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Responses of exporters to trade protectionism: Inferences from the US-China trade war

Lingduo Jiang [a], Yi Lu [b], Hong Song [c], Guofeng Zhang [a,*]

[a] School of International Trade and Economics, University of International Business and Economics, Beijing, China
[b] School of Economics and Management, Tsinghua University, Beijing, China
[c] School of Economics, Fudan University, Shanghai, China

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A B S T R A C T

This paper investigates how exports respond to trade protection by studying the US-China trade war in 2018. Using monthly customs data in China from January 2017 to May 2019, we find that the launch of the trade war against Chinese exports by the US on average reduces Chinese total exports to the US by 16.47%. Further decomposition shows that the reduction in exports is mostly explained by a decrease in quantity, with prices relatively unchanged. Meanwhile, negative trade shocks cause export diversion to countries that are closer and have larger economies, and exports in R&D-intensive, skilled-labor-intensive, high-capital-income-share, and upstream industries have been diverted even more. Heterogeneous analyses show that industries with a comparative advantage, high export growth, large export value, and high elasticity of substitution are more responsive to trade protection.

1. Introduction

After decades of trade liberalization, anti-globalization momentum has recently increased. Leading examples are the waves of tariff increases launched by the US in 2018 and the UK's withdrawal from the European Union (EU). This momentum has spurred concerns about how increases in trade protectionism affect the global economy.

A starting point in understanding the effects of trade protection is to investigate how it affects exporting behavior. Although a considerable literature documents the effects of trade liberalization, these results may not directly apply to the recent state of trade protection. First, the gains and losses may not be symmetric. Specifically, a reduction in tariffs triggers the entry of new exporters, who incur fixed costs of investment; in contrast, exits from exporting markets induced by tariff increases entail the liquidation of exporting network assets. Second, with the significant investment in transportation and communication infrastructures in past decades, trade diversion could easily be achieved, especially for incumbent exporters that operate in multiple countries. Third, the world is now more integrated with respect to the global production chain, which complicates the effects of tariffs.

* Corresponding author.
E-mail addresses: lingduo@uibe.edu.cn (L. Jiang), luyi@sem.tsinghua.edu.cn (Y. Lu), songhong@fudan.edu.cn (H. Song), zhangguofeng@uibe.edu.cn (G. Zhang).

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This study makes three contributions to the literature by studying the US-China trade war in 2018. Specifically, the Trump administration in the US launched several waves of tariff increases on specific products imported from China in mid-2018. The trade war started with steel and aluminum products in February 2018 and was followed by three rounds of tariff increases that sequentially covered all Chinese exports. First, we have access to monthly customs data in China from January 2017 to May 2019, which spans the period of the US-China trade war. These data allow us to examine the actual responses of exporters to negative trade shocks. In addition, the several waves of tariff increases on specific products from China to the US in mid-2018 provide us with an identification strategy to examine the short-run effects of trade protection on exporting behavior. Second, we decompose the trade-protection effect on exports into quantity and price components and investigate whether export diversion occurs and, if so, to which countries. This approach yields a clear picture of how exports respond to trade protection. Third, because of the terms-of-trade effect, we use firm-level monthly transaction data to exploit the underlying reasons for price response—specifically, the compositional change and wage response.

We obtain four sets of empirical findings. First, we conduct a difference-in-differences (DD) analysis by comparing war-affected products with war-unaffected products before and after the tariff increases. We find that the launch of the trade war against Chinese exports by the US reduces Chinese total exports to the US by 16.47% on average. Translating this percentage into the elasticity of exports to tariffs, we find that when statutory tariff $1 + \tau$ increases by 1%, exports for war-affected products drop by 0.69% on average. Meanwhile, for war-affected products with their applied tariffs increased, the average trade elasticity is 1.99. Our estimates are smaller than the corresponding values inferred from the imports data in the US by Fajgelbaum et al. (2020) (i.e., the average trade elasticity associated with statutory tariffs for war-affected products is 1.52, and for war-affected products with their applied tariffs increased is 2.50). Both the data discrepancies (i.e., data by US importers vs. those by Chinese exporters) and specification difference (i.e., triple difference vs. DD) account for this difference, with the former explaining 31% and the latter explaining the remaining 69% of the difference. Meanwhile, our estimate of the short-run effects of trade protection is higher than the corresponding effect of trade liberalization. Specifically, in a comparable caliber, our instrumental variable (IV) estimates of trade elasticity associated with applied tariffs are 1.99 within a year, whereas Boehm et al. (2020), using a global database, find a trade elasticity associated with applied MFN tariffs from the IV estimation of approximately 0.7 in one year. These results suggest that trade liberalization and trade protection have different short-term effects on exports.

Second, we decompose the effect on total exports into the quantity effect and the price effect to shed light on export responses to trade protection. We find that the drop in Chinese exports to the US caused by the additional tariffs is mostly explained by decreases in quantity, with prices relatively unchanged. These results are consistent with recent studies on the trade-protection movement under the Trump administration using US import and consumer price data (i.e., Amiti et al., 2019; Cavallo et al., 2021; Fajgelbaum et al., 2020). These studies find that the tariffs on Chinese exports are completely passed through to US consumers, with import prices almost unchanged. Although our study differs from those studies in terms of data (i.e., Chinese export data vs. US import and consumer price data) and perspective (i.e., exporting behavior vs. importing and consumption behavior), the consistent conclusions of the two lines of research lend support to our identification.

