extensively and with varying conclusions. Some experts' studies, such as Helpman and Freund, showed that the intensive margin was more significant for export growth [5]. Amurgo-Pcheco and Pierola found that in virtually all countries, export growth mostly depends on the intensive margin and that the extensive margin contributes little to export growth when comparing the exports of developed and developing nations [6]. Liu et al. found that quantity margin was a main driving force of China's export boom [7].

Scholars have steadily increased their study on trade policy uncertainty in recent years, mostly focusing on studies regarding the influence of trade policy uncertainty on trade, commodity prices, household income, investment, and changes in national welfare. Among them, there are two main mechanisms of the impact of trade policy uncertainty on exports; on the one hand, rising or falling changes in trade policy uncertainty would affect exporters' expectations of future earnings and would prompt exporters to exit or enter the export market. Kyle Handley found that trade policy uncertainty affects firms' expectations of future earnings. If the level of trade policy uncertainty decreases, the number of firms entering the export market will increase [8]. In addition, on the other hand, changes in trade policy uncertainty would also have an impact on the importing country's own business activities, which would ultimately affect imports. Changes in trade policy uncertainty would affect changes in the cost of imported goods purchased by domestic consumers. Michele Imbruno, based on a trade policy uncertainty perspective, explored the identification of the larger grocery costs that may be faced when purchasing foreign goods [9]. Changes in trade policy uncertainty would also influence business investment; Dario Caldara et al. examined the impact of unexpected changes in trade policy uncertainty on the U.S. economy and found that an increase in the level of TPU reduces the level of business investment activity [10]. Constantinescu et al. used data from 18 countries and 24 years of policy uncertainty to find that a 1% increase in uncertainty would lead to a 0.02% decrease in the growth of trade in goods and services, and in particular, an increase in the level of policy uncertainty since mid-2018 could lead to a 1% decrease in world trade growth [11]. According to Kyriazis Nikolaos A., trade policy uncertainty makes products more expensive and of lower quality, and it also makes people less likely to engage in international trade [12]. In general, trade policy uncertainty hinders economic globalization [13].

No more consistent findings have been presented regarding the effects of trade policy uncertainty on the intensive and extensive margins, with various conclusions reported for different samples. Some empirical studies have revealed that trade policy uncertainty mostly influences commerce through the extensive margin. Carballo et al. showed that an increased level of trade policy uncertainty reduces overall trade and the extensive margin while having no effect on the intensive margin [14]. Another group of experts believed that trade policy uncertainty mostly impacted commerce through the intensive margin.

Osnago et al. discovered that a 1% reduction in trade policy uncertainty was connected with a 12% rise in the number of product categories exported, while the existence of trade policy uncertainty was comparable to a 1.7% to 8.7% increase in tariffs [2]. However, it had also been proposed that trade policy uncertainty influences trade through the intensive and extensive margins. Handley et al. [15] and Shepotylo and Stuckatz [16] indicated that reductions in the level of trade policy uncertainty led to the expansion of both the intensive and extensive margins. Zhou Fengxiu and Wen Huwei analyzed the impact of trade policy uncertainty on firms' export behavior using panel data from listed firms in China's industrial sector. The empirical results showed that a high level of trade policy uncertainty significantly inhibits the expansion margin and the intensification margin of firms' exports [17]. Other scholars take a different view on the impact of trade policy uncertainty on trade margins. Andrew Greenland et al. examined the impact of policy uncertainty on exports in 18 large economies and found that an increased level of policy uncertainty reduces the extensive margin but increases the intensive margin [18].

Regarding the impact of U.S. trade policy uncertainty, Olasehinde discovered that U.S. trade policy uncertainty was a significant predictor of global production volatility [19]. Rexford Abaidoo showed that economic policy uncertainty associated with the United States often had significant negative or restrictive effects on international trade [20]. Yan et al. discovered that increases in the level of U.S. trade policy uncertainty had significant adverse impacts on China's yield, consumption, and net exports in both the long and short run but had a positive effect on investment in the near term and a negative effect in the mid to long term [21]. Some scholars argued that policy uncertainty lowered U.S. prices and increased consumer incomes by the equivalent of a permanent 13 percentage point reduction in tariffs. Chen Xiaoping and Zhao Xiaotao found that the decline in the level of trade policy uncertainty between China and the U.S. reduced the volatility of firms' exports to the U.S. but increased the volatility of exports to other countries and regions in the world, using data regarding Chinese exporters before and after China's WTO accession [22]. Changes in trade policy uncertainty, according to Serdar Ongan and Ismet Gocer, were significant determinants of U.S. trade volume in bilateral trade with China, and a decline in the level of TPU would boost Chinese exports to the U.S. in the short run [23]. Using Chinese customs transaction data from 2000 to 2009, Meredith Crowley et al. found that, when Chinese firms' products encountered increased levels of trade policy uncertainty, the likelihood of exiting mature foreign markets also increased [24]. Studies on the impact of U.S. trade policy uncertainty on China's exports to the U.S. have focused on the binary margin of trade. According to Feng et al., the decrease in ambiguity regarding U.S. trade policy toward China since China's entrance to the WTO had increased Chinese exports to the U.S. This was realized through an increase in the extensive margin rather than an increase in the intensive margin [25].

