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Liu, Nan

University of Virginia

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Nan Liu*

Department of Economics, University of Virginia, Charlottesville, VA, United States

Abstract

From 2018 through 2019, the United States and China imposed a series of wide-ranging increases in import tariffs which have dramatically raised trade barriers between the two largest economies in the world. With a focus on the import side, this paper provides evidence on the impact of the trade war on China's trade quantities and prices, and estimates related trade elasticities. Both Chinese import quantities and values dropped sharply following the tariffs, and there is evidence for incomplete pass-through of Chinese import tariffs in the very short run. More importantly, this paper shows that while China's non-processing imports declined dramatically during the trade war, the processing imports almost remain unaffected. The results suggest that the Chinese special duty-free policy on processing trade may have served as a built-in mechanism to better protect domestic firms from the damage of the trade war through the global value chain channel.

Keywords: Trade war, Tariff, China, Processing trade, Global value chain

JEL classification: F10, F13, F14

*Corresponding author

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Email address: nl3fd@virginia.edu (Nan Liu)

1. Introduction

From 2018 to 2019, the import tariffs enacted by the United States and the following retaliation by China have dramatically raised trade barriers between the two largest economies in the world. Recent studies have documented the effects of this trade war on the US economy (Amiti et al. 2019; Fajgelbaum et al. 2019). However, the story from China's perspective is yet to be told. During the trade war, China levied six rounds of retaliatory tariffs on over 5,000 products from the United States, with rates ranging between 10 to 50 percent. The products that were subject to the tariffs account for over 80 percent of China's total imports from the United States, in terms of trade value.

The economic consequences of these bilateral tariffs on Chinese trade flows and prices depend on the tariff incidence and elasticities. First, are the tariffs being passed on to consumers or being absorbed by the producers? Second, are Chinese importers seeking alternative source countries to import from? Moreover, it is important to understand how trade policy plays out in a global value chain era, especially in China's context: close to half of China's total trade volume are processing trade, in which China imports parts from foreign countries, assembling or processing them into final products to be re-exported.

Using monthly Chinese customs data from 2017-2019, this paper offers a comprehensive picture of the impact of tariffs on China's trade quantities and prices. I first show the direct impact of Chinese import tariffs on trade quantities and prices. Second, I estimate the Chinese import demand and US export supply elasticities using tariff changes as instruments. Third, I embed the analysis into a global value chain context by focusing on the differences between Chinese processing import and ordinary imports. Finally, I explore the potential trade diversion (substitution) effect to see whether Chinese importers are seeking alternative source countries to import from.

I find a large decline in Chinese imports when the retaliatory tariffs were implemented. Looking at the month-to-month changes, a one percent increase in Chinese retaliatory tariff immediately leads to a 0.87 percent decrease in import quantities and a 1.38 percent decrease in import values of targeted products, respectively. The prices of targeted products received by US exporters (duty-exclusive unit values) decreased by 0.51 percent and the price paid by Chinese importers (duty-inclusive unit values) increased by 0.49 percent. These results imply incomplete tariff pass-through of Chinese import tariffs in the very short run. The impact is much larger when I look at year-to-year changes. A one percent tariff increase results in a 3.94 percent decrease in target products' import quantities and a 3.08 percent decrease in values. Following the approach taken by Fajgelbaum et al. (2019), I use the tariff changes as instruments and estimate the Chinese import demand elasticity to be 1.76 using monthly differences and 2.11 using yearly differences.

Compared to the US trade regime, the most distinct feature of Chinese imports is that nearly half are processing imports of inputs used in export-oriented products. Two major processing trade regimes are called "processing-with-assembly" and "processing-with-inputs" with the latter one be the dominant component of Chinese processing imports since 2000. It is important to identify the processing imports because Chinese trade policy exempts them from tariffs. Even during the trade war, these special tariff treatments on processing imports remain largely unchanged in practice. Therefore, despite the high retaliatory import tariffs enacted by the Chinese government, we would not expect to see processing imports getting a large direct impact. In the data, I directly observe each transaction's trade regime which allows me to separately analyze the effects on ordinary trade and processing trade. When estimated by trade regimes, I find that the impact of the tariffs are almost purely driven by ordinary imports while there is no statistically significant effect on processing imports. The results are likely to be driven by the special duty-free policy. These results highlight the importance of considering the institutional detail of trade policy—especially the difference to the US.

Another potential consequence of raising import tariffs that has occupied the forefront of the debate among politicians as well as economists is the trade diversion effect (Gonzalez and Veron 2019). Facing higher import tariffs on US products, were Chinese importers seeking alternative source from third countries? If so, this may lead to a reorganization of value chains (Nicita 2019; Bekkers and Schroete 2020). However, by examining the relationship between Chinese import tariffs and Chinese imports from the rest of the world other than the US, I do not find a significant import trade diversion effect. There is also no evidence showing that third countries were taking over the share of US products in Chinese imports. The results are consistent across products that vary in terms of differentiation or elasticity of substitution.

A key challenge in getting unbiased estimates in this paper is to address the potential endogeneity of tariff changes. The analysis in my paper requires the trade war tariffs to be exogenous and uncorrelated with potential supply and demand shocks. Most rounds of tariffs from both China and US were announced and enacted in a very short time-period. Therefore, anticipation effects may not have enough time to play an important role. I also perform several robustness checks by testing pre-trends, and by visualizing the trends before and after the tariffs were being implemented using an event-study framework. The results show that there is no significant pre-trend before the tariffs were implemented.

This paper contributes to the on-going research on the impact of the 2018-2019 trade war. Amiti et al. (2019) look at the impact of the 2018 tariffs on US prices. They find that both US export and import quantities dropped significantly following the US import tariffs and other countries' retaliatory tariffs. Also, the US import tariffs have been almost entirely passed through into domestic prices, leaving exporter prices unchanged. In contrast, I find incomplete pass-through of China's retaliatory tariffs, at least in the very short run. Fajgelbaum et al. (2019) find similar results. They use the tariff changes as instruments to estimate the trade elasticities and show that the US import demand elasticity is around 2.5 and the elasticity of foreign demand for US products to be unitary. They further embed the estimated elasticities in a general-equilibrium model to find that the US aggregate real income loss from the trade war is 0.04 percent of GDP. Using bilateral product-level trade data, Berthou and Stumpner (2020) find similar average trade elasticities for both US and China and a sizeable decline in aggregate exports for both countries. Other research has examined the impact of trade war from the US perspective at a more micro-level. Cavallo et al. (2021) find that US exporters drop their prices significantly facing the Chinese retaliatory tariffs. They further show that this is almost entirely driven by US shipments of non-differentiated and agricultural products which are easier to source from third countries.

To the best of my knowledge, my paper is one of the first to look at the impact of the trade war from China's perspective with a focus on Chinese imports. One exception is the recent work by Benguria et al. (2020) who use pre-trade war custom data to measure firm-level exposure to the trade war and then study the impact of tariffs on Chinese listed firms. While many papers have studied the impact of Chinese tariffs on US exports to China, it is still important to analyze the impact on Chinese imports using the Chinese data. By observing Chinese imports from third countries, I can explore the potential trade diversion effect which may has long-run impact on global trade. Meanwhile, the Chinese custom data allows me to distinguish processing and ordinary imports. Understanding the role of China's special duty-free policy on processing imports and its implications can provide a more comprehensive picture of the impact of the trade war.

From a broader perspective, this paper is also related to the estimation of trade elasticities which are important parameters for quantifying the gain from trade (Arkolakis et al. 2012). One common approach is to use time-series tariff variation to estimate this elasticity (Romalis 2007; Spearot 2013; Caliendo and Parro 2015; Hillberry and Hummels 2013). A different strand of literature estimates the elasticities structurally (Broda and Weinstein 2006; Soderbery 2018; Feenstra 1994; Feenstra et al. 2018). Following Fajgelbaum et al. (2019), my paper further contributes to this literature by providing elasticity estimates using the trade war shock for more than 5,000 products at the HS-8 level and I also devote significant attention to address the endogeneity of the trade war tariffs.

The paper also contributes to the literature on trade policy. Previous literature have shown that global value chain is an important determinant of trade policy (Blanchard et al. 2016). Since the Chinese economic reform in 1978, processing trade has experienced a rapid increase as a result of China's comparative advantage in low-skilled labor. In fact, the share of processing imports is larger than the share of ordinary imports from 1996 to 2007 (Yu and Zhu 2019). More importantly, processing imports enjoy a special duty-free tariff treatment even during the trade war. Therefore, it is very important to recognize the special role that processing trade plays when analyzing trade-related topic in China's context (Feenstra et al. 2014; Yu 2015; Dai et al. 2014; Tian and Yu 2019). Meanwhile, during the trade war, the global supply chains could potentially magnify the impact of import tariffs by transmitting the import tariffs to exports (Boehm et al. 2021). The recent work by Handley et al. (2020) shows that a large share of US exports were facing increased tariffs on importing inputs during the trade war, which in turn leads to a even larger decline in exporting. Flaaen and Pierce (2019) show that U.S. manufacturing industries more exposed to tariff increases experience relative reductions in employment as a positive effect from import protection is offset by larger negative effects from rising input costs and retaliatory tariffs. Therefore, while trade wars have always been disruptive, they are particularly expensive and divisive in the global value chain era as the import tariffs could backfire on domestic production (Blanchard 2019). Although at the later stage of the trade war Trump administration allowed firms to apply for tariff exemptions, the effect might be small especially for smaller firms for whom the cost of applying for exemption could be prohibitively expensive. On the contrary, the Chinese special duty-free policy on processing trade may have served as a built-in mechanism to better protect domestic firms from the damage of the trade war through the global value chain channel.

Finally, this paper contributes to the literature examining the trade diversion effect of trade policy changes (e.g., Magee 2008; Dai et al. 2014). In the context of the trade war, Berthou and Stumpner (2020) show that there was no reallocation of exports to other countries for both

US and China. However, from the import side, Nicita (2019) shows that one consequence of the tariffs between United States and China has been to increase United States imports from elsewhere. Bekkers and Schroete (2020) also show that while the reduction in US imports from China in 2019 was accompanied by considerable trade diversion from other regions, Chinese imports from US were not countered by more imports from third countries. My results provide further evidence that during the trade war, there is no systematic diversion (substitution) going on from the Chinese imports side.