Third, we investigate trade-diversion effects. We find that while US tariffs significantly reduced Chinese exports to the US, they barely affected Chinese total exports to the world. To further understand how China diverts its exports from the US to other countries, we correlate the diversion magnitude to features across countries and industries. We find that in response to the trade war, China is more likely to divert its exports to countries that are closer and have larger economies. Meanwhile, the export of products in R&D-intensive, skilled-labor-intensive, high-capital-income-share, and upstream industries have been diverted even more.

Fourth, to understand the distributional effects of trade protection, we study the heterogeneity of treatment effects with respect to some industry features, including input-factor intensity, comparative advantage, elasticity of substitution, exporting experience, and so on. Specifically, we find that exports are more sensitive to trade protection in labor-intensive industries than in capital-intensive ones, more sensitive in unskilled-labor-intensive industries than in skilled-labor-intensive ones, and more sensitive in R&D-scarce industries than in R&D-intensive ones. Because China has comparative advantages in labor-intensive industries, unskilled-labor-intensive industries, and R&D-scarce industries, these results consistently suggest that a country's comparative-advantage industries are more responsive to trade protection, and the same conclusions are obtained from the perspective of industry's revealed comparative advantage (RCA) index. Further, exports of products in industries with high export growth, large initial export value, and high elasticity of substitution decrease more in response to trade protection.

This paper mainly contributes to the recent literature that analyzes the impacts of the 2018 trade war. For instance, Amiti et al. (2019), Cavallo et al. (2021), and Fajgelbaum et al. (2020) have investigated the effects of the trade war on the US economy. However, we still know little about the effect of the trade war on the economy of China, which is the largest developing country in the world. Our research on export responses complements this strand of the literature.

Our study is related to the literature on trade elasticities, which are of central importance in the quantitative analysis of trade models. However, considerable disagreement exists about the magnitude of trade elasticities. Specifically, studies that rely on cross-sectional variation (often considered microanalysis) yield high values for trade elasticity of around 5 or higher (e.g., Head and Ries, 2001; Eaton and Kortum, 2002; Romalis, 2007; Caliendo and Parro, 2015).[1] Meanwhile, studies that exploit time-series variation in trade costs (often considered macroanalysis) are often seen as capturing short-run adjustments to trade costs and yield low estimates for trade elasticity of approximately 1 or less (e.g., Bergstrand, 1989; Shiells and Reinert, 1993;

[1] An exception to the common finding of high long-run trade elasticities is the estimates for the Mozambique-South Africa trade agreement by Sequeira (2016), who finds a virtually zero elasticity of trade flows to tariffs. This finding suggests that incumbent firms located in the main trade corridor under analysis do not appear to significantly adjust their import behavior in response to sizable tariff changes in the context of pervasive corruption.

Table 1
Timeline of the trade war between China and the US.

Round	Country	Trade value ($ billion)	Variety (HS8)	Tariff added	Announce date	Effective date
Prelude	US	–	–	10%; 25%	2018-03-08	2018-03-23
	China	3.3	128	10%; 25%	2018-04-01	2018-04-02
First round	US	34	818	25%	2018-06-15	2018-07-06
	China	34	545	25%	2018-06-16	2018-07-06
	US	16	279	25%	2018-06-15	2018-08-23
	China	16	333	25%	2018-08-08	2018-08-23
Second round	US	200	5733	10%	2018-07-10	2018-09-24
	China	60	5207	5%–10%	2018-08-03	2018-09-24
	US	200	5733	25%	2018-07-10	2019-05-10
	China	60	5140	5%–25%	2019-05-13	2019-06-01
Third round	US	300	3805	15%	2019-08-15	I:2019-09-01 II:2019-12-15
	China	75	5078	5%–10%	2019-08-23	I:2019-09-01 II:2019-12-15

Sources: United States Trade Representative (USTR); Ministry of Finance of the People's Republic of China.

Hillberry and Hummels, 2013; Goldberg and Pavcnik, 2016). The literature often attributes these discrepancies to attenuation bias due to measurement error and the endogeneity of trade costs (Bagwell and Staiger, 2016). Most estimates based on gravity models do not attempt to address the reverse causality of tariffs with respect to trade flows (Boehm et al., 2020). We exploit the quasi-experimental variation in import tariffs induced by the trade war between China and the US in mid-2018 to estimate short-run trade elasticity, which is especially crucial for the quantitative analysis of structural gravity models of international trade.

The rest of the paper is organized as follows. Section 2 discusses the policy's background, data, and estimation strategy. Section 3 presents the empirical findings, including the effects on exports to the US, trade-diversion effects, and the heterogeneity of responses across industries. Section 4 concludes.

2. Background, data, and estimation strategy

2.1. The US-China trade war

In 2018, the Trump administration launched several waves of tariff increases on specific products imported from China. The backdrop of this movement was an increase in the trade deficit with China in recent years. For example, the trade deficit in the US reached $891.3 billion in 2018, the highest on record. Overall, the trade deficit with China represented 47.03% of the total deficit. In response, China imposed retaliatory tariffs on US exports to China. Table 1 provides a timeline of the trade war between China and the US.

2.1.1. The prelude

The trade war between China and the US began with the investigation of steel and aluminum imports under Section 232 of the Trade Expansion Act of 1962. The US Commerce Department completed this investigation in February 2018 and concluded that imports of steel and aluminum could pose a threat to US national security. The department recommended that tariffs or quotas be imposed to limit imports of steel and aluminum products. President Trump then signed a proclamation on March 8, 2018, whereby imported steel and aluminum products would be taxed starting on March 23 at respective rates of 25% and 10%. On April 2, 2018, China began to suspend tariff concessions on 128 imported products worth $3.3 billion from the US, including fruit and pork. At that point, trade tensions between China and the US became increasingly high.