Scholars have researched trade policy uncertainty in a variety of areas and have reached convincing and informative conclusions, but only a few studies have focused on the effect of U.S. trade policy uncertainty on Chinese exports, particularly with regard to the extensive margin, intensive margin, price margin, and quantity margin of U.S. trade uncertainty on Chinese exports to the U.S., and research findings are few and far between. As a result, in this article, we investigated the influence of U.S. trade policy uncertainty on the trade margins of China's exports to the U.S.

3. Theoretical Framework

This study referred to Melitz's [3] neo-neo-trade theory model and drew on the model of Liu et al. [26].

Assume that the consumer preference function for the importing country is

$$U_j = \left[\int_{\omega \in \Phi} q_j(\omega)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad (1)$$

where $q_j(\omega)$ denotes the number of products consumed by consumers in the importing country, ω denotes the product type, Φ denotes the set of product types, and σ denotes the elasticity of substitution between products ($\sigma > 1$).

The demand function can be solved by maximizing consumer utility as follows:

$$q_j(\omega) = Y_j \frac{p_j(\omega)^{-\sigma}}{I_j(\omega)^{1-\sigma}} \tag{2}$$

where Y_j denotes the total expenditure in importing country j, P_j denotes the product price, and I_j is the price index of importing country j.

The enterprise needs to pay a fixed cost f and a variable production cost q/φ depending on labor productivity to produce the product in quantity q. Therefore, the enterprise profit function can be organized as follows:

$$\pi = p_j(\omega)q_j(\omega) - f - \frac{q(\omega)}{\varphi} \tag{3}$$

According to the conditions when the firm maximizes profit, the optimal price in the domestic market is obtained:

$$p(\omega) = \frac{\sigma}{\sigma - 1} \times \frac{1}{\varphi} \tag{4}$$

The firm's equilibrium price in the domestic market is multiplied by the variable trade cost (τ) to obtain the export market price P_x:

$$P_x = \tau p(\omega) = \frac{\sigma}{\sigma - 1} \times \frac{\tau}{\varphi} \tag{5}$$

Drawing on Handley [8], the probability of a tariff change is set to γ to indicate the risk of tariff adjustment by the importing party, with a smaller γ indicating a lower level of trade policy uncertainty. When a shock occurs, the policy maker will reset the new tariff level τ', and the new tariff obeys the $H(\tau')$ distribution, with τ' taking values between $[1, \tau_{max}]$, with τ_{max} referring to the maximum tariff that may be imposed by the foreign country.

Firms entering the export destination market need to pay a one-time entry cost (sunk cost), and firms deciding to export to foreign countries pay a fixed cost of export f_x per period. Referring to Feng [25], fixed export costs are assumed to increase with the number of exporting firms, $f_x = N_k f$, with N representing the number of exporting firms and k denoting the degree of congestion into the export market ($k \geq 0$).

According to Equations (2)–(5), the variable profit function and earnings of exporters can be obtained as follows:

$$\begin{aligned} v(\varphi) &= \tfrac{\sigma}{\sigma-1} \times \tfrac{1}{\varphi} \times q - \tfrac{q}{\varphi} = [\varphi(\sigma-1)]^{-1} Y_j \tfrac{P_j(\omega)^{-\sigma}}{I_j(\omega)^{1-\sigma}} \\ &= Y(\sigma\tau)^{-\sigma}[P\varphi(\sigma-1)]^{\sigma-1} \end{aligned} \tag{6}$$

Let $\mu(\varphi)$ denote the productivity distribution of surviving firms, and let the price index be expressed as follows:

$$I = \left[\int_0^{\infty} p(\varphi)^{1-\sigma} N \mu(\varphi) d\varphi \right]^{\frac{1}{1-\sigma}} \tag{7}$$

Bringing Equation (5) into Equation (7) gives the following equation:

$$I = \frac{\sigma}{\sigma - 1} \frac{\tau}{\varphi} N^{\frac{1}{1-\sigma}} \tag{8}$$

where $\overline{\varphi} = \left[\int_0^{\infty} \varphi^{\sigma-1}\mu(\varphi)d\varphi\right]^{\frac{1}{1-\sigma}}$ represents the average productivity of the surviving firm. Bringing Equation (8) into Equation (6) gives the following equation:

$$v(\varphi) = \frac{1}{\tau\sigma}\frac{Y}{N}\left(\frac{\varphi}{\overline{\varphi}}\right)^{\sigma-1} \tag{9}$$

Whether a firm exports or not is based on a comparison between the present value of variable profits and the fixed cost of exporting, and the firm will only export if the present value of variable profits is greater than the fixed cost of exporting. The present value of variable profits for a firm with a production rate φ is

$$v(\tau_t, \varphi) = v(\tau_t, \varphi) + \rho\left[(1-\gamma)v_p(\tau_t, \varphi) + \gamma E_\tau v_p(\tau_{t+1}, \varphi)\right] \tag{10}$$