The reminder of this paper is structured as follows. Section 2 describes the data and lists the key events during the trade war. Section 3 provides an event-study framework to visualize the impact of the trade war. Section 4 shows the main empirical specifications and the estimation results. Section 5 performs the robustness checks and Section 6 concludes.

2. Data Description and Summary Statistics

This section describes the data, lists the key events during the trade war and shows stylized facts about the response of Chinese imports to the series of tariffs.

2.1. Data

The primary data I use is the administrative Chinese monthly import and export data from the General Administration of Customs. The data period covers from January 2017 to December 2019. It records the universe of Chinese import and export transactions and has a variety of information for each transaction, including product (HS-8 level), quantity, value, and firm's province. More importantly, I can also observe each transaction's trade regime which allows me to perform analysis separately on processing and ordinary trade.

However, I do not directly observe the custom duties or tariff lines in the data. Therefore, I combine data from multiple additional sources and construct a monthly panel data set of tariffs. The US-China specific tariffs data during the trade war are obtained from the Ministry of Finance of China. These ad valorem tariffs are mostly set at the HS-8 level. Since many rounds of tariffs were enacted in the middle of the month, I scale the tariffs by the number of days of the month they were in effect.[1]

To construct the baseline Chinese import tariffs, I first collect the Most Favored Nation (MFN) tariff rates at the HS-8 level published by the central government of China. Then I compile the list of country-products that are subject to regional trade agreements. These include, for example, the tariffs applied to products from the Association of Southeast Asian Nations (ASEAN), from 35 least-developed countries (LDC), and from other countries (regions) which have signed specific trade agreements with China.[2] Then I compute the effective Chinese import tariff rate for each country-product pair (variety) as the sum of the baseline tariff rate and the announced trade war tariff rate changes. In the baseline analysis, I ignore the changes in Chinese MFN tariffs and regional trade agreements during the trade war. Therefore, I only use the trade war tariff changes as identifying variation.[3] However, each year China also adjusted the MFN rates due to the commitment to the WTO and sign/modify the regional trade agreements. It is difficult to judge whether some of the changes were driven by the trade war. Thus, I also examine all the official documents published by the Ministry of Finance of China and present the results that include all the tariff adjustments in section 5.3.

2.2. Chinese Import Tariffs

Table 1 reports the scope of the six waves of Chinese import tariffs. Following the US tariffs on steel and aluminum, the first wave of China's retaliatory tariffs began in April 2018 targeted 128 HS-8 level products. The second wave implemented in July 2018 only targeted for 545 distinct products (mostly agricultural products), and the total value of these products exceeds 3 billion USD. Starting from September 2018, additional tariffs have been added to most products that China imported from the US and the scale of these tariffs were being elevated again in 2019.

[1] For example, if a 25% tariff was enacted on June 15, then the effective tariff will be 25×15/30=12.5% in June and 25% in the following month.

[2] These include South Korea, Laos, Macao, New Zealand, Pakistan, Peru, Singapore, Sri Lanka, Switzerland, Taiwan, Chile, Australia, Iceland, Costa Rica, Georgia, and Hongkong.

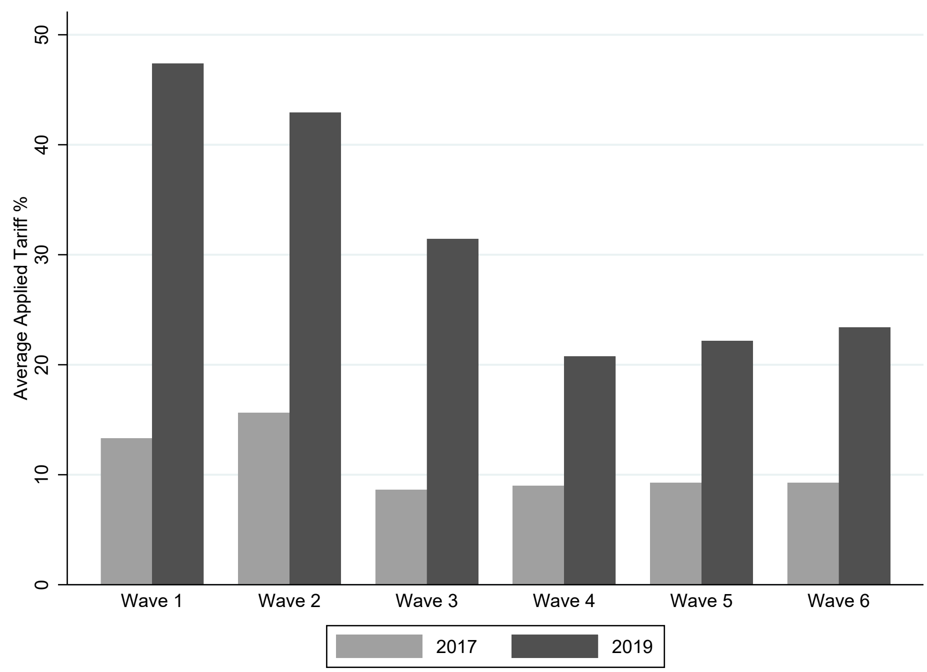
[3] Fajgelbaum et al. (2019) also ignore the changes in US import tariffs due to preexisting treaty commitments when analyzing the impact of trade war on US imports.

Table 1: Summary Statistics: Tariffs on Chinese Imports

Tariffs	Date	# of Products	Value (mil USD)	Average Tariff (%)
Wave 1	Apr 2, 2018	128	297	16
Wave 2	July 6, 2018	545	3383	25
Wave 3	Aug 23, 2018	333	1411	25
Wave 4	Sep 24, 2018	5207	5816	8.4
Wave 5	June 1, 2019	4544	4022	11.7
Wave 6	Sep 1, 2019	1717	2866	7.7

Notes: Table reports the scope of the six waves of Chinese import tariffs. Number of products is at the HS-8 level. Value (in million USD) is calculated as the 2017 Chinese annual import value of targeted products in each tariff wave. Average tariff is calculated as the unweighted ad valerom average tariff across targeted products.

Figure 1: Average Chinese Import Tariffs



Notes: Figure shows the unweighted average applied Chinese import tariff rates for products being targeted in each tariff wave. The light grey bar shows the tariffs in 2017 (pre-trade war) and the dark grey bar shows the tariffs in 2019.

Figure 1 shows the average applied tariff on products that were being targeted in each wave. For products that were being targeted in the first three waves, the average ad valerom tariff has

Table 2: Tariff Variation by SITC Sector

SITC Category	# of Products	Value (mil USD)	Average Tariff (%)
Machinery and transport equipment	1403	3232	18
Crude materials, inedible, except fuels	276	2830	19
Chemicals and related products	964	1169	18
Miscellaneous manufactured articles	881	1027	19
Manufactured goods	1623	703	19
Commodities and transactions	6	477	21
Mineral fuels, lubricants and related materials	53	407	25
Food and live animals	215	340	21
Beverages and tobacco	32	30	26
Animal and vegetable oils, fats and waxes	32	11	22

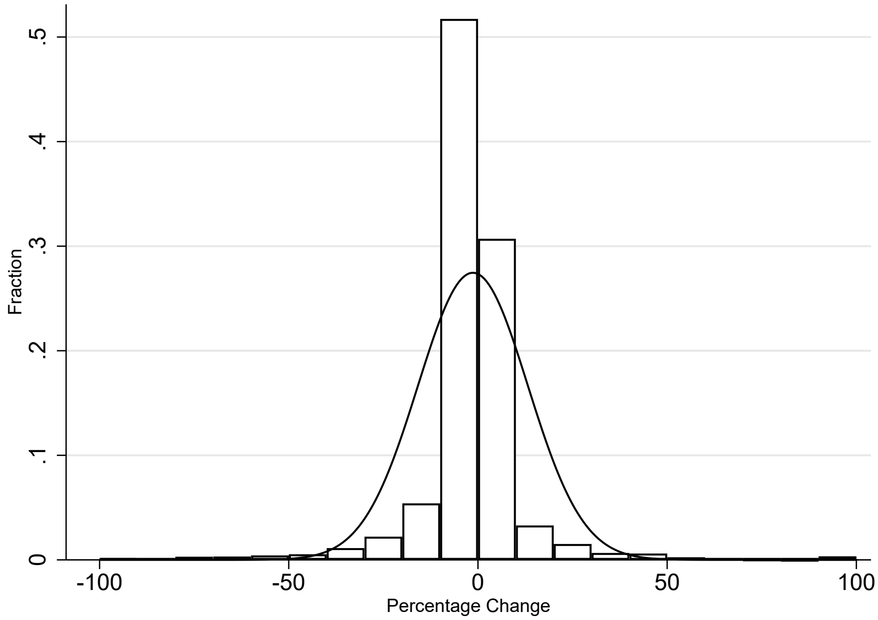
Notes: Table reports the tariff variation by SITC one-digit sector. Number of products is at the HS-8 level. Value is calculated as the 2017 annual import value of targeted products in each SITC category. Average tariff is calculated as the unweighted ad valerom average tariff across targeted products in each category.

been increased to over 30%. And in the later stage of the trade war, the majority of products that China imported from the US were subjected to tariffs over 20%.

Table 2 reports the summary statistics for Chinese import tariffs across the broad SITC one-digit sectors. It shows that China placed greater protections on machinery and transport equipment sector as well as crude materials sector which include products such as soybean. Meanwhile, the unweighted-average tariff increases on targeted import products are similar across sectors. This suggests that China was not choosing specific sectors to target because otherwise we should observe tariff variation across sectors.

To demonstrate the effect of the trade war on Chinese imports by isolating price effects, figure 2 shows the change in the quantity share of US product in Chinese imports from 2017 to 2019. I first calculate the percentage change in the quantity share of each US product at the HS-8 level and then aggregate them into bins. The width of the each bin is 10 percentage points. The vertical axis shows the fraction of US products that fall into each bin. The curve shows the scaled normal distribution. From 2017 to 2019, a significant fraction of US products experienced declines in terms of their quantity shares of Chinese imports. However, for more than 50% of the US products the declines are relatively small ranging from 0-10% and over 30% of the US products even experienced increases in their quantity shares.