2.1.2. The first round

On June 15, 2018, the office of the US Trade Representative (USTR) released a list of products imported from China with an annual trade value of approximately $50 billion. The list consisted of two sets of US tariff lines. The first contained 818 lines and covered approximately $34 billion in imports from China. On July 6, 2018, the USTR began to impose an additional duty of 25% on these 818 product lines. The second set contained 279 lines identified by the Section 301 Committee as benefiting from Chinese industrial policies, including the “Made in China 2025” industrial policy. These 279 lines applied to approximately $16 billion in imports from China and were subject to 25% additional tariffs starting on August 23, 2018.

In response, on June 16, 2018, the Tariff Commission of China released a list of $34 billion in products imported from the US and imposed a 25% additional import tariff starting on July 6, 2018. On August 8, 2018, the Commission released a list of another $16 billion in imports from the US, with an additional import tariff of 25% imposed starting on August 23, 2018.

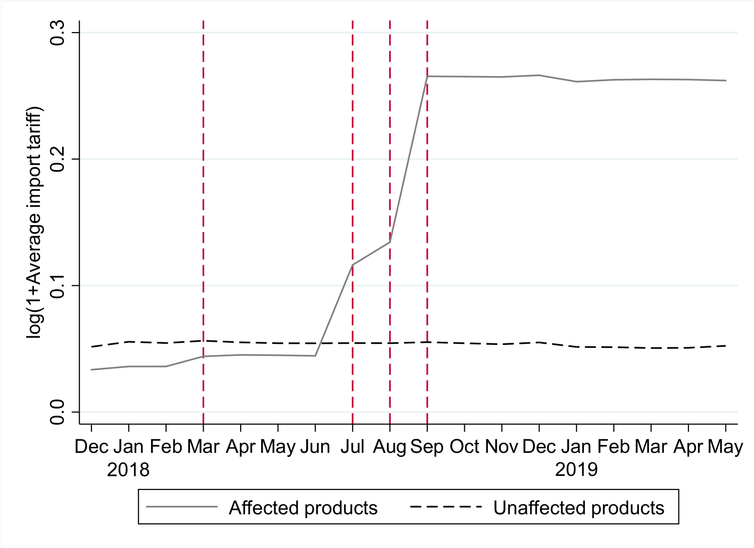


Fig. 1. Average US tariff rate on Chinese products.
Notes: This figure shows unweighted average US import tariffs on products imported from China during the period December 2017 to May 2019.

2.1.3. The second round

An additional ad valorem duty of 10% was imposed on additional products imported from China with an annual trade value of approximately $200 billion. The USTR released the product list on July 10, 2018, which took effect on September 24, 2018. The additional duty was increased to 25% on May 10, 2019. In response, the Tariff Commission of China imposed an additional import duty of 5%–10% on another list of $60 billion in imports from the US starting on September 24, 2018, which was further increased to 5%–25% on June 1, 2019.

2.1.4. The third round

The US took further action on additional products from China with an annual trade value of approximately $300 billion. The product list was released on August 15, 2019. The first tranche, with an additional 15% tariff on $125 billion in Chinese products, became effective on September 1, 2019, followed by a second tranche of 15% tariffs on another $175 billion in Chinese products on December 15, 2019. China retaliated by levying additional 5%–10% tariffs on US exports of $75 billion. The product list was released on August 23, 2019, and the effective dates were the same as those of the two tranches in the US. However, a trade agreement was reached between the two countries on December 13, 2019, which annulled the additional tariffs for the second tranche.

Fig. 1 plots the US average tariff rates on Chinese products during the period December 2017 to May 2019 separately for war-affected products and war-unaffected ones. For war-affected products, average tariff rates increased remarkably after the trade-war shock. The first tariff increase occurred in March 2018, due to taxes on steel and aluminum products. The first round of the trade war included two time points in 2018: July and August. Tariff rates increased even further in the second round in September 2018. Tariffs on war-unaffected products remained constant during the entire period. We explore this differential behavior across products to identify the effects of trade protection.

2.2. Data and variables

The main dataset used in this study is Chinese customs data from January 2017 to May 2019 obtained from the General Administration of Customs of China. This dataset covers the monthly import and export transactions of every Chinese exporter and importer, including trade value, trade quantity, identification of exporter or importer, and exporting destination country or importing source country. Product information, which is classified at the Chinese HS 8-digit level, is also included. Because firm ID codes have not been reported in the dataset since 2017, we aggregate total exports and export quantity from the firm level to the product level. The average price (i.e., unit value) for a product is constructed as the ratio of total exports to quantity (following, e.g., Amiti et al., 2019; Fajgelbaum et al., 2020).

Our study investigates the effects of the first and second rounds of the trade war between China and the US during our sample period.[2] To identify Chinese products targeted by the US, we first collect the lists of products subject to additional tariffs from the official website of the USTR; the data include information on tariff lines at the US HS 8-digit level, tariff rates, announcement

[2] The third round was announced in August 2019 and the two tranches of this round put into effect in September and December 2019, respectively. Because we only have trade data until May 2019, it is unable to study the third-round effects.

dates, and effective dates. Meanwhile, exclusions were announced periodically through Federal Register notices. We collect the lists of products exempted from tariffs and exclude them in the following analysis.