Taking the expectation on both sides of Equation (10) yields the following equation:

$$E_\tau v(\tau, \varphi) = \frac{1}{1-\rho}E_\tau v(\tau, \varphi) \tag{11}$$

Bringing Equation (11) into Equation (10), the present value of variable profit is expressed as

$$v_p(\tau_t, \varphi) = \frac{1}{1-\rho}\left[\frac{1-\rho}{1-\rho(1-\gamma)}v(\tau_t, \varphi) + \frac{\rho\gamma}{1-\rho(1-\gamma)}E_\tau v(\tau_t, \varphi)\right] \tag{12}$$

Let $\delta_a = \frac{1-\rho}{1-\rho(1-\gamma)}$, $\delta_e = \frac{\rho\gamma}{1-\rho(1-\gamma)}$. The square brackets in Equation (12) denote the weighted average of current variable profits, mainly based on the current tariff τ_t and the unconditional expected variable profits that explain the uncertainty of future tariff changes. If trade policy uncertainty increases, i.e., γ increases, firms will increase the weight of the expected variable profit term and decrease the weight of the profit term based on the currently applied tariffs.

$$v_p(\tau_t, \varphi) = \frac{1}{(1-\rho)N\sigma\overline{\varphi}^{\sigma-1}}Y\left[\delta_a\tau^{-1} + \delta_e E_\tau(\tau^{-1})\right] \tag{13}$$

Let $A = \frac{1}{(1-\rho)N\sigma\overline{\varphi}^{\sigma-1}}$, $T = \delta_a\tau^{-1} + \delta_e E_\tau(\tau^{-1})$. Thus, Equation (13) can be simplified as

$$v_p(\tau_t, \varphi) = AYT\varphi^{\sigma-1} \tag{14}$$

According to Equation (14), the expected profit of the firm's export can be expressed as

$$\pi_x = v_p(\tau_t, \varphi) - \frac{f_x}{1-\rho} = AyT\varphi^{\sigma-1} - \frac{N^k f}{1-\rho} \tag{15}$$

The variable profit of a firm with average productivity is

$$v(\tau_t, \overline{\varphi}) = AYT\varphi^{\sigma-1} = \frac{YT}{(1-\rho)N\sigma} \tag{16}$$

Thus, the average profit of the firm can be expressed as

$$\overline{\pi_x} = v(\tau_t, \overline{\varphi}) - \frac{fx}{1-\rho} = \frac{1}{1-\rho}\left(\frac{YT}{N\sigma} - N^k F\right) \tag{17}$$

When trade policy uncertainty increases, the expected term $E(\tau^{-1})$ decreases, and thus, the compound tariff term T decreases. It is clear from Equation (16) that the decrease in T implies a lower expected return to entry, leading to a large number of firms exiting the export market.

From this analysis, it is clear that an increase in the level of trade policy uncertainty will force low- and medium-productivity firms to exit the export market, which will inhibit the increase in the extensive margin, the intensive margin, and the quantity margin. An increase in the level of trade policy uncertainty means that exporters are highly likely to face a tariff increase, and high-productivity firms may be forced to choose to reduce the price quoted for export goods in order to have a market share and maintain the stability of the end price in the export market, meaning an increase in the level of trade policy uncertainty will also suppress the price margin of exports.

4. Materials and Methods

4.1. Decomposition Framework of Trade Margins

Referring to Feenstra [27], Hummels et al. [4], Bing-Zhan Shi [28], and other domestic and foreign scholars' decomposition methods of trade margins, the extensive margin (*EM*), the intensive margin (*IM*), the price margin (*PM*), and the quantity margin (*QM*) are defined as:

$$EM_{jm} = \frac{\sum_{i \in I_{jm}} p_{rmi} x_{rmi}}{\sum_{i \in I_{rm}} p_{rmi} x_{rmi}} \tag{18}$$

where *j* represents China, *r* represents the world, and m represents the importing country—the U.S. I_{rm} represents the set of certain types of goods exported from China to the U.S. I_{jm} represents the set of certain types of goods exported from the world to the U.S. $I_{rm} \in I_{jm}$. The extensive margin (*EM*) represents the share of China's trade in overlapping goods exported to the U.S. with the world in the world's total trade in exports to the U.S. A larger *EM* indicates that China is exporting more types of goods in exports to the U.S.

$$IM_{jm} = \frac{\sum_{i \in I_{jm}} p_{jmi} x_{jmi}}{\sum_{i \in I_{jm}} p_{rmi} x_{rmi}} \tag{19}$$

The numerator of the intensive margin (*IM*) indicates China's exports to the U.S. in a given category of goods, and the denominator indicates the world's exports of goods that overlap with China. The intensive margin indicates the share of Chinese exports in the world's exports to the U.S. for the overlapping goods, and the larger the intensive margin, the more Chinese exports are realized for the same category of products.