Figure 2: Change in the Quantity Share of US Product in Chinese Imports



Notes: Figure shows the change in quantity share of US product in Chinese imports. The horizontal axis shows the percentage change in share of the US product at the HS-8 level from 2017 to 2019. The width of each bin is 10 percentage points. The vertical axis shows the fraction of US products in each bin. The curve shows the scaled normal density.

3. Event Study Framework

To better visualize the effects of tariff increases on Chinese import, I implement an event study specification. Specifically, I compare the trends of targeted products from the US to the same HS-8 products from other countries which were not subject to the tariff increases. The equation I estimate is as follows:

$$log[y_{ict}] = \sum_{j=-6}^{j=6} \beta_{0j} \mathbb{1}[t=j] + \sum_{j=-6}^{j=6} \beta_{1j} \mathbb{1}[t=j] \times Target_{ic} + f_{ic} + f_{ct} + f_{it} + \epsilon_{ict} \qquad (1)$$

where y_{ict} represents quantity, value, duty-exclusive unit value or duty-inclusive unit value for product i (HS-8) from country c at month t. j represents the introduction time of each round of tariffs. $Target_{ic}$ equals to one if product i from country c was subject to the Chinese retaliatory tariffs and equals to zero otherwise. I include product-country fixed effects f_{ic} as the identification is coming from time variation by variety. f_{it} is the product-month fixed effects controlling for demand variation and seasonality. f_{ct} is month-country fixed effects controlling for time-varying country factors such as exchange rates. The standard errors are clustered at HS8-country level. β_{1j} is the coefficient of interest. It is identified using variation between targeted variety (those directly affected by a tariff increase) to the non-targeted variety within the same HS product code at the same time. Following Fajgelbaum et al. (2019), the event date of targeted product is the nearest full month when the tariffs were enacted. Non-targeted varieties in the same HS code as a targeted variety are assigned the earliest event date (tariff wave) within that HS code.[4] Event times less than -6 (i.e., 6 months before the roll out) are dropped and event times greater than 6 are binned together. Therefore, this event study framework only shows the trend in the very short run.

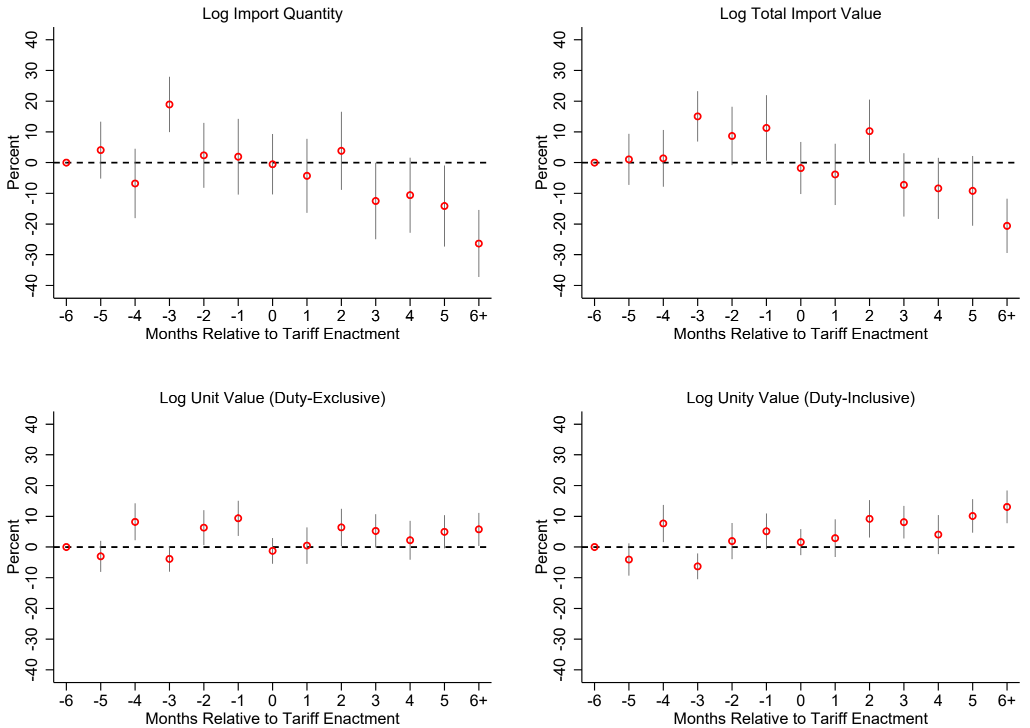
The top two panels in figure 3 report the impact on import quantities and values, and the bottom panels show the impact on before-duty and after-duty unit values. The error bar shows 95% confidence intervals. While the estimates are not very precise, there are downward trends on both import quantities and values following the tariffs. The before-duty unit values fluctuate but mostly are not significantly different from zero. In contrast, the duty-inclusive unit values increased by around 10 percent following the tariffs.

One caveat of this event-study framework described above is that during the trade war, many products were being targeted multiple times.[5] However, under the previous specification, for the non-targeted products within the same HS code, I can only assign one event date (the earliest) to them. Therefore, for products being targeted multiple times, the trends before the event time may be affected by the previous rounds of tariffs. To address this concern, figure 4 reports the event-study coefficients by excluding products that were being targeted more than once by the Chinese import tariffs. Overall, I observe similar trends using this subset of sample. The observed trends from the event study specification is similar to the results from Fajgelbaum et al. (2019) who use the US export data to plot the impact of the Chinese retaliatory tariffs on US exports. They observe downward trends in terms of export quantities and values, find insignificant results

[4]For example, if a product from US was first targeted in the Sep 24 wave, the event date for this product from other countries (non-targeted) will be October 2018.

[5]Out of all the products (HS-8) that China imports from the US during my sample period, 778 products got targeted once (25%), 4161 products got targeted twice (33%), 712 products got targeted 3 times (5%) and 3 products got targeted 4 times (0%). The percentage in the parentheses represents the products' corresponding value share of total Chinese imports from US in 2017.

Figure 3: Event Study of Tariffs Changes on Chinese Imports

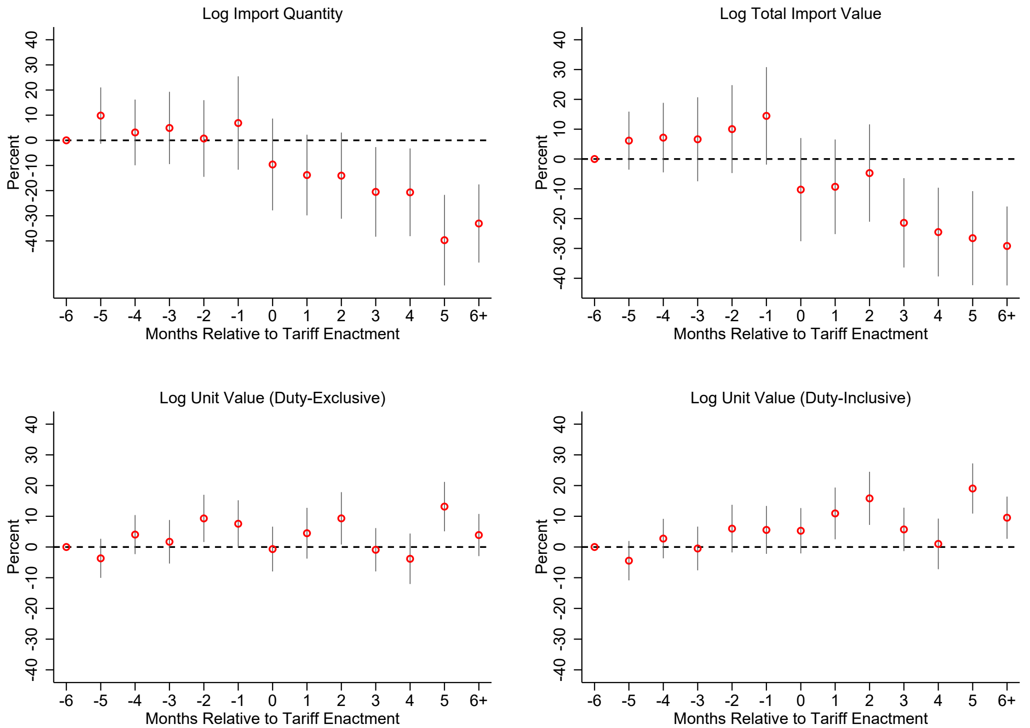


Notes: Figure plots the event-study dummies for targeted varieties relative to untargeted varieties estimated from equation (1). Regressions include country-product, product-time, and country-time fixed effects. Standard error are clustered at the country-HS8 level. Event time before -6 are dropped, and event time ≧ 6 are binned. The sample period is 2017:1 to 2019:12. Error bar shows 95% confidence interval.

on before-duty unit values but upward trends for after-duty unit values.

The event study plots also suggests that there is no significant anticipation effect that would complicate the elasticity estimates. While there is an upward trend in total import values before the tariffs were being implemented, there is no significant trend in terms of import quantities. Therefore, the concern that importers might anticipate the upcoming tariffs and purchase earlier seems to be minimal.

Figure 4: Event Study Dropping Multiple Tariff Changes



Notes: Figure plots the event-study dummies for targeted varieties relative to untargeted varieties estimated from equation (1). Regressions include country-product, product-time, and country-time fixed effects. Standard error are clustered at the country-HS8 level. Event time before -6 are dropped, and event time $\geqq 6$ are binned. The sample period is 2017:1 to 2019:12. Error bar shows 95% confidence interval. Products being targeted more than once during the sample period are dropped to avoid noisy trends caused by previous rounds of tariffs.

4. Empirical Strategy and Estimation

4.1. Impact of Chinese Tariffs on Chinese Imports

4.1.1. Reduced-form Analysis

A key first step in analyzing the impact of the trade war is to understand how prices and quantities move in response to a tariff change. Therefore, I estimate the following regression:

$$\Delta log[z_{ict}] = \eta \Delta log(1 + \tau_{ict}) + f_{ct} + f_{it} + f_{ic} + \epsilon_{ict} \tag{2}$$

where $z \in \{q,\ p{\times}q,\ p^*,\ p\} \equiv$ {import quantity, import value, duty-exclusive unit value, duty-inclusive unit value}. τ_{ict} represents the statutory import tariff rates.[6] The regression includes country-time fixed effects, product-time fixed effects and product-country fixed effects to control for seasonality, time-varying country-specific factors (such as exchange rates), and product-country time-invariant trends. Under the assumption that the import tariffs enacted by Chinese government are exogenous, the coefficient of interest η is identified using variation in product-country-level over time. The robust standard errors are clustered by country and HS8. Each regression is run separately in month-to-month differences and year-to-year differences.