We also download pre-war annual statutory import tariff data for the US from the US International Trade Commission (USITC). By combining these data with the additional tariffs, we can construct the US statutory tariff rates for each tariff line on Chinese exports at the US HS 8-digit level. Specifically, tariffs are levied in three ways: ad valorem tariffs levied by value, specific tariffs levied by quantity, or both (compound tariffs). Many tariffs are in the form of specific taxes and must be converted to ad valorem equivalents using price information, which are then matched to tariffs (Anderson and Van Wincoop, 2004). The additional import tariffs imposed during the US-China trade war are entirely ad valorem based on the duty-inclusive price. For products previously subject only to ad valorem tariffs, the tariff rate is calculated as

$$1+\tau_i^{statutory}=\left(1+\tau_i^{pre-ad}\right)\left(1+\tau_i^{added}\right),$$

where τ_i^{pre-ad} is the pre-war ad valorem tariff of product i and τ_i^{added} is the additional tariff charged due to the trade war. For products previously subject only to specific tariffs, the tariff rate is

$$1+\tau_i^{statutory}=\left(1+\tau_i^{added}\right)+\left(\tau_i^{pre-sp}+\tau_i^{pre-sp}\tau_i^{added}\right)/p_i^{pre},$$

where τ_i^{pre-sp} is the pre-war specific tariff and p_i^{pre} is the pre-war export price. For products previously subject to compound tariffs, the tariff rate is

$$1+\tau_i^{statutory}=\left(1+\tau_i^{pre-ad}\right)\left(1+\tau_i^{added}\right)+\left(\tau_i^{pre-sp}+\tau_i^{pre-sp}\tau_i^{added}\right)/p_i^{pre}.$$

In the benchmark analysis, we include all products—that is, those subject to ad valorem tariffs, specific tariffs, and compound tariffs. However, constructing ad valorem equivalents of specific and compound tariffs is subject to noise, and such measurement error could bias our estimates downward. To alleviate this concern, in a robustness check we exclude products subject to specific or compound tariffs and focus on products subject to ad valorem tariffs. To control for Chinese retaliatory tariffs in our estimation, we collect the lists of affected products released by the Ministry of Finance of China. We also use the applied import tariffs of the US on Chinese products at HS 8-digit products sourced from Fajgelbaum et al. (2020) as a robustness check.

Another complication is that HS 8-digit product classifications are defined in different ways across countries. Hence, we use a concordance table to match our trade information from Chinese customs data (defined by the Chinese HS 8-digit code) with the additional tariffs imposed by the US (defined by the US HS 8-digit code). To do so, we first link the two HS classification systems at the HS 6-digit level, which is uniform around the world. We then manually match the US and Chinese HS 8-digit codes within the same HS 6-digit product code based on product descriptions. For the 6842 war-affected products, we precisely match 6350 products between the two classification systems, with a success rate of 92.81%. For the war-unaffected products, we match 3813 of 4516 products, with a success rate of 84.43%.[3]

To analyze the effect of trade protection on industrial production, we need to construct a concordance to match Chinese industry codes (CIC) with product codes from the HS system. The correspondence table for the manufacturing industries has been provided by Brandt et al. (2017), which uses the 2002 version of the HS 6-digit product classification. We then use the correspondence table for the HS 6-digit codes between 2002 and 2017 provided by UN Trade Statistics to match the CIC 4-digit industries with the HS 6-digit products in 2017. Non-manufacturing sectors (e.g., agriculture) and unmatched manufacturing sectors in Brandt et al. (2017) are manually matched based on the description of the CIC industry and HS product.

2.3. Estimation strategy

To identify the effects of trade protection on exporting behavior, we explore the trade-war episodes to conduct a DD analysis. Specifically, we compare the trajectories of Chinese exports facing additional tariffs imposed by the Trump administration in mid-2018 with the trajectories of those without additional tariffs before and after the imposition of additional tariffs. The DD regression specification is

$$\ln y_{it}=\beta Treatment_i\times Post_{it}+\lambda_i+\lambda_t+\mathbf{X}_{it}^{'}\gamma+\varepsilon_{it},\tag{1}$$

where $\ln y_{it}$ measures the outcome of interest (e.g., total exports, export quantity, or export price) for HS 8-digit product i in time (year-month) t; $treatment_i$ denotes whether product i was subject to additional tariffs imposed by the US; and $Post_{it}$ indicates the post-war period. Standard errors are clustered at the product level to address potential heteroskedasticity and serial correlation.

[3] One could be concerned about sample attrition—that is, the different success rates of matching for war-affected and war-unaffected products in response to the trade war. However, we conducted the matching in the post-war period and used the same procedure. Hence, the factors that cause the differential matching rates are constant throughout our sample period and are accounted for by product fixed effects in the regressions.

To isolate the effect of trade protection, we include HS 8-digit product fixed effects λ_i, which captures all time-invariant product heterogeneity such as product characteristics and matching success. Time fixed effects λ_t are included to capture monthly shocks common to all products, such as exchange-rate fluctuations and macro policies. We also include a vector of time-varying controls $\mathbf{X}_{it}$, which include Chinese retaliatory tariffs; HS 6-digit product-specific seasonalities (i.e., $\lambda_i^{HS6} \times \mathbf{Month}_t$, where $\mathbf{Month}_t$ are dummies for {*January*, *February*, …, *December*}; and $\lambda_i^{HS6} \times \mathbf{Festival}_t$, where $\mathbf{Festival}_t$ indicates the Chinese Spring Festival). Furthermore, we add the HS 6-digit product-specific linear trend to control for any time differences across HS 6-digit products in a linear fashion; that is, $\lambda_i^{HS6} \times t$.

The identifying assumption of our DD estimation requires that treated products follow trends similar to the control products in the absence of a trade war. The unexpected move by the Trump administration to charge additional tariffs on Chinese exports presents a plausibly exogenous shock to Chinese exports; in particular, to the timing and selection of targeted products (Fajgelbaum et al., 2020). Nonetheless, we perform a standard verification test to corroborate the identifying assumption—that is, the parallel trends between treated and control groups during the pre-treatment period. Specifically, we implement an event-study analysis using an 8-month window before and after the event,

$$\ln y_{it} = \sum_{j=-8}^{8} \beta_j Treatment_i \times I\left[Post_{it} = j\right] + \lambda_i + \lambda_t + \mathbf{X}_{it}^{'}\gamma + \varepsilon_{it}, \tag{2}$$

where $I[Post_{it} = j]$ indicates that the event occurred in month j and the omitted time category is the ninth month before the event.