To analyze the composition of trade growth more effectively, the intensive margin (*IM*) can be further decomposed as the product of the price margin (*PM*) and the quantity margin (*QM*).

$$IM_{jm} = PM_{jm} \times QM_{jm} \tag{20}$$

$$PM_{jm} = \prod_{i \in I_{jm}} \left(\frac{p_{jmi}}{p_{rmi}} \right)^{w_{jmi}} \tag{21}$$

$$QM_{jm} = \prod_{i \in I_{jm}} \left(\frac{q_{jmi}}{q_{rmi}} \right)^{w_{jmi}} \tag{22}$$

The price margin (*PM*) is the weighted average of the prices of Chinese exports to America, meaning the ratio of the average price of Chinese exports to the world can be obtained. The quantity margin (*QM*) is the weighted average of the quantity of Chinese exports of U.S. goods, meaning the ratio of the quantity of Chinese exports to the world can be obtained. The weight w_{jmi} is calculated using the following equation:

$$w_{jmi} = \frac{\frac{s_{jmi} - s_{rmi}}{lns_{jmi} - lns_{rmi}}}{\sum_{i \in I_{jm}} \frac{s_{jmi} - s_{rmi}}{lns_{jmi} - lns_{rmi}}} \tag{23}$$

where s_{jmi} denotes the share of commodity i in China's total U.S. exports and s_{rmi} denotes the share of commodity i in the world's total U.S. exports, which can be calculated using the following equation:

$$s_{jmi} = \frac{p_{jmi}x_{jmi}}{\sum_{i \in I_{jm}} p_{jmi}x_{jmi}} \tag{24}$$

$$s_{rmi} = \frac{p_{rmi}x_{rmi}}{\sum_{i \in I_{jm}} p_{rmi}x_{rmi}} \tag{25}$$

In this regard, the Chinese export share in the American market for a product can be decomposed as the product of the extensive margin, the price margin, and the quantity margin.

$$R_{jm} = EM \times IM = EM \times PM \times QM \tag{26}$$

It follows that the change in China's export market share of a category of products in the U.S. is closely related to the change in the extensive margin, the price margin, and the quantity margin.

4.2. Empirical Model Setting

Drawing on research models often used by domestic and foreign scholars in the study of trade issues, in this paper, we used the following empirical model to determine the impact of U.S. trade policy uncertainty on the ternary margin of Chinese exports of U.S. goods:

$$lnY_{jmht} = \beta_0 + \beta_1 lnTPU_{mt} + \varphi_2 lnZ + \gamma_t + \mu_h + \varepsilon_{jmht} \tag{27}$$

In Equation (27), the subscript j is the exporting country, China; the subscript m is the importing country, the U.S.; h is one of the 21 categories of HS code; and t is the year. Y_{jmht} is the dependent variable; TPU_{mt} is the core independent variable; Z is the other independent variables, including the GDP per capita of China, the GDP per capita of U.S., the actual tariff rate, China's direct investment to the U.S., oil prices, and exchange rate. γ_t is a possible time-fixed effect, μ_h is a possible industry-fixed effect, and ε_{jmht} is the random error term.

4.3. Dependent and Independent Variables

4.3.1. Dependent Variables

In this paper, four explanatory variables were used: the extensive margin (*EM*), intensive margin (*IM*), price margin (*PM*), and quantity margin (*QM*) of China's annual exports to the U.S. Following the abovementioned decomposition framework of trade margins of China's exports to the U.S. from 2001 to 2019 in 21 major categories (excluding the 22nd category: special traded goods and unclassified goods), HS codes were calculated by using data regarding HS6-digit-level commodity trade in the CEPII- BACI database.

4.3.2. Independent Variables

1. U.S. trade policy uncertainty—TPU_{mt}

The core independent variable in this paper was U.S. trade policy uncertainty (TPU_{mt}). There are different approaches to the measurement of U.S. trade policy uncertainty: one is an index constructed by Scott R. Baker, Nick Bloom, and Steven J. Davis [1] to capture trade policy uncertainty based on the frequency of U.S. newspaper articles discussing trade-policy-related uncertainty. Another is the use of tariff measures to measure the magnitude of changes in trade policy which are unfavorable to firms when they occur. Although simple to implement and calculate, the factors influencing international trade policy uncertainty are not always limited to tariff changes but can also be the result of other economic and political factors. Therefore, in this paper, we adopted the first approach to measure U.S. trade policy uncertainty, with detailed data from http://www.policyuncertainty.com/ (accessed on 9 January 2022). As the U.S. trade policy uncertainty index is a monthly index,

drawing on the general practice of other scholars, we processed it using the arithmetic average method, and then, its average value was taken as the annual value.

2. GDP per capita—$CPGDP_t$ and $APGDP_t$

The annual GDP per capita in China and America was calculated using current dollars and data from the World Bank to reflect the supply and market size of both countries.

3. Actual tariff rate—AHS_{jmht}

The annual actual tariff rate imposed by the U.S. on China's HS2-digit product-level imports from the WITS database was used and averaged using the arithmetic average method after grouping it by HS21 categories.

4. China's direct investment to the U.S.—$COFDI_t$

Using data regarding China's direct investment stock to the U.S. from the "Statistical Bulletin of China's Outward Foreign Direct Investment" in previous years, of which data for 2001 and 2002 are missing, and the average growth rate from 2003 to 2019 esd used to estimate the missing values.

5. Oil prices—$OILPRICE_t$

Oil prices were used to reflect the movement of transportation costs, using the annual spot prices of crude oil and petroleum products published by the U.S. Energy Information Administration. The data were obtained from https://www.eia.gov (accessed on 9 January 2022).