Table 3 panel A reports the responses of Chinese imports to the tariff changes in first differences. Column (1) shows that import quantities dropped sharply following the tariff increases. Column (2) shows that the decline in import values is even larger, because the before-duty unit values (received by US exporters) also decreased as shown in column (3). Column (4) shows that a one percent increases in tariff resulted in a 0.49 percent increases in duty-inclusive unit values (paid by Chinese importers).[7] The results from column (3) and (4) are interesting because it provides evidence that, at least in the very short run, the incidence of Chinese import tariffs was borne by both Chinese importers and US exporters. Amiti et al. (2019) and Fajgelbaum et al. (2019) examine the impact of US tariffs on US imports using monthly differences and find complete pass-through of tariffs to duty-inclusive import prices. However, the reduced-form estimates in my paper suggest incomplete pass-through of Chinese import tariffs in the very short run.

Table 3 panel B reports the responses of Chinese imports to the tariff changes in twelve-month differences. Over a year, the declines of import quantities and values are significantly larger. A one percent increase in tariff resulted in a 3.94 percent decrease in quantities and a 3.08 percent decrease in import values, respectively. However, both before-duty and duty-inclusive unit values increased in response to the import tariffs when using yearly variations. The result in Column (3) suggests that Chinese importers were paying higher prices to the US exporters. One possible explanation is that during the trade war, the US import tariffs increased the production cost for the US manufactures through the global supply chain. Therefore, the US exporters were adjusting

[6] I ignore the changes in baseline MFN rates and changes in regional trade agreements during 2018 and 2019. Thus, I only use the import tariffs changes as the result of the trade war as identifying variation in the main analysis.

[7] Because I do not directly observe the duty-inclusive unit value in the data, I impute the duty-inclusive unit value as $p = p^* \times (1 + \tau)$. Therefore mechanically the coefficient in column (4) is 1 plus the coefficient in column (3). However, the coefficient in column (3) alone is sufficient to show the tariff incidence.

Table 3: Impact of Chinese Tariffs on Chinese Imports

Panel A: month-to-month differences				
	$\Delta ln q_{ict}$ (1)	$\Delta ln p^*_{ict} q_{ict}$ (2)	$\Delta ln p^*_{ict}$ (3)	$\Delta ln p_{ict}$ (4)
$\Delta ln(1+\tau_{ict})$	-0.87***	-1.38***	-0.51***	0.49***
	(0.30)	(0.26)	(0.14)	(0.14)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.13	0.14	0.11	0.11
N	2,328,703	2,328,703	2,328,703	2,328,703
Panel B: year-to-year differences				
	$\Delta ln q_{ict}$ (1)	$\Delta ln p^*_{ict} q_{ict}$ (2)	$\Delta ln p^*_{ict}$ (3)	$\Delta ln p_{ict}$ (4)
$\Delta ln(1+\tau_{ict})$	-3.94***	-3.08***	0.86***	1.86***
	(0.18)	(0.16)	(0.10)	(0.10)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.23	0.23	0.19	0.19
N	1,513,561	1,513,561	1,513,561	1,513,561

Notes: Table reports the variety-level import responses to the Chinese import tariffs. Column (1)-(4) report changes in import quantities, values, before-duty unit values, and duty-inclusive unit values regressed on changes in statutory tariff rates. Panel A uses the month-to-month differences and panel B uses 12-month differences. All regressions include product-time, country-time and product-country fixed effects. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. The sample period is 2017:1 to 2019:12.

to this cost shock and eventually raised their prices. Under this hypothesis, the before-duty unit values should have increased more for ordinary trade than for processing trade because the former are primarily final products and the latter are mostly intermediate inputs. In section 4.2 I show that this is the case.

4.1.2. IV Estimation of Trade Elasticities

Beyond the reduced-form analysis above, the tariff changes could be viewed as a natural experiment to further estimate the Chinese import demand elasticity and US export supply elasticity. The estimations of these elasticities can be important for future welfare analysis.

I follow the previous literature to use the variation in Chinese import tariffs to estimate the Chinese import demand elasticity and US export supply elasticity simultaneously (Romalis 2007; Zoutman et al. 2018; Fajgelbaum et al. 2019). To be more specific, I estimate the following two equations:

$$\Delta log[q_{ict}] = -\sigma \Delta log[p_{ict}] + f_{ct} + f_{it} + f_{ic} + \epsilon_{ict} \tag{3}$$

$$\Delta log[p^*_{ict}] = \omega \Delta log[q_{ict}] + f_{ct} + f_{it} + f_{ic} + \epsilon_{ict} \tag{4}$$

Equation (3) identifies the Chinese import demand elasticity σ by regressing observed import quantities on import duty-inclusive unit values, using change in log tariffs $\Delta ln(1 + \tau_{ict})$ as instruments for import duty-inclusive unit values. Equation (4) identifies the US supply elasticity ω by regressing before-duty unit values on observed import quantities, using $\Delta ln(1+\tau_{ict})$ as instruments for observed quantities.

Intuitively, as long as the incidence of the tariff is shared between both sides, for a given price received by US exporter (before-duty price), an exogenous increase in Chinese import tariffs will affect the Chinese import demand through and only through the change in duty-inclusive prices paid by the Chinese importers. Conversely, for a given price paid by the Chinese importers, an exogenous tariff increase will shift up the US supply curve through and only through reducing the quantities ordered by the Chinese importers. The identification assumption here is that the Chinese retaliatory tariffs are uncorrelated with unobserved import demand or foreign export supply shock. The multiple fixed effects included in the estimation control for potential unobserved trends. Meanwhile, the event-study framework shows no significant preexisting trend prior to the implementation of the tariffs. In section 5, I formally perform robustness checks to test the preexisting trends which provide support to this identification assumption.

Under this specification, Column (4) and column (1) in table 3 panel A serve as the first-stage estimation for equation (3) and (4), respectively. Column (1) and (2) in table 4 panel A report the IV estimation of σ and ω, respectively. It shows that the estimated Chinese import demand elasticity is 1.76. The estimated positive US supply elasticity of 0.59 supports the finding of incomplete tariff pass-through in the reduced-form analysis above. Compared to the estimation from the US side, Fajgelbaum et al. (2019) estimate the US import demand elasticity to be 2.53 and the foreign

Table 4: IV Estimation of Chinese Import Demand Elasticity and US Export Supply Elasticity

Panel A: month-to-month differences		
	Δlnq_{ict} (1)	Δlnp^*_{ict} (2)
Δlnp_{ict}	-1.76***	
	(0.55)	
Δlnq_{ict}		0.59**
		(0.32)
Product × time FE	Y	Y
Country × time FE	Y	Y
Product × country FE	Y	Y
N	2,328,703	2,328,703
Panel B: year-to-year differences		
	Δlnq_{ict} (1)	Δlnp^*_{ict} (2)
Δlnp_{ict}	-2.11***	
	(0.11)	
Δlnq_{ict}		-0.22***
		(0.02)
Product × time FE	Y	Y
Country × time FE	Y	Y
Product × country FE	Y	Y
N	1,513,561	1,513,561

Notes: Column (1) reports the IV estimated Chinese import demand elasticity $\hat{\sigma}$ from equation (3); the first stage is column (4) in table 3. Column reports the IV estimated US export supply elasticity $\hat{\omega}$ from equation (4); the first stage is column (1) in table 3. Panel A uses the month-to-month differences and panel B uses 12-month differences. All regressions include product-time, country-time and product-country fixed effects. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. The sample period is 2017:1 to 2019:12.

supply elasticity to be a statistical zero when looking at the month-to-month differences. One potential explanation for China to have a lower import demand elasticity is the special processing trade regime as I will discuss in detail below.

Table 4 panel B shows the estimation at twelve-month differences with Column (4) and column (1) in table 3 panel B as the first-stage. The Chinese import demand elasticity is larger when looking at yearly differences. The sign of estimated US export supply elasticity, however, turns negative which implies a downward sloping inverse supply curve.

4.2. The Impact on Ordinary and Processing Imports

When analyzing the tariff incidence in the Chinese context, it is important to distinguish ordinary imports and processing imports because processing imports enjoy a special duty-free tariff treatment. Table 5 reports a simple summary statistics for Chinese import transaction data by trade regimes and year from 2017-2019. Overall, at the HS-8 product level, approximately 60 percent of total import value comprises ordinary imports, whereas processing imports account for around 40 percent.

Processing trade in China started after the reform and opening-up in 1978. In order to promote development and take advantage of low labor costs, the Chinese government encouraged firms to import raw materials or intermediate inputs, and re-export the final goods after processing. Today, the Chinese Custom reports very detailed and specific types of processing trade. Among all types of processing trade, two are the most important: "processing-with-assembly" and "processing-with-inputs". Both types of processing trade require certain certifications and licenses. For processing-with-assembly, the Chinese firms import raw material or parts from their foreign partners without paying for the materials and custom duty. However, they must re-export the final products to the same foreign partners after processing. This trade regime was very popular before year 2000 because it imposed a smaller credit constraint on Chinese firms (Feenstra et al. 2014). However, it now only account for a very small portion of total Chinese imports. For processing-with-inputs, Chinese firms pay the custom duties for imported inputs first. They get a full rebate on import duties only after exporting the goods that used these imported inputs.[8]

The special duty-free policy on processing imports remained largely unchanged during the trade

[8] Note here, if a Chinese firm imports foreign inputs but sell the final products to the domestic market after processing, the custom duties will not be refunded.