One concern with eq. (1) is that trade may not respond immediately after the tariff change and result in downward bias. To address this concern, we use an alternative specification—the regression of $\ln y_{it}$ on $\ln(1 + tariff_{it})$ with the same controls in Specification (1):

$$\ln y_{it} = \beta^e \ln\left(1 + tariff_{it}\right) + \lambda_i + \lambda_t + \mathbf{X}_{it}^{'}\gamma + \varepsilon_{it}, \tag{3}$$

where $tariff_{it}$ includes two kinds of tariffs: statutory and applied tariffs. This specification also allows us to identify the elasticity β^e of exports with respect to trade protectionism. To further alleviate the concern that $\ln(1 + tariff_{it})$ may be endogenous, we use the interaction term, $Treatment_i \times Post_{it}$, as the instrumental variable for $\ln(1 + tariff_{it})$. Specifically, the first stage is

$$\ln\left(1 + tariff_{it}\right) = \alpha Treatment_i \times Post_{it} + \lambda_i + \lambda_t + \mathbf{X}_{it}^{'}\gamma + \varepsilon_{it}. \tag{4}$$

3. Empirical findings

3.1. Exports to the US

We start with the analysis of how Chinese exports to the US respond to the additional tariffs imposed by the US. Fig. 2 shows the estimated coefficients of total exports (in logarithm) from the event-study analysis (2), along with 95% confidence intervals. Before the imposition of additional tariffs, we see a fairly flat trend of exports between war-affected products and war-unaffected ones. This trend suggests that control products provide a good counterfactual for treated products in our focal period. Meanwhile, in the post-treatment period, the differences in exports between treated and control products fluctuate in the first 3 months and then begin a substantial drop that flattens after 6 months. These results suggest that the imposition of additional tariffs significantly reduced Chinese exports to the US. Meanwhile, the delayed response is consistent with the fact that US manufacturers and retailers may need time to search for alternative suppliers and that some contracts may be locked in for several months.

Estimation results of the DD eq. (1) are reported in column (1) of Table 2. We find a statistically significant and negative estimated coefficient, which confirms the pattern in Fig. 2. Regarding magnitude, the launch of the trade war against Chinese exports by the US on average reduces Chinese total exports to the US by 16.47%.

To gauge the elasticity of exports to tariffs, we report the estimated coefficient of statutory tariffs from regression (3) in column (1) of Table A1 in the Appendix. The coefficient is statistically significant, with a magnitude of −0.6648. This result indicates that when statutory tariff $1 + \tau$ increases by 1%, total exports drop by 0.6648% on average. The IV estimate reported in column (4) shows a similar pattern; that is, with a coefficient of −0.6930. In Table A2 in the Appendix, we experiment with applied tariffs to estimate the trade elasticity. As shown in column (1), we obtain a statistically significant coefficient of −0.5417. However, although the IV estimate reported in column (4) is also negative and statistically significant, the magnitude jumps to −1.9909, whose absolute value is larger than the values of the ordinary least squares (OLS) and IV estimates using statutory tariffs and the OLS estimate using applied tariffs. The difference pattern between OLS and IV estimates resembles those documented by Fajgelbaum et al. (2020). Specifically, using statutory tariffs as the regressor of interest in the OLS estimation, they find a coefficient of -1.52. When they use the statutory tariffs as an instrument for applied tariffs, the IV estimate becomes −2.50. The heterogeneity treatment framework (discussed by Imbens and Angrist, 1994; Angrist and Imbens, 1995; and Heckman and

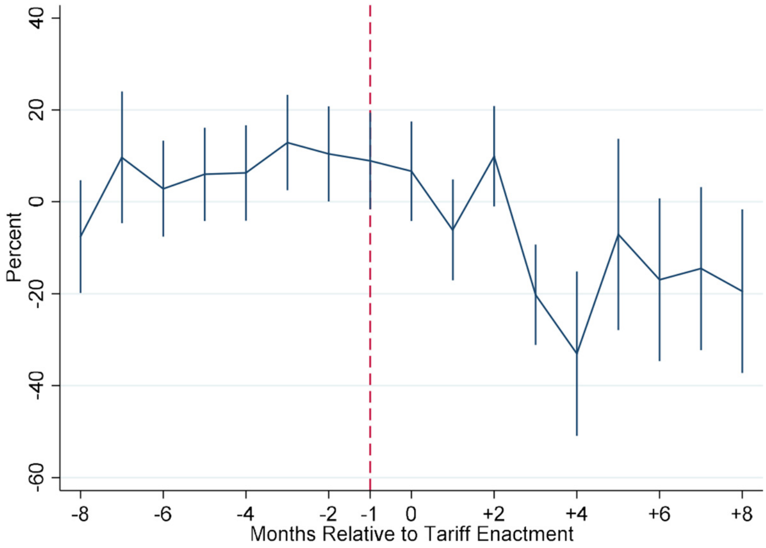


Fig. 2. Event-study estimates for export value (in logarithm) to the US.
Notes: This figure plots event-time dummies for affected products relative to unaffected products. Error bars show 95% confidence intervals. Regressions include HS-6-digit-product month fixed effect, HS-6-digit-product Spring Festival fixed effect, time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, time fixed effect, and Chinese retaliatory tariffs. We delete the unmatched HS-8-digit products between Chinese and US classifications whose tariffs are missing. Event periods before −9 are dropped, and event periods ≥ 8 are binned.