6. Exchange Rate—$EXCHANGE_t$

The annual official exchange rate of the U.S. dollar to the Chinese yuan, expressed using the direct markup method, was used with data from the World Bank database. See Table 1 for specific explanatory notes on the variables.

Table 1. Descriptive statistics for the variables included in the study.

Variable	Obs	Mean	Std. Dev.	Min	Max
ID	399	11	6.063	1	21
YEAR	399	2010	5.484	2001	2019
EM	399	0.873	0.185	0.072	1
IM	399	0.182	0.18	0.003	0.714
PM	399	2.147	14.711	0.368	285.7
QM	399	0.186	0.192	0	0.778
APGDP	399	50,088.67	7987.593	37,133.238	65,279.531
CPGDP	399	5018.341	3119.206	1053.108	10,216.63
AHS	399	3.272	3.2	0	26.072
COFDI	399	2,233,584.7	2,765,435.8	25,867	7,779,750
TPU	399	121.002	185.465	28.74	797.12
OILPRICE	399	63.47	23.933	25.98	99.67
EXCHANGE	399	7.142	0.797	6.143	8.277

Note: the extensive margin of China's export to U.S. (*EM*), the intensive margin of China's export to U.S. (*IM*), the price margin of China's export to U.S. (*PM*), the quantity margin of China's export to U.S. (*QM*), U.S. trade policy uncertainty (*TPU*), GDP per capita of U.S. (APGDP), GDP per capita of China (CPGDP), the actual annual tariff rate imposed by the United States on Chinese exports (AHS), China's direct investment to the U.S. (COFDI), oil price (OILPRICE), the annual official exchange rate of the U.S. dollar to the Chinese yuan (EXCHANGE).

4.4. Data

Descriptive statistics for the variables included in the study are shown in Table 1.

5. Results and Discussion

5.1. Analysis of Results

5.1.1. Analysis of the Whole Sample's Results

In this paper, we established a model based on Equation (27), and we first needed to determine the appropriate form of the model. After the F-test and Hausman test, the final

extensive margin, intensive margin, price margin, and quantity margin regression models all had to adopt the panel random effects model as more appropriate. The regression results are analyzed here.

Table 2 shows the estimation results of the total sample. From the regression results, the core independent variable of this paper—U.S. trade policy uncertainty—is negatively related to the growth of the extensive margin, intensive margin, price margin, and quantity margin of China's exports to the U.S., but the levels of significance are different, meaning that the increase in U.S. trade policy uncertainty will significantly inhibit the growth of the extensive margin, intensive margin, and quantity margin of China's exports to the U.S., and the effect on the price margin, although negatively correlated, is not significant. In addition, from the regression coefficients, each 1% increase in the U.S. trade policy uncertainty index on average will lead to a 0.02%. 0.13%, and 0.1% decrease in the extensive margin, intensive margin, and quantity margin of Chinese exports of U.S. goods, respectively, which means that there is a difference in the degree of suppression of the extensive margin, intensive margin, and quantity margin of Chinese exports of U.S. goods by an increase in the level of trade policy uncertainty, which is five times higher than the extensive margin. Conversely, each 1% decrease in the U.S. trade policy uncertainty index would increase the extensive margin, intensive margin, and quantity margin of China's exports to the U.S. by 0.02%, 0.13%, and 0.1%, respectively.

Table 2. The estimation results of the whole sample.

Variables	(1)	(2)	(3)	(4)
	EM	***IM***	***PM***	***QM***
lnTPU	−0.0185 *	−0.126 ***	−0.0152	−0.111 ***
	[0.0102]	[0.0266]	[0.0216]	[0.0302]
lnAPGDP	−0.622 **	−0.0859	1.083 *	−1.178
	[0.3064]	[0.7993]	[0.6494]	[0.9078]
lnCPGDP	0.250 **	0.718 **	−0.437 *	1.161 ***
	[0.1162]	[0.3032]	[0.2461]	[0.3443]
lnAHS	0.0953 ***	−0.0571 *	0.00303	−0.0552
	[0.0108]	[0.0296]	[0.0228]	[0.0336]
lnCOFDI	0.00188	−0.0855	0.0217	−0.108
	[0.0261]	[0.0680]	[0.0553]	[0.0773]
lnEXCHANGE	0.807 **	1.385	−1.062	2.462 **
	[0.3460]	[0.9030]	[0.7333]	[1.0256]
lnOILPRICE	0.0185	0.0681	−0.0609	0.129 *
	[0.0262]	[0.0684]	[0.0556]	[0.0777]
_cons	2.859	−8.555	−5.962	−2.571
	[2.0101]	[5.2479]	[4.2600]	[5.9602]
obs	364	364	364	364
adj.R−sq	/	/	/	/
AIC	/	/	/	/
BIC	/	/	/	/

Note: Standard errors of the corresponding variables are in parentheses; *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