Table 5: Chinese Transaction-level Trade Data by Trade Regimes and Year

Imports by Trade Regimes	2017	2018	2019
Percentage of import value			
Ordinary imports	58.7	59.7	60.5
Processing imports	39.3	39.1	38.0

war.[9] Therefore, we should expect ordinary imports were subject to larger impact of tariffs while processing imports should not be heavily affected at least in the short-run. In the data, I directly observe the trade regime of each transaction, so I split my data into processing and non-processing imports and estimate equation (2)-(4) again to test this hypothesis.

Table 6 shows the results using the month-to-month difference and is analog to table 3 panel A. It shows that almost all the impact we observed in table 3 are coming from the impact on ordinary imports. Column (1)-(3) in table 6, panel B show that import quantities, values and before-duty unit prices were not changed significantly for processing import.

Table 7 is analog to table 4 panel A. Column (1) shows that while the Chinese import demand elasticity is high for ordinary imports, it is inelastic for processing import. Column (2) shows that while the US export supply elasticity is positive for ordinary imports in the short-run, I cannot reject a horizontal supply curve for the processing imports. Table A1 and A2 in the appendix show the estimation results in twelve-month differences. I find that the US producer prices increased significantly and the US export supply elasticity becomes negative for ordinary imports. This is consistent with the idea that the input prices and the cost of US manufacturers were higher because of the US import tariffs hence the US exporters were adjusting to this cost shock and eventually raised their prices.

The results in this section highlight the importance of considering the trade structure and

[9] All the official documents on retaliatory tariffs published by the Ministry of Finance of China state that “For products from the United States included in the tariffs list, the tariffs will be added in addition to the current baseline tariffs. Current duty-free and duty-reduction policy will remain unchanged. Tariff deduction is not applied to the products on the list.” This statement is ambiguous and it is difficult to tell whether processing imports still enjoy the duty-free policy. However, I find solid evidence support that processing imports remain largely unaffected during the trade war. First, I find explanatory documents from professional lawyers implying that according to the Chinese Customs Law the current duty-free policy on processing import remain valid even for products involved in the trade war. Second, many Chinese firms that engaged in processing imports stated that they were not affected by the import tariff increases. For example, a large listed company in China made a public announcement in 2019 saying they confirmed with the Chinese Custom and their imported cotton products from the US would still be duty-free as processing imports.

Table 6: Impact of Chinese Tariffs on Imports

Panel A: ordinary imports only				
	Δlnq_{ict} (1)	$\Delta lnp^{*}_{ict}q_{ict}$ (2)	Δlnp^{*}_{ict} (3)	Δlnp_{ict} (4)
$\Delta ln(1+\tau_{ict})$	-1.29***	-1.99***	-0.70***	0.30
	(0.31)	(0.26)	(0.18)	(0.18)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.14	0.15	0.12	0.12
N	1,967,462	1,967,462	1,967,462	1,967,462
Panel B: processing imports only				
	Δlnq_{ict} (1)	$\Delta lnp^{*}_{ict}q_{ict}$ (2)	Δlnp^{*}_{ict} (3)	Δlnp_{ict} (4)
$\Delta ln(1+\tau_{ict})$	-0.28	-0.32	-0.04	0.96***
	(0.33)	(0.31)	(0.18)	(0.18)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.16	0.17	0.13	0.13
N	1,092,999	1,092,999	1,092,999	1,092,999

Notes: Table reports the variety-level import responses to the Chinese import tariffs. Column (1)-(4) report changes in import quantities, values, before-duty unit values, and duty-inclusive unit values regressed on changes in statutory tariff rates. Panel A only includes ordinary imports and panel B only includes processing imports. Both panel uses the month-to-month differences. All regressions include product-time, country-time and product-country fixed effects. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. The sample period is 2017:1 to 2019:12.

distributional consequences of the US-China trade war. On one hand, due to China's free-duty policy on processing imports, Chinese firms that completely or partially engaged in processing trade may not be largely affected (although they have to face the US import tariffs when exporting). On the other hand, previous literature that estimated the impact of trade-war from the US perspective may have over-estimated the welfare loss because they cannot distinguish processing and ordinary trade when analyzing the effect of China's retaliatory tariffs on US exports.

Meanwhile, the global value chain are transforming the nature of production during the past several decades. Instead of "made in China" or "made in USA", more products are actually "made

Table 7: IV Estimation of Chinese Import Demand Elasticity and Foreign Export Supply Elasticity

Panel A: ordinary imports only		
	Δlnq_{ict} (1)	Δlnp^*_{ict} (2)
Δlnp_{ict}	-4.33*	
	(2.25)	
Δlnq_{ict}		0.54**
		(0.24)
Product × time FE	Y	Y
Country × time FE	Y	Y
Product × country FE	Y	Y
N	1,967,462	1,967,462
Panel B: processing imports only		
	Δlnq_{ict} (1)	Δlnp^*_{ict} (2)
Δlnp_{ict}	-0.29	
	(0.33)	
Δlnq_{ict}		0.15
		(0.72)
Product × time FE	Y	Y
Country × time FE	Y	Y
Product × country FE	Y	Y
N	1,092,999	1,092,999

Notes: Column (1) reports the IV estimated Chinese import demand elasticity $\hat{\sigma}$ from equation (3); the first stage is column (4) in table 6. Column reports the IV estimated US export supply elasticity $\hat{\omega}$ from equation (4); the first stage is column (1) in table 6. Panel A only includes ordinary imports and panel B only includes processing imports. Both panel uses the month-to-month differences. All regressions include product-time, country-time and product-country fixed effects. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. The sample period is 2017:1 to 2019:12.

in the world". Therefore, while trade wars have always been disruptive, they are particularly expensive and divisive in the global value chain era (Blanchard 2019). The global value chains could be an important channel of transmitting the impact of import tariffs to exports because they can amplify shocks (Handley et al. 2020).

To bring production and jobs back to the US was one important incentive of the US import tariffs. However, Trump administration has imposed tariffs disproportionately on imported intermediate inputs (Bown and Zhang 2019). Therefore, the import tariffs could potentially backfire and shift the production away from the US. The recent work by Handley et al. (2020) shows that a large share of US exports were facing increased tariffs on importing inputs during the trade war, which in turn leads to a even larger decline in exporting. Flaaen and Pierce (2019) also show that U.S. manufacturing industries more exposed to tariff increases experience relative reductions in employment as a positive effect from import protection is offset by larger negative effects from rising input costs and retaliatory tariffs. In the later stage of the trade war, Trump administration initiated a tariff exclusion process for Chinese products and over 2,500 US firms filed for tariff exclusions for Chinese imports. However, failure to consider the global value chain linkages when the administration first imposed the import protection may have already added large unintentional burdens on US producers.

By contrast, although the Chinese government imposed protection at a similar magnitude, the Chinese special duty-free policy on processing trade may have served as a built-in mechanism that protects input-importing domestic firms from the damage of the trade war through the global value chain channel. In other words, such policy prevented the Chinese import tariffs to backfire on Chinese exporting, which is one major driver of China's economy growth.

4.3. Import Trade Diversion

One question that is of great public interest is whether the Chinese importers were substituting across source countries during the trade war. If there was a significant trade diversion effect, it may lead to a reorganization of global value chains (Nicita 2019; Bekkers and Schroete 2020). To formally assess the extend of trade diversion (substitution), I propose a simple regression to check the relationship between Chinese import tariffs and Chinese imports from the rest of the world other than the US:

$$\Delta log(RoW_i) = \beta \Delta log(1 + Tariff_i^{CHN}) + f_i + \epsilon_i \tag{5}$$

where on the left hand side, I take the difference of the total Chinese import quantities (and values) of product i at the HS-6 level from all countries other than the US between 2019 Q4 and 2017 Q4. Because many products experienced multiple rounds of tariff increases, comparing the change

Table 8: Import Trade Diversion Effect

	$\Delta log(RoW\ Quantity)$ (1)	$\Delta log(RoW\ Value)$ (2)
$\Delta log(1 + Tariff_i^{CHN})$	-0.44*	-0.29
	(0.24)	(0.19)
Product FE (HS-2)	Y	Y
R^2	0.05	0.06
N	4,711	4,711

Notes: Column (1)-(2) report total import quantities and values from all third countries other than the US regressed on trade weighted Chinese retaliatory tariffs at the HS-6 level. The changes are from 2017 Q4 to 2019 Q4. Both regressions include product fixed effects at the HS-2 level. Robust standard errors in the parentheses are clustered at HS-6. Significance: * 0.10, ** 0.05, *** 0.01.

before (2017 Q4) and after (2019 Q4) the trade war yields a less noisy trend. On the right hand side, $Tariff_i^{CHN}$ represents the trade weighted effective Chinese trade war tariffs on product i at the HS-6 level.[10] f_i represents the product fixed effects at the HS-2 level and the robust standard error ϵ_i is clustered at the HS-6 level.

Table 8 shows that overall there is little evidence that the Chinese import tariffs have impact on Chinese import quantities and values from the rest of the world. This result is consistent with Bekkers and Schroete (2020) where they find the reduction in Chinese imports from the US are not countered by more imports from third countries but reinforced by a fall in imports from third countries.

To further assess the trade diversion effect at the product-level, I take a closer look at products which US was the major source country to check whether third countries were filling in the US share in Chinese imports. Specifically, I choose a subset of products in which the US had a share greater than 20 percent before the trade war in 2017. This subset contains 902 products at the HS-6 level. Then in this subset, for products that US was the largest source country in 2017, I record the share of the second largest source country; and for products that US was not the largest source country, I record the share of the largest source country. By comparing these third countries' share changes from 2017 and 2019, I find the differences on average to be 0.01 with a standard deviation of 0.17.

[10] I examine the impact at the HS-6 level because HS codes across countries are not comparable at the HS-8 level.

This further implies that despite the Chinese import tariffs on US products, third countries were not taking over US share in Chinese imports.

One possible explanation is that there might be considerable heterogeneity across products or sectors that may mask the overall variations. For example, Cavallo et al. (2021) show that US exporters drop their prices significantly in the face of Chinese retaliatory tariffs because agricultural and non-differentiated goods represent a large share of US exports. If the price quoted by the US exporter dropped significantly, there will be no need for Chinese importers to seek alternative source. Therefore, in table A3 in the appendix, I explore this potential source of heterogeneity by interacting the Chinese import tariffs with Rauch classification (Rauch 1999) and import demand elasticities estimated by Soderbery (2018). However, neither interaction term yields significant results.[11] Therefore, although there may be heterogeneity across different product characteristics, I did not find any significant heterogeneous effect.