Table 2
Exporting behavior to the US.

	(1) ln*export*	(2) ln*quantity*	(3) ln*price*
$Treatment_i \times Post_{it}$	-0.1647^{***}	-0.1599^{***}	−0.0047
	(0.0338)	(0.0354)	(0.0247)
Chinese retaliatory tariffs	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y
Time FE	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y
Observations	105,335	105,335	105,335
adj. R^2	0.8893	0.9203	0.9255

Notes: (1) In columns (1) to (3), dependent variables are the logarithm of export volume (ln*export*), the logarithm of export quantity (ln*quantity*), and the logarithm of the average export price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism is an interaction between the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Vytlacil, 2005) helps us understand the difference between the OLS and IV estimators.[4] Specifically, with heterogeneity in treatment effects, the OLS estimator captures the (weighted) average treatment effect on the treated, whereas the IV estimator represents the (weighted) average treatment effect on compliers (i.e., products whose tariffs were raised due to the US-China trade war in our setting). With statutory tariffs, all of the war-affected products increased their tariffs according to the formula in Section 2.2. In other words, all products are compliers in the IV estimation, and hence both OLS and IV estimators with statutory tariffs represent the average treatment effect on the treated. We find similar estimates of OLS and IV associated with statutory

[4] An alternative explanation is that outliers are driving the different estimates from OLS and IV regressions using statutory and applied tariffs. To examine this possibility, we first plot the scatter between statutory tariffs and applied tariffs to observe outliers. Fig. A1 shows that some extreme values do exist for these two kinds of tariffs. We then exclude the top 1% of statutory and applied tariffs and rerun the OLS and IV regressions for the statutory and applied tariffs. Estimation results are reported in Table A3 in the Appendix. We find no significant changes in the overall patterns: (1) the OLS and IV estimates using statutory tariffs are close; (2) the OLS estimates using statutory and applied tariffs become more similar; and (3) the IV estimate using applied tariffs is still significantly larger than other estimates. These results imply that outliers may not be the main driver for the different estimates.

tariffs—namely, −0.6648 versus −0.6930.[5] However, regarding applied tariffs, about 27% of the war-affected products did not increase their tariffs. Hence, the IV estimator of the applied tariffs captures the average treatment effect for the remaining 73% of compliant products (including partial and full compliance).[6] The larger effect of the IV estimate (than the corresponding OLS estimate) associated with the applied tariffs indeed suggests that the US increased tariffs on products that Chinese exporters were most sensitive to.

3.1.1. Comparison with the literature

To shed light on the significance of the trade-protection effect, we compare our estimated trade elasticity to the elasticities reported in the literature. Notably, our research studies the short-term effects of trade protection, whereas the literature mostly focuses on the mixed timing effects of trade liberalization (for reviews on prior trade-elasticity estimates, see Anderson and Van Wincoop, 2004 and Head and Mayer, 2014). Two recent papers also study the effects of the trade-protection movement launched by the Trump administration, using US imports data. Specifically, both Amiti et al. (2019) and Fajgelbaum et al. (2020) find negative and significant effects of trade protection on import value and import quantity but no effect on import price. The consistent pattern and magnitude using data from both sides of the trade war further confirm the damaging effects of trade protection.

However, in terms of the magnitude, Fajgelbaum et al. (2020)'s OLS estimate with statutory tariffs implies a trade elasticity of 1.52, which is larger than the corresponding value in our study (0.66). The departure of our study from Fajgelbaum et al. (2020)'s lies in two dimensions. The first is the estimation specification. Our identification comes from the comparison of war-affected with war-unaffected products by Chinese exporters to the US before and after the imposition of additional tariffs, whereas Fajgelbaum et al. (2020) use a triple difference by comparing US imports from China with imports from other countries, war-affected with war-unaffected imported products, and before and after the imposition of additional tariffs. The second difference concerns the data. We use export information documented by the China Customs office, whereas Fajgelbaum et al. (2020) use import data collected by the US Customs office. Discrepancies in the trade data reported by US importers and Chinese exporters have long been documented in the literature (e.g., Feenstra et al., 1999; Ferrantino and Zhi, 2008) and are due to reasons such as re-exporting through Hong Kong and the timing of data collection (caused by the shipping time). We conduct an analysis to formally examine how much these two dimensional differences account for the different estimates found by us and by Fajgelbaum et al. (2020). Specifically, we obtain the data used by Fajgelbaum et al. (2020) and use our DD specification to run a regression. Estimated coefficients are reported in Table A4 in the Appendix. Consistently, we find that the increase in statutory tariffs reduces US imports, with a trade elasticity of 0.9302. These results suggest that for the 0.86 (=1.52 − 0.66) difference in the magnitude of trade elasticity between ours and Fajgelbaum et al. (2020)'s, about 31% (=(0.93 − 0.66)/0.86) is due to data discrepancies and the remaining 69% to the specification difference.