In terms of the other dependent variables, the increase in U.S. GDP per capita significantly contributes to the increase in the price margins of Chinese exports of U.S. goods, but it does dampen the extensive margins of Chinese exports of U.S. goods. The possible reason for this is that the increase in U.S. GDP per capita represents an increase in consumption power, which will expand the demand for Chinese goods and therefore increase the overall average price of Chinese goods; however, the increase in U.S. GDP per capita may also mean that the demand for Chinese goods by U.S. residents will change structurally with the increase in GDP per capita, which may reduce the demand for certain low-quality Chinese goods. Therefore, the extensive margin of China's exports of goods to the U.S. is dampened. The increase in China's GDP per capita significantly contributes to the extensive margin,

intensive margin, and quantity margins of China's exports to the U.S. but depresses the price margins of China's exports to the U.S. The growth in China's GDP per capita implies an increase in China's ability to produce goods, especially since 2001, when China joined the WTO and rapidly developed into a major manufacturing and exporting country. This naturally boosted the extensive, intensive, and quantity margins of China's exports to the U.S. with the increase in supply capacity and exports, but due to the possible fierce competition among Chinese exporters, it led to mutual price pressures. This may be the main reason for the negative correlation between the increase in China's GDP per capita and the price margins of Chinese exports to the United States. The increase in the actual tariff rate imposed by the U.S. on Chinese products mainly affects the extensive margin of China's exports to the U.S., with no significant impact on the quantity and price margins. On average, each percentage point increase in the U.S. tariff rate on Chinese goods will increase the extensive margin of China's exports to the U.S. by 0.095 percentage points, while causing the intensive margin to decrease by 0.057 percentage points. This is similar to the findings of other scholars, and the possible reason for it is that the increase in tariffs weakens the competitiveness of exported goods in the markets of importing countries, causing the volume of imports to decrease and therefore the intensive margin to decline. In addition, tariff increases force exporters to shift more resources to the production of more profitable products, thus directly contributing to the increase in the extensive margin. Chinese direct investment in the U.S. has no significant impact on the extensive margin, intensive margin, price margin, or quantity margin of China's exports to the U.S. The likely reason for this is that a large portion of Chinese direct investment in the U.S. is in hotels, real estate, or acquisitions of businesses, and there is not much demand for Chinese goods. The RMB exchange rate is positively related to both the extensive margin and quantity margin of China's exports to the U.S., and it is negatively but insignificantly related to the intensive margin and price margin, implying that the depreciation of the RMB will increase the extensive and quantity margins of China's exports to the U.S. and have no significant effect on the intensive margin and price margin. The reason for this is that Chinese goods will become more competitive in the U.S. market after the depreciation of the RMB against the U.S. dollar, which will directly contribute to the increase in the quantity of Chinese goods exported to the U.S. At the same time, after the devaluation of the RMB, goods that were not price advantageous begin to become advantageous, so exporters export new kinds of goods to the U.S., which will directly contribute to an increase in the extensive margin. The international spot prices of crude oil and petroleum products mainly positively affect the quantity margins of China's exports to the U.S., but they do not significantly affect the extensive margin, intensive margin, and price margin. The regression results are surprising. It is generally believed that the higher the transportation cost, the stronger the impediment to international trade. However, regressions using the annual spot prices of crude oil and petroleum products as proxies for changes in transportation costs show that the prices of crude oil and petroleum products are positively correlated with the volume margins. The likely reason for this is that the rise in oil prices is a sign of increased demand for commodities in the U.S. and a sign of an economic rebound, so the demand for U.S. exports to China also increases, which will directly lead to the increase in the quantity margin of Chinese exports to the U.S.

5.1.2. Heterogeneity Analysis

In order to investigate whether there is heterogeneity in the effect of U.S. trade policy uncertainty on different broad categories of Chinese goods, in this study, we selected typical broad categories of Chinese exports to the U.S. for classification regressions, and agricultural products (categories 1–4 in HS21) and electromechanical products (products in categories 15–18 (chapters 73–92)) were selected for use in the heterogeneity analysis. The regression results are shown in Table 3.

Table 3. The estimation results of the heterogeneity analysis.

Variables	Electromechanical Products				Agricultural Products			
	EM	***IM***	***PM***	***QM***	***EM***	***IM***	***PM***	***QM***
lnTPU	0.00392	−0.130 ***	−0.0640 **	−0.0703	−0.0158	−0.157 ***	−0.0706 *	−0.0878 **
	[0.0106]	[0.0391]	[0.0289]	[0.0435]	[0.0168]	[0.0386]	[0.0390]	[0.0447]
lnAPGDP	−0.648 **	−0.171	2.395 ***	−2.573 **	−0.785	−0.978	0.895	−1.948
	[0.3131]	[1.1312]	[0.8478]	[1.2600]	[0.5034]	[1.1635]	[1.1724]	[1.3465]
lnCPGDP	0.248 **	1.172 ***	−0.459	1.649 ***	0.471 **	0.983 **	0.187	0.832
	[0.1185]	[0.4296]	[0.3213]	[0.4785]	[0.1903]	[0.4421]	[0.4439]	[0.5117]
lnAHS	−0.0142	−0.455 ***	−0.082	−0.323 **	0.161 ***	−0.0556	−0.0331	0.0212
	[0.0229]	[0.1288]	[0.0744]	[0.1432]	[0.0159]	[0.0914]	[0.0583]	[0.1060]
lnCOFDI	−0.00799	−0.171 *	−0.0728	−0.0982	−0.0434	−0.119	−0.0816	−0.043
	[0.0267]	[0.0963]	[0.0722]	[0.1073]	[0.0429]	[0.0989]	[0.0998]	[0.1145]
lnEXCHANGE	0.794 **	1.877	−1.263	3.223 **	1.313 **	1.67	0.391	1.369
	[0.3550]	[1.2925]	[0.9636]	[1.4395]	[0.5677]	[1.3131]	[1.3225]	[1.5196]
lnOILPRICE	0.0129	0.0888	−0.144 **	0.233 **	−0.0105	0.127	0.0435	0.0822
	[0.0269]	[0.0970]	[0.0727]	[0.1081]	[0.0431]	[0.0989]	[0.1002]	[0.1145]
_cons	3.399 *	−11.33	−17.86 ***	6.294	2.205	−2.174	−10.52	8.728
	[2.0589]	[7.4964]	[5.5789]	[8.3345]	[3.3045]	[7.6233]	[7.6898]	[8.8226]
obs	57	57	57	57	76	76	76	76
adj.R-sq	/	/	/	/	/	/	/	/
AIC	/	/	/	/	/	/	/	/
BIC	/	/	/	/	/	/	/	/