5. Robustness Checks

This section checks the robustness of the results. I first assess concerns that underlying trends or tariff anticipation bias the estimates. Then I explore the heterogeneity across different product characteristics. I also discuss the MFN and RTA changes during the trade war, examine how the results change with alternative sets of fixed effects and address the concerns over endogenous tariff selection.

5.1. Preexisting Trends

The previous estimations treat the tariff changes during the trade war as exogenous and assume that the changes are uncorrelated with potential demand and supply shocks. To support this identification assumption, I test the pre-trends by regressing the import outcomes before the trade war (i.e., year 2017) on the subsequent tariff changes. The equation I estimate is as following:

$$\Delta_{\overline{2017}} log[z_{ic}] = \eta \Delta_{2018-2019} log(1+\tau_{ic}) + f_i + f_c + \epsilon_{ic} \quad (6)$$

[11] I obtain similar results when using a sample consists of only non-processing imports.

Table 9: Testing for Preexisting Trends

	$\Delta_{\overline{2017}} lnq_{ic}$ (1)	$\Delta_{\overline{2017}} lnp^*_{ic}q_{ic}$ (2)	$\Delta_{\overline{2017}} lnp^*_{ic}$ (3)	$\Delta_{\overline{2017}} lnp_{ic}$ (4)
$\Delta_{2018-2019} log(1+\tau_{ic})$	0.12	0.15	0.03	0.03
	(0.11)	(0.11)	(0.07)	(0.07)
Product FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
R^2	0.08	0.08	0.08	0.08
N	98,264	98,264	98,264	98,264

Notes: Column (1)-(4) reports pretrend test regressions of the 2017:1-2017:12 average monthly changes in import quantities, values, before-duty unit values, after-duty unit values against net changes in Chinese import tariffs from 2018:1-2019:12. All regressions include product and country fixed effects. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01.

where $z \in \{q,\ p{\times}q,\ p,\ p\} \equiv$ {import quantity, total import value, duty-exclusive unit value, duty-inclusive unit value}. The left hand side is the average monthly change of each of four outcomes from 2017:1-2017:12. $\Delta_{2018-2019} log(1+\tau_{ic})$ represents the net log changes in import tariff rates for product i from country c between 2018:1 and 2019:12. The regression control for HS-8 product and country fixed effects. Robust standard errors are two-way clustered by country and HS-8.

Table 9 reports the estimation results. There is no statistical significant relationship between pre-trend outcomes and the subsequent Chinese import tariffs. This result, combined with the event-study above, suggest that targeted products from the US were not on different trends before the trade war which supports the main identification assumption in this paper.

5.2. Heterogeneity

The estimation results in this paper assign one common elasticity across all products and sectors which may mask variations. For example, an important sector that may react differently to tariffs is the agricultural sector. It accounts for a significant share of Chinese imports from US but has a relatively high elasticity of substitution, and hence more readily available substitutes exist, so exporters may have adjusted their prices more steeply. In the contrast, we may expect a different pattern for more differentiated products as less substitutes are available. Other product characteristics such as storability may also induce heterogeneous effects through inventory effects.

Table 10: Variety Import Tariff Pass-Through, Product Characteristics, 12-month Differences

	Δlnp^*_{ict} (1)	Δlnp^*_{ict} (2)	Δlnp^*_{ict} (3)	Δlnp^*_{ict} (4)	Δlnp^*_{ict} (5)
$\Delta ln(1+\tau_{ict})$	1.00***	0.49***	1.00***	2.08***	0.89***
	(0.11)	(0.10)	(0.14)	(0.20)	(0.13))
$\Delta ln(1+\tau_{ict})$×Agricultural (0/1)	-0.58***				
	(0.12)				
$\Delta ln(1+\tau_{ict})$×BEC Consumption (0/1)		1.07***			
		(0.14)			
$\Delta ln(1+\tau_{ict})$×BEC Intermediate (0/1)			-0.30**		
			(0.14)		
$\Delta ln(1+\tau_{ict})$×BEC Durable (0/1)				-1.57***	
				(0.17)	
$\Delta ln(1+\tau_{ict})$×Rauch Differentiation (0/1)					-0.13
					(0.17)

Notes: Each column report 12-month changes in log before-duty unit value regressed on 12-month changes in log import tariffs interacts with the product characteristics: 1) Agricultural product indicator from the WTO; 2) Consumption good indicator from the BEC; 3) Intermediate good indicator from the BEC; 4) Durable good indicator from the BEC; 5) Indicator of product differentiation from Rauch (1999). All regressions include product-time, country-time and country-product fixed effects. Robust standard errors in the parentheses are clustered by country and HS8. Significance: * 0.10, ** 0.05, *** 0.01.

In table 10, I regress changes in the import before-duty unit value on changes in import tariffs, controlling for product-time, country-time, and country-product fixed effects. Each specification interacts the changes in import tariffs with different measures of product characteristics: 1) Agricultural product indicator from the WTO; 2) Consumption good indicator from the Broad Economic Categories (BEC); 3) Intermediate good indicator from the BEC; 4) Durable good indicator from the BEC; 5) Indicator of product differentiation from Rauch (1999). Because month-to-month differences might suffer from seasonality issues especially for agricultural products, the regression uses 12-month changes instead.

I observe a significant decline in the before-duty prices for agricultural products. Meanwhile, the before-duty prices for differentiated products did not change in a statistically significant way which suggests the tariffs passed through almost entirely to the Chinese importers. These results are consistent with the key results from Cavallo et al. (2021). They find a large decline in relative US export price of retaliated-upon products and show that it is almost entirely driven by US shipments of non-differentiated and agricultural goods to China. I also find that the ex-tariff prices increased for consumption goods but dropped for intermediate goods as well as durable goods. Overall, product characteristics seem to play an important role in term of the tariff pass-through from the Chinese import side.[12]

5.3. MFN Tariff Reductions

Since this paper is focusing on the impact of trade war tariffs, I ignored the MFN changes as well as RTA changes during the trade war in the previous estimations. However, one may concern that during the trade war China may have deliberately lowered the tariffs on products from other countries to counter the impact of the US specific tariffs.

Typically, every year in January and in July, the Chinese government would publish a list of products with corresponding MFN rate adjustments. For most of the products (around 90 percent), they got MFN tariff reductions because China had to fulfill its commitment to the WTO. And for a very small number of products, the Chinese government reduced their MFN rates because there were domestic shortages. For example, China imposed zero tariffs on 63 anticancer drugs in January 2019, and implemented lower tariffs on 298 information technology products in July 2019. However, it is very difficult to justify whether the Chinese government was deliberately reducing MFN tariffs on products that were being targeted by the trade war tariffs. Therefore, I first checked the percentage point changes of the MFN tariffs. During the trade war, conditional on products that have experienced MFN rate reductions, the average MFN change is -0.06 percentage point. Conditional on products being targeted by the trade war tariffs, the average MFN change is -0.03 percentage point. Conditional on products that have both experienced MFN reduction and import tariff increases, the average MFN change is -0.06 percentage point. In terms of number of products at the HS-8 level, less than one third of products (out of all products China imports from the US) have experienced both MFN reductions and import tariff increases. The average reduction on MFN rates is actually smaller for those products being targeted by Chinese import tariffs and the average change of MFN rates is much smaller than the trade war tariffs in terms of magnitude. Therefore, it does not seem like China was manipulating the MFN rates to counter the effects from the trade war tariffs.

[12]Table A4 in the appendix parallels the exercise in table 10 but focus on the import quantities and the results well reflect the changes in ex-tariff prices.

Table 11: Impact of Chinese Tariffs on Imports (Including MFN and RTA Changes)

Panel A: month-to-month differences				
	Δlnq_{ict}	$\Delta lnp^*_{ict}q_{ict}$	Δlnp^*_{ict}	Δlnp_{ict}
	(1)	(2)	(3)	(4)
$\Delta ln(1+\tau_{ict})$	-0.33	-0.69**	-0.36**	0.64***
	(0.34)	(0.33)	(0.15)	(0.15)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.13	0.14	0.11	0.11
N	2,307,350	2,307,350	2,307,350	2,307,350
Panel B: year-to-year differences				
	Δlnq_{ict}	$\Delta lnp^*_{ict}q_{ict}$	Δlnp^*_{ict}	Δlnp_{ict}
	(1)	(2)	(3)	(4)
$\Delta ln(1+\tau_{ict})$	-2.06***	-1.56***	0.51**	1.51***
	(0.78)	(0.60)	(0.21)	(0.21)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.23	0.23	0.19	0.19
N	1,511,344	1,511,344	1,511,344	1,511,344

Notes: Table replicates the estimation in table 3. Column (1)-(4) report log changes in import quantities, values, before-duty unit values, and duty-inclusive unit values regressed on log changes in statutory tariff rates (including MFN and RTA changes during the trade war). Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01.

Furthermore, I replicate the main results in section 4 but include all the MFN and RTA rate changes. Table 11 parallels the estimation from table 3. While under this specification, the quantity response in the very short run is insignificant, the estimates are quantitatively similar. Table 12 replicates the estimation for ordinary imports in table 6. Because the processing imports are exempt from the import tariffs including MFN and RTA tariffs, the results for them in table 12 are mechanically the same as in table 6. For ordinary imports, I find similar but quantitatively smaller impact when including the MFN and RTA adjustments.

Table 12: Impact of Chinese Tariffs on Imports (Including MFN and RTA Changes)

Panel A: ordinary imports only				
	$\Delta ln q_{ict}$ (1)	$\Delta ln p^*_{ict} q_{ict}$ (2)	$\Delta ln p^*_{ict}$ (3)	$\Delta ln p_{ict}$ (4)
$\Delta ln(1+\tau_{ict})$	-0.82**	-1.17***	-0.35*	0.65***
	(0.36)	(0.39)	(0.20)	(0.20)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.14	0.15	0.12	0.12
N	1,954,678	1,954,678	1,954,678	1,954,678
Panel B: processing imports only				
	$\Delta ln q_{ict}$ (1)	$\Delta ln p^*_{ict} q_{ict}$ (2)	$\Delta ln p^*_{ict}$ (3)	$\Delta ln p_{ict}$ (4)
$\Delta ln(1+\tau_{ict})$	-0.28	-0.32	-0.04	0.96***
	(0.33)	(0.31)	(0.18)	(0.18)
Product × time FE	Y	Y	Y	Y
Country × time FE	Y	Y	Y	Y
Product × country FE	Y	Y	Y	Y
R^2	0.16	0.17	0.13	0.13
N	1,092,999	1,092,999	1,092,999	1,092,999

Notes: Table replicates the estimation in table 6. Column (1)-(4) report log changes in import quantities, values, before-duty unit values, and duty-inclusive unit values regressed on log changes in statutory tariff rates (including MFN and RTA changes during the trade war). Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01.