Two papers in the literature explicitly differentiate between the short-term and long-term effects of trade liberalization. Specifically, using micro data from Ireland, Fitzgerald and Haller (2018) find that the elasticity of aggregate exports with respect to tariff changes within 5 years is between 1.5 and 3.5, and that the elasticity beyond 6 years is between 2 and 5. Using a global database, Boehm et al. (2020) find that the trade elasticity associated with applied MFN tariffs from the IV estimate is approximately 0.7 in 1 year and 1.57–2 in the long run (i.e., after approximately 7–10 years). Our study uses monthly data from January 2017 to May 2019, with the first and second trade shocks in mid-2018. In a comparable caliber, our IV estimate of trade elasticity associated with applied tariffs is −1.99 within a year, which is clearly higher than theirs. These results suggest that trade liberalization and trade protection have different short-term effects on exports.[7]

3.1.2. Decomposition of the exports effect

To shed further light on export responses to trade protectionism, we decompose the effect on export value into two components: the quantity effect and the price effect. Specifically, we report the event-study graphs in Fig. 3a and Fig. 3b, with the former for the export quantity and the latter for the export price. In both figures, we find parallel trends between treated and control products in the pre-treatment period, which lends support to our identification strategy. In the post-treatment period, the export quantity exhibits a pattern similar to that of total exports; that is, a significant decrease occurs after 3 months, which becomes flat in 6 months. However, for the export price, the differences between treated and control products remain fairly flat in the post-treatment period. Regression results from DD eq. (1) are reported in columns (2) and (3) of Table 2 for export quantity and export price, respectively. We find consistent patterns, as shown in Fig. 3a and Fig. 3b; that is, the coefficient on export quantity is statistically and economically significant and that on export price is small and statistically insignificant. Taken together, these results suggest that the drop in Chinese exports to the US caused by the additional tariffs is mostly explained by the decrease in quantity, with prices relatively unchanged.

Our findings are consistent with recent studies on the trade-protection movement using US import data (i.e., Amiti et al., 2019; Cavallo et al., 2021; Fajgelbaum et al., 2020). Their results show that the additional US tariffs on Chinese exports are completely passed through to US consumers, since import prices are almost unchanged. In spite of the differences between our study and

[5] The slight difference between the OLS and IV estimates of the statutory tariffs comes from the different weight used in the average treatment effect on the treated. Specifically, the OLS regression uses the treatment variance as the weight (Angrist and Pischke, 2009), whereas the IV regression uses the IV treatment covariance as the weight.

[6] The difference in the OLS estimates between the statutory and applied tariffs is due to the treatment-variance weights associated with different tariff measures being different.

[7] Another possible reason for the different estimates documented in our paper and the literature is the heterogeneity in trade elasticities across targeted products in different studies. Also, China could have a comparative advantage in products with high trade elasticities.

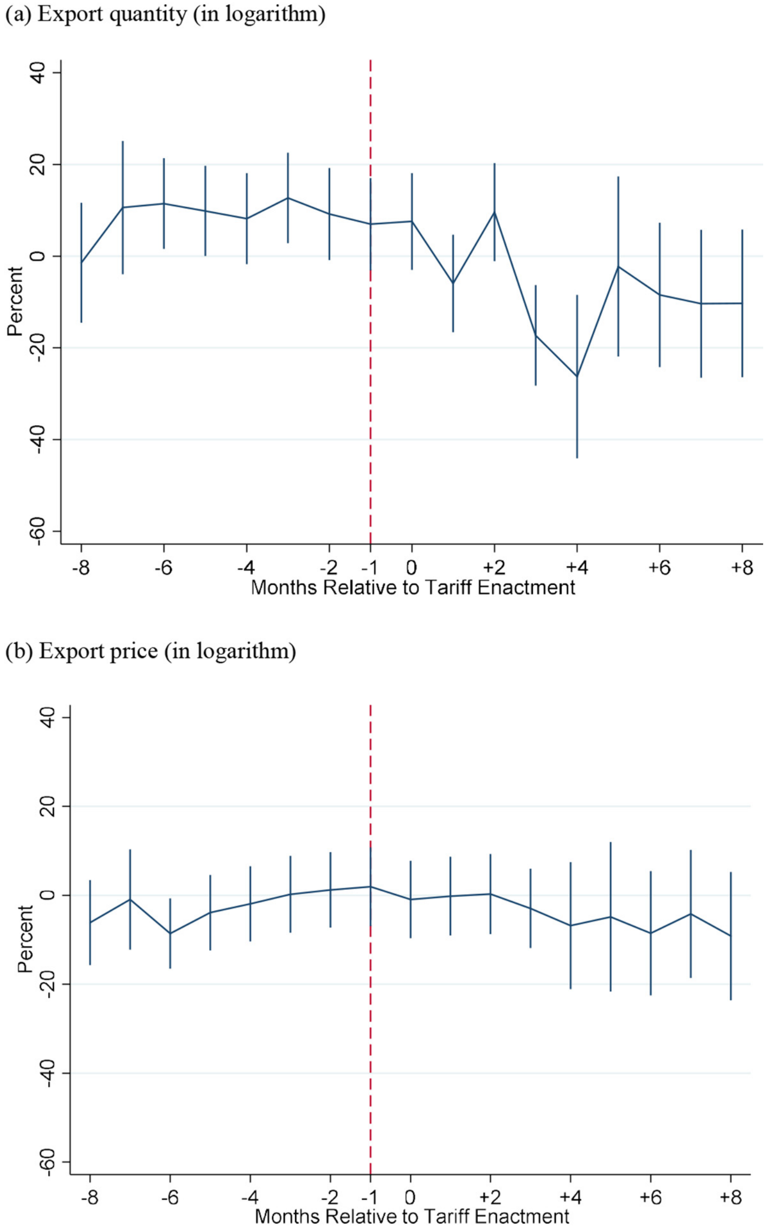


Fig. 3. Event-study estimates for export quantity and price (in logarithm) to the US.
Notes: These figures plot event-time dummies for affected products relative to unaffected products. Error bars show 95% confidence intervals. Regressions include HS-6-digit-product month fixed effect, HS-6-digit-product Spring Festival fixed effect, time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, time fixed effect, and Chinese retaliatory tariffs. We delete the unmatched HS-8-digit products between Chinese and US classifications whose tariffs are missing. Event periods before −9 are dropped, and event periods ≥ 8 are binned.

those studies in terms of data (i.e., Chinese export data vs. US import and consumer price data) and perspective (i.e., exporting behavior vs. importing and consumption behavior), the consistent conclusions support our identification.