Note: Standard errors of the corresponding variables are in parentheses; *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

The results show that the effect of U.S. trade policy uncertainty on the trade margins of Chinese agricultural and electromechanical products exported to the U.S. differs significantly. The same thing is true: U.S. trade policy uncertainty has the same impact on China's agricultural and electromechanical exports to the U.S. in terms of the intensive margin and the price margin; that is, U.S. trade policy uncertainty has a negative and statistically significant relationship with the intensive margin and the price margin of China's exports to the U.S. for both agricultural and electromechanical products. On average, a 1 percentage point increase in the uncertainty index of U.S. trade policy will lead to a 0.16 and 0.13 percentage point decrease in the intensive margins of China's agricultural and electromechanical exports to the U.S., respectively, and will also lead to a 0.07 and 0.13 percentage point decrease in the price margins of China's agricultural and electromechanical exports to America. The differences are as follows: First, the impact of U.S. trade policy uncertainty on the quantity margins of China's exports of U.S. agricultural and electromechanical products is also slightly different. U.S. trade policy uncertainty is negatively correlated with the quantity margin of Chinese exports of U.S. agricultural products and is statistically highly significant at the 5% level. U.S. trade policy uncertainty is negatively but statistically insignificantly related to the quantity margin of China's exports of U.S. electromechanical products. Second, the effect of changes in U.S. trade policy uncertainty on the extensive margins of Chinese exports of U.S. agricultural and electromechanical products is more different, with U.S. trade policy uncertainty being negatively but statistically insignificantly related to the extensive margins of Chinese exports of agricultural products to the United States. U.S. trade policy uncertainty is positively, though statistically insignificantly, related to the extensive margin of China's exports of electromechanical products to America. The possible reason for this is that the variation in agricultural products exported from China to the U.S. is much smaller than the variation in electromechanical products exported from China to the U.S. In order to reduce this effect when U.S. trade policy uncertainty increases, Chinese electromechanical product exporters are forced to increase the variety of goods exported to the U.S.

5.2. Robustness Test

In the benchmark regression, the trade policy uncertainty index was calculated according to the monthly simple arithmetic average method. In order to test the robustness of the parameters, we referred to the practice of other scholars. First, we summarized the monthly indices of U.S. trade policy uncertainty on an annual basis, and then recalculated the U.S. trade policy uncertainty index by using the weighted average method according to the weight of each month in the annual sum. This was put into Equation (27) as annual data to test the robustness of the model. After the F-test and Hausman test, the extensive margin, the intensive margin, the price margin, and the quantity margin still needed to be estimated using the panel random effects model. The results of the robustness tests are shown in Table 4. From the regression results, we found that the core dependent variable, U.S. trade policy uncertainty, negatively affects the growth of the extensive margin, the intensive margin, the price margin, and the quantity margin, and especially significantly negatively affects the increase in the extensive margin, the intensive margin, and the quantity margin, and thus remains consistent with the benchmark regression in terms of both the positive and negative coefficients and the significance of the respective effects. In addition, the other dependent variables are also consistent with the baseline regression in terms of both positive and negative coefficients and significance levels.

Table 4. The estimation results of the robustness test.

Variables	(1)	(2)	(3)	(4)
	EM	***IM***	***PM***	***QM***
*lnTPU*2	−0.0178 *	−0.121 ***	−0.0154	−0.105 ***
	[0.0102]	[0.0266]	[0.0216]	[0.0302]
lnAPGDP	−0.638 **	−0.188	1.064	−1.262
	[0.3092]	[0.8084]	[0.6551]	[0.9174]
lnCPGDP	0.222 **	0.529 *	−0.456 *	0.991 ***
	[0.1105]	[0.2890]	[0.2340]	[0.3280]
lnAHS	0.0955 ***	−0.0552 *	0.00323	−0.0535
	[0.0108]	[0.0297]	[0.0228]	[0.0337]
lnCOFDI	0.0128	−0.0113	0.0308	−0.0428
	[0.0259]	[0.0676]	[0.0548]	[0.0767]
lnEXCHANGE	0.785 **	1.227	−1.066	2.310 **
	[0.3430]	[0.8972]	[0.7266]	[1.0182]
lnOILPRICE	0.0239	0.105	−0.0569	0.163 **
	[0.0256]	[0.0668]	[0.0541]	[0.0758]
_cons	3.133	−6.698	−5.719	−0.955
	[2.0227]	[5.2924]	[4.2851]	[6.0062]
obs	364	364	364	364
adj.R-sq	/	/	/	/
AIC	/	/	/	/
BIC	/	/	/	/