5.4. Alternative Fixed Effects

The sets of product-time, country-time and product country fixed effects in the baseline estimation control for potentially confounding shocks such as demand variation or exchange rate changes. However, these fixed effects may sweep variation that is itself potentially worth exploring. In table 13, I replicate the estimation in table 3 panel A using different sets of fixed effects to check this possibility. The top panel reports the impact on Chinese import quantities and the bottom panel reports the impact on before-duty unit values. Column (1) in each panel reports the baseline estimates from table 3 for comparisons. I do find that the impact on import quantities are larger when excluding the product-time fixed effects which implies that there could be seasonality in imports of products especially when using the monthly differences. Therefore, it is important to

Table 13: Impact of Chinese Tariffs with Alternative Fixed Effects (Monthly Differences)

Panel A: Import Quantities				
	Δlnq_{ict} (1)	Δlnq_{ict} (2)	Δlnq_{ict} (3)	Δlnq_{ict} (4)
$\Delta ln(1+\tau_{ict})$	-0.87***	-1.45***	-1.47***	-0.92***
	(0.30)	(0.00)	(0.32)	(0.28)
Product × time FE	Y	N	Y	Y
Country × time FE	Y	Y	N	Y
Product × country FE	Y	Y	Y	N
R^2	0.13	0.04	0.13	0.11
N	2,328,703	2,358,721	2,329,525	2,347,481
Panel B: Unit Values (Before-duty)				
	Δlnp^*_{ict} (1)	Δlnp^*_{ict} (2)	Δlnp^*_{ict} (3)	Δlnp^*_{ict} (4)
$\Delta ln(1+\tau_{ict})$	-0.51***	-0.32***	-0.46***	-0.44***
	(0.14)	(0.00)	(0.10)	(0.13)
Product × time FE	Y	N	Y	Y
Country × time FE	Y	Y	N	Y
Product × country FE	Y	Y	Y	N
R^2	0.11	0.03	0.11	0.09
N	2,328,703	2,358,721	2,329,525	2,347,481

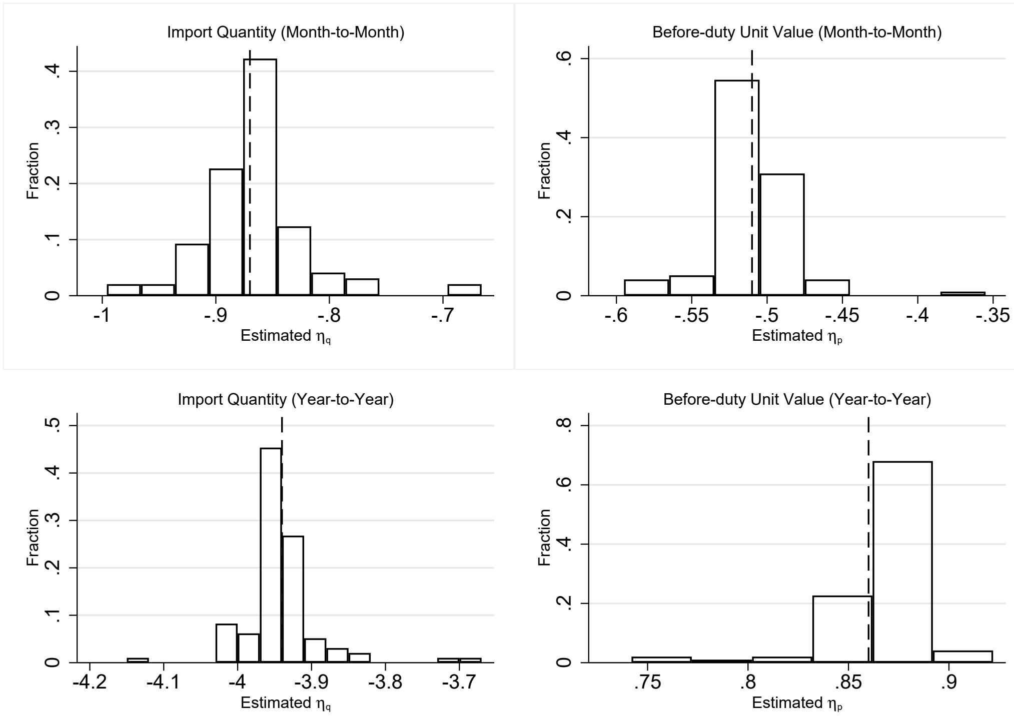
Notes: Table reports the variety-level import responses to the Chinese import tariffs using alternative sets of fixed effects. Panel A reports the impact on import quantities and panel B reports the impact on before-duty unit values. Column (1) in panel A and B is the same as column (1) and (3) in table 3 respectively. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. The sample period is 2017:1 to 2019:12.

control for the product-time fixed effects. The impact on quantities are also larger when excluding country-time fixed effects which suggests that the baseline specification may mask some country-specific responses such as the USD-RMB exchange rate changes. However, I find very consistent results when looking at the impact on before-duty unit values which implies the tariff pass through rates are not sensitive to alternative sets of fixed effects.

5.5. Endogenous Tariff Selection

Sections 3 and 5.1 document that overall anticipation effects and preexisting trends are unlikely to threaten the identification. However, the fact that different US products are subject to different

Figure 5: Distribution of $\hat{\eta_q}$ and $\hat{\eta_p}*$



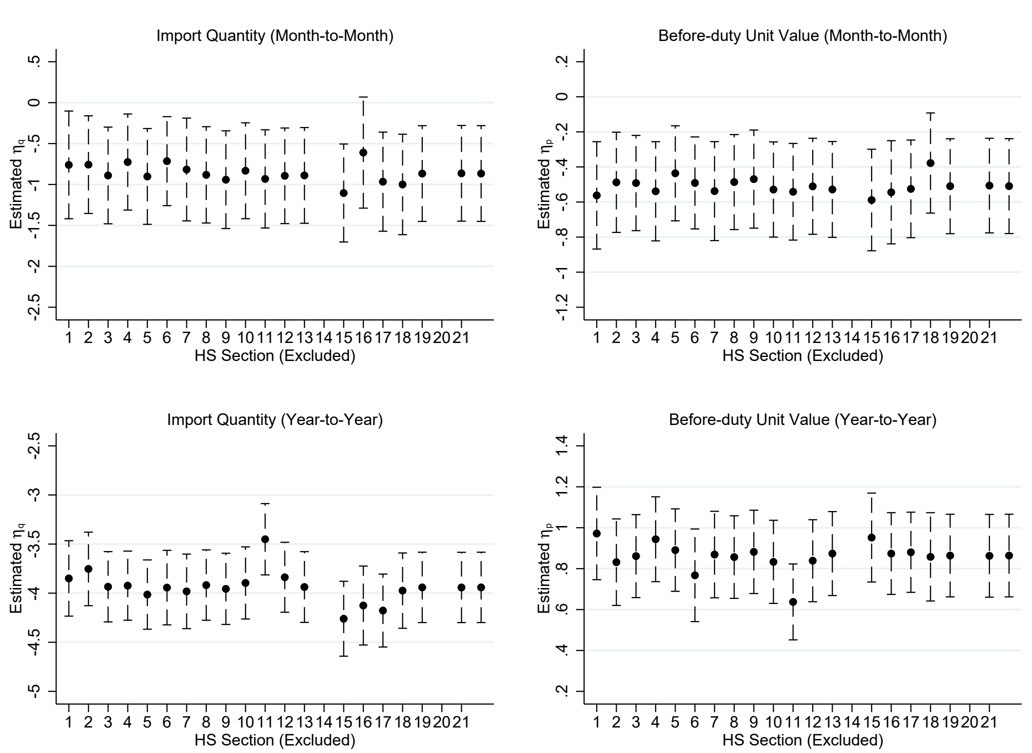
Notes: Figure plots the distribution of the estimate of η in equation (2), obtained from estimating the equation 98 times and excluding one HS-2 chapter from the sample at one time. The top two panels present the estimates for import quantity and before-duty unit value using monthly differences and the bottom two panels present the same estimates using yearly differences. The width of each bin is 0.03 and the dash lines represent the points estimates in table 3 for comparisons. The sample period is 2017:1 to 2019:12.

tariffs rates during the trade war may raise a concern over endogenous tariff selection. Although over 5,000 US products are involved in the trade war, there could be many reasons that the potential for endogenous tariff selection as well as anticipation effects are more acute for some products than others. For example, China may have implemented heavy tariffs on aircraft, autos and soybeans in order to push the US into trade deal negotiation. Meanwhile, some products may be more sensitive to tariffs due to differences in market structure and competitiveness within the product category.

In order to check whether the main results are sensitive to the product selection, figure 5 presents the distribution of the estimated η in equation (2), obtained from estimating the equation for 98 times and excluding one HS-2 chapter from the sample at one time. The top two panels present the estimates for import quantity and before-duty unit value using monthly differences, and the bottom two panels present the same estimates using yearly differences. The width of each bin is 0.03 and the dash lines represent the points estimates in table 3 for comparisons. The figure shows that all the coefficients are very concentrated around the original points estimates and the dispersion is small. Furthermore, I take a look at the more aggregated level by running equation (2) for 19 times and excluding one HS section at one time.[13] Figure 6 plots the estimated η and the corresponding 95% confidence intervals for Chinese import quantity and before-duty unit-value. The horizontal axis represents the HS section that I excluded in each regression. The estimates at the right end of each panel show the points estimates and the confidence intervals from table 3 for comparisons. Again, I do not find any estimate that is significantly different from the pooling estimates. The estimates of products that could be more problematic such as metals (section 15) and autos (section 17) are also not significantly different from the pooling estimates. These results suggest that the concerns over product selection or endogenous tariff selection are mild.