The lack of a price response is interesting and deserves further investigation. A possible explanation is that it could be the result of a compositional change; that is, low-priced goods were driven out of the market due to the increased tariffs and high-priced goods were forced to lower their prices. To examine this potential channel, we fully exploit the customs data that contain firm-level monthly transaction data. Specifically, we depict the distributions of prices before and after the tariff increases for different periods in Fig. A2 in the Appendix. Clearly, few changes occur in the price distributions before and after tariff increases, which suggests that the price response is not mainly due to the compositional effect.

Although a significant portion of production cost in China is labor wage, the insignificant price effect could be due to the fact that wages did not change significantly during this period or were cancelled out because treated and control products were largely in the same location. To examine this potential explanation, we collect city-level wages between 2017 and 2019. In Fig. A3 in the Appendix, we divide cities into 40 bins and plot the share of treated products for each bin. The top panel is for 2017, the year before the trade war, and the bottom panel is for years 2017–2019. Although some variations exist, we find that the share of treated products is around 50%, which suggests that treated and control products in our analysis are often in the same location. We further examine whether a wage response to the trade war occurs. To this end, we aggregate product-level trade shocks to the city level using the Bartik specification. Estimation results are reported in Table A5 in the Appendix. Column (1) uses the share of treated products in each city as the regressor of interest, whereas column (2) uses the degree of the trade-war impact (the weighted average from product to city level using the city-product export share in 2017 as the weight) in each city. Both results find statistically and economically insignificant effects, which suggests that no significant wage response occurred during our sample period. Combined, these results suggest that the lack of a price response could be due to the lack of a wage effect.

3.1.3. Dynamic effects

Fig. 2 shows a dynamic pattern regarding the export response to the policy shock. Thus, estimating the dynamic pattern of trade elasticity is interesting. Specifically, as shown by the recent literature on DD estimation (e.g., Callaway and Sant'Anna 2021; Sun and Abraham, 2021), the DD estimator in eq. (1) represents the weighted average treatment effect across treated products and across time. To estimate trade elasticity over time, we proceed in the following steps. First, we estimate a dynamic-effect version similar to the event-study specification (2) but using the entire pre-treatment period as the benchmark time category. We estimate the dynamics of both export and tariff responses and focus on the statutory tariff, because its estimated trade elasticities from both IV and OLS estimations reflect the average treatment effect on the treated. Second, with the estimated coefficients of export and tariff responses over time, we obtain the dynamic trade elasticity using the IV estimator formula (i.e., trade elasticity is the ratio of export response over tariff response). Estimation results are reported in Table A6 in the Appendix, in which column (1) presents the dynamics of export response, column (2) presents the dynamics of tariff response, and column (3) presents the dynamics of trade elasticity. Given that tariffs were largely constantly applied over time, the dynamics of trade elasticity resemble the dynamics of export response in Fig. 2. Fluctuations occur in the first 3 months after the negative tariff shocks, then begin a substantial drop in the next 6 months, with a trade elasticity of around 0.97–1.44.

3.1.4. Robustness checks

We conduct a series of robustness checks to alleviate various concerns regarding our aforementioned estimation results. First, to check whether the inclusion of products subject to specific or compound tariffs biases our estimates due to tariff construction errors, we conduct a robustness analysis using only products subject to ad valorem tariffs and report the results in Table A7 in the Appendix. We find that the overall message remains robust to this refined samples. That is, the US-China trade war reduced Chinese exports to the US significantly, and all of the reduction came from the fall in export quantity; export prices were unchanged. Meanwhile, we find that the negative effects on total export value and export quantity become smaller, which suggests the presence of some measurement-error bias with the inclusion of products subject to specific or compound tariffs.

Second, in addition to the retaliatory tariffs, the Chinese government lowered most-favored-nation (MFN) tariffs on non-US trading partners (see Fig. A4 in the Appendix). If this action was in response to the US-China trade war (e.g., offsetting a drop in foreign demand by a drop in imported input costs), our previous estimation results could be biased. To address this concern, we collect Chinese MFN tariffs during this period and conduct two additional analyses. We start by showing whether the lowering of MFN tariffs was in response to the increased tariffs imposed by the US. Column (1) of Table A8 in the Appendix shows a negative estimated coefficient from the regression of ln(1 + CHN MFN $Tariff_{it}$) on $Treatment_i \times Post_{it}$, which suggests that products subject to US increased tariffs also witness lowered MFN import tariffs by the Chinese government. In column (2), we further show that the lower MFN tariffs lead to an increase in Chinese imports, and the increase is due to the quantity change instead of the price change (as shown in columns (3) and (4)). For the second analysis, we attempt to address the concern regarding whether the change in Chinese MFN import tariffs affects our previous estimation results. To this end, we include Chinese MFN tariffs as an additional control in the DD eq. (1). Results are reported in Table A9 in the Appendix. Although the coefficients change slightly, the overall message remains unchanged; that is, the US-China trade war significantly reduced Chinese exports to the US, and most of the effect comes from the quantity response rather than the price response.

Third, in the aforementioned analysis, we focus on trade between China and the US and use unaffected products as the control group to identify the trade-war effect. In the data, we also have Chinese exports to non-US countries, in which their tariffs on Chinese products remained unchanged. Fajgelbaum et al. (2020) exploit this dimension by using affected products from countries other than China as the control group. As a further robustness check, we also include country variations to conduct a triple-