Note: Standard errors of the corresponding variables are in parentheses; *, **, and *** represent 10%, 5%, and 1% significance levels, respectively.

5.3. Discussion

The empirical results of this study confirm that U.S. trade policy uncertainty has an impact on the extensive margin, intensive margin, price margin, and quantity margin of China's exports of U.S. goods. It can be said that an increase in U.S. trade policy uncertainty will hinder China's exports to the U.S.; conversely, if U.S. trade policy uncertainty decreases, it will promote China's exports to the U.S. The results of this paper are also similar to the findings of most scholars that an increase in U.S. trade policy uncertainty will inhibit the extensive margin and intensive margin of China's exports of goods to the United States. The results also support the view of some scholars that U.S. trade policy uncertainty is a source of trade volatility [29]. In this study, we also found that U.S. trade policy uncertainty

had different effects on trade margins for different broad categories of goods, which also corroborates with the views of some scholars. The possible reason for this is that China is a large manufacturing country, and when exporters face increased uncertainty in U.S. trade policy, for example, when exporters predict the possibility of new U.S. anti-dumping policies, exporters may choose to export new types of goods to the U.S. to reduce the adverse effects of possible anti-dumping policies on themselves.

While the U.S. is currently the world's first economic power in the world, the U.S. worries that China's economic development will threaten its economic hegemony in the future. This, coupled with the gradual decline in traditional U.S. manufacturing, means that the U.S. has strong strategic reasons to create trade policy uncertainty and use it to undermine the import competitiveness of other countries, especially Chinese goods. The recent Sino–U.S. tensions will create a high level of trade policy uncertainty for China's exports and will certainly affect China's expansion margin and agglomeration margin for U.S. electromechanical products, etc.

Of course, there are some limitations to this study, including taking into account 21 major categories of commodities, without analyzing the impact of U.S. trade policy uncertainty on China's commodity exports from the perspective of more detailed and specific industries, which could also be a future research direction.

6. Conclusions and Policy Recommendation

In this paper, we used trade data in the HS6 quantile of the CEPII BACI database from 2001 to 2019 to estimate the impact of U.S. trade policy uncertainty on the trade margins of Chinese exports of U.S. goods using a panel random effects model, focusing on the influence of changes in U.S. trade policy uncertainty on the type, quantity, and price of Chinese exports of U.S. goods. It was found that the effects of the annual U.S. trade policy uncertainty index (calculated using the arithmetic average method) and the annual U.S. trade policy uncertainty index (calculated using the weighted average method) on the extensive margin, intensive margin, price margin, and quantity margin of China's exports of U.S. goods are consistent, i.e., an increase in the level of U.S. trade policy uncertainty will significantly inhibit the increase in the extensive margin and quantity margin of China's exports of U.S. goods. A decline in the level of U.S. trade policy uncertainty will significantly contribute to the improvement in the extensive margin, intensive margin, and quantity margin of China's exports to the U.S. Changes in the level of U.S. trade policy uncertainty will not have a significant impact on the price margin of China's exports to the U.S. It can be said that U.S. trade policy uncertainty is also a trade barrier for China's exports. There were some limitations to this study, as we did not analyze the impact of U.S. trade policy uncertainty on China's commodity exports in various industries from the perspective of more detailed and specific industries, which is a direction that needs to be researched further in the future.

With the improvement in China's comprehensive national strength and the decline in U.S. influence, the U.S. is bound to suppress China in many ways for its own interests, especially in the trade sector, meaning China's foreign export trade, especially to the U.S., may face a more complex and severe situation in the future. As of October 2022, the trade policy of imposing additional tariffs on imports from China under the Trump presidency is still being implemented; therefore, there many uncertainties will continue to affect U.S.–China trade in the future. According to the findings of this paper, for the sake of stabilizing China's exports to the United States, China should make efforts to reduce the level of uncertainty of the U.S. trade policy towards China and its impact on Chinese exports. Specific measures can be taken in the following ways: First, China should increase the support given to the technological R&D and innovation of export enterprises and try to optimize the upgrading and adjustment of domestic industries to continuously improve the competitiveness of their export goods. Second, China should continue to expand bilateral or multilateral free trade agreements with other countries, especially to consolidate and strengthen China's exports to "Belt and Road" countries to reduce the dependence of

Chinese exporters on the U.S. market. Third, efforts should be made to promote the internationalization of RMB and maintain the stability of the RMB exchange rate, increase the proportion of RMB international settlement, and further reduce the exchange rate risk and uncertainty faced by Chinese enterprises' exports.

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