[13]The World Customs Organization defines 21 HS Sections using the HS-2 codes. China did not import any products in section 14 and 20 from the US during my sample period.

Figure 6: Estimates of $\hat{\eta_q}$ and $\hat{\eta_p}*$



Notes: Figure plots the estimates of η in equation (2) and the corresponding 95% confidence intervals, obtained from estimating the equation 19 times and excluding one HS section from the sample at one time. The top two panels present the estimates for import quantity and before-duty unit value using monthly differences and the bottom two panels presents the same estimates using yearly differences. The estimates at the right end of each panel show the points estimates and the confidence intervals from table 3 for comparisons. The sample period is 2017:1 to 2019:12.

6. Conclusion

This paper analyzes the impact of the 2018-2019 trade war from China's perspective. I first show the direct impact of Chinese import tariffs on trade quantities and prices. Both Chinese import quantities and values dropped sharply following the tariffs. The before-duty unit values decreased in the short-run, suggesting incomplete tariff pass-through and a tariff incidence borne by both Chinese importers and US exporters. Using Chinese import tariff variation, I also provide estimates of Chinese import demand and US export supply elasticities.

Furthermore, I consider the role of global value chains in the trade war and highlight the role of Chinese processing trade regime. Chinese processing imports enjoy a special duty-free tariff treatment which remained largely unchanged even during the trade war. As a consequence, I find that the impact is almost purely driven by ordinary imports while there is no statistically significant effect on processing imports. These results highlight the importance of considering the institutional details in trade policy—especially the difference between China and US in this context. Recent studies have suggested that the impact of such tit-for-tat tariff increases would be more disruptive because the existence of global value chain could potentially magnify the impact and even backfire on one country's export or labor market. However, the Chinese special duty-free policy on processing trade may have served as a built-in mechanism that protects input-importing domestic firms from the damage of the trade war through the global value chain channel.

I also examine the potential diversion effect to see whether Chinese importers were seeking alternative source from third countries in the face of higher import tariffs on US products. However, despite all the discussion about trade diversion, I find no evidence for systematic diversion. There is also no evidence showing that third countries were taking over the share of US products in Chinese imports.

Let me finish by noting two important limitations. First, this paper only provides short-run analysis on the impact of the trade war from the Chinese perspective. The long-run consequence of the trade war such as future trade agreements as well as the reshaping of global value chains are yet to be examined. Second, this paper does not provide detailed analysis on the sectoral or regional level, which I believe are important areas to focus on for future research.

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Appendix

Table A.1: Impact of Chinese Tariffs on Imports (Twelve-month Differences)

Panel A: ordinary imports only				
	Δlnq_{ict} (1)	$\Delta lnp^*_{ict}q_{ict}$ (2)	Δlnp^*_{ict} (3)	Δlnp_{ict} (4)
$\Delta ln(1+\tau_{ict})$	-5.16***	-3.71***	1.44***	2.44***
	(0.22)	(0.17)	(0.13)	(0.13)
it, ct, ic FE	Y	Y	Y	Y
R^2	0.24	0.24	0.20	0.20
N	1,273,697	1,273,697	1,273,697	1,273,697
Panel B: processing imports only				
	Δlnq_{ict} (1)	$\Delta lnp^*_{ict}q_{ict}$ (2)	Δlnp_{ict} (3)	Δlnp_{ict} (4)
$\Delta ln(1+\tau_{ict})$	-0.57**	-0.36	0.20	1.20***
	(0.27)	(0.23)	(0.15)	(0.15)
it, ct, ic FE	Y	Y	Y	Y
R^2	0.26	0.26	0.22	0.22
N	707,186	707,186	707,186	707,186

Notes: Table reports the variety-level import responses to the Chinese import tariffs. Column (1)-(4) report changes in import quantities, values, before-duty unit values, and duty-inclusive unit values regressed on changes in statutory tariff rates. Panel A only includes ordinary imports and panel B only includes processing imports. Both panel uses the 12-month differences. All regressions include product-time, country-time and product-country fixed effects. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. The sample period is 2017:1 to 2019:12.

Table A.2: IV Estimation of Chinese Import Demand Elasticity and Foreign Export Supply Elasticity (Twelve-month Differences)

Panel A: ordinary imports only		
	Δlnq_{ict} (1)	Δlnp^{*}_{ict} (2)
Δlnp_{ict}	-2.11***	
	(0.08)	
Δlnq_{ict}		-0.28***
		(0.02)
it, ct, ic FE	Y	Y
N	1,273,697	1,273,697
Panel A: processing imports only		
	Δlnq_{ict} (1)	Δlnp^{*}_{ict} (2)
Δlnp_{ict}	-0.47**	
	(0.20)	
Δlnq_{ict}		-0.36
		(0.23)
it, ct, ic FE	Y	Y
N	707,186	707,186

Notes: Column (1) reports the IV estimated Chinese import demand elasticity $\hat{\sigma}$ from equation (3); the first stage is column (4) in table A1. Column reports the IV estimated US export supply elasticity $\hat{\omega}$ from equation (4); the first stage is column (1) in table A1. Panel A only includes ordinary imports and panel B only includes processing imports. Both panel uses the 12-month differences. All regressions include product-time, country-time and product-country fixed effects. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. The sample period is 2017:1 to 2019:12.

Table A.3: Trade Diversion Effect Heterogeneity

	$\Delta log(RoW\ Quantity)$ (1)	$\Delta log(RoW\ Quantity)$ (2)
$\Delta log(1 + Tariff_i^{CHN})$	-0.33	-0.54*
	(0.38)	(0.29)
$\Delta log(1 + Tariff_i^{CHN})\times$ Rauch Differentiation (0/1)	0.08	
	(0.39)	
$\Delta log(1 + Tariff_i^{CHN})\times$ Soderbery Elasticity (2018)		0.00
		(0.01)
Product FE (HS-2)	Y	Y
R^2	0.05	0.05
N	3,802	3,267

Notes: Column (1)-(2) report total import quantities and values from all third countries other than the US regressed on trade weighted Chinese retaliatory tariffs at the HS-6 level interacts with Rauch classification (Rauch 1999) and Soderbery elasticities (Soderbery 2018). The changes are from 2017 Q4 to 2019 Q4. Both regressions include product fixed effects at the HS-2 level. Robust standard errors in the parentheses are clustered at HS-6. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.4: Variety Import Quantity, Product Characteristics, 12-month

	Δlnq_{ict} (1)	Δlnq_{ict} (2)	Δlnq_{ict} (3)	Δlnq_{ict} (4)	Δlnq_{ict} (5)
$\Delta ln(1 + \tau_{ict})$	-3.79***	-2.92***	-4.76***	-6.78***	-4.66***
	(0.19)	(0.10)	(0.22)	(0.29)	(0.28)
$\Delta ln(1 + \tau_{ict})\times$Agricultural (0/1)	-0.34				
	(0.12)				
$\Delta ln(1 + \tau_{ict})\times$BEC Consumption (0/1)		-2.95***			
		(0.27)			
$\Delta ln(1 + \tau_{ict})\times$BEC Intermediate (0/1)			1.66***		
			(0.24)		
$\Delta ln(1 + \tau_{ict})\times$BEC Durable (0/1)				3.68***	
				(0.27)	
$\Delta ln(1 + \tau_{ict})\times$ Rauch Differentiation (0/1)					1.00***
					(0.28)

Notes: Each column report 12-month changes in log import quantities regressed on 12-month changes in log import tariffs interacts with the product characteristics: 1) Agricultural product indicator from the WTO; 2) Consumption good indicator from BEC; 3) Intermediate good indicator from BEC; 4) Durable good indicator from BEC; 5) Indicator of product differentiation from Rauch (1999). All regressions include product-time, country-time and country-product fixed effects. Robust standard errors in the parentheses are clustered by country and HS8. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.5: Impact of Chinese Tariffs on Imports (Semi-elasticity)

	Δlnq_{ict} (1)	$\Delta lnp^*_{ict}q_{ict}$ (2)	Δlnp^*_{ict} (3)	Δlnp_{ict} (4)
$\Delta\tau_{ict}$	-0.68***	-1.04***	-0.36***	0.43***
	(0.24)	(0.21)	(0.11)	(0.11)
it, ct, ic FE	Y	Y	Y	Y
R^2	0.13	0.14	0.11	0.11
N	2,328,703	2,328,703	2,328,703	2,328,703

Notes: Column (1)-(4) report log changes in import quantities, values, before-duty unit values, and duty-inclusive unit values regressed on changes in statutory tariff rates. Each regression is run on monthly differences. Product-time, country-time and product-country fixed effects are included. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.6: Impact of Chinese Tariffs on Imports (Semi-elasticity)

Panel A: ordinary imports only				
	Δlnq_{ict} (1)	$\Delta lnp^*_{ict}q_{ict}$ (2)	Δlnp^*_{ict} (3)	Δlnp_{ict} (4)
$\Delta\tau_{ict}$	-0.97***	-1.49***	-0.53***	0.26*
	(0.25)	(0.22)	(0.15)	(0.15)
it, ct, ic FE	Y	Y	Y	Y
R^2	0.14	0.15	0.12	0.12
N	1,967,462	1,967,462	1,967,462	1,967,462
Panel B: processing imports only				
	Δlnq_{ict} (1)	$\Delta lnp^*_{ict}q_{ict}$ (2)	Δlnp^*_{ict} (3)	Δlnp_{ict} (4)
$\Delta\tau_{ict}$	-0.31	-0.35	-0.03	0.83***
	(0.29)	(0.27)	(0.16)	(0.16)
it, ct, ic FE	Y	Y	Y	Y
R^2	0.16	0.17	0.13	0.13
N	1,092,999	1,092,999	1,092,999	1,092,999

Notes: Column (1)-(4) report log changes in import quantities, values, before-duty unit values, and duty-inclusive unit values regressed on changes in statutory tariff rates. Each regression is run on monthly differences. Product-time, country-time and product-country fixed effects are included. Robust standard errors in the parentheses are clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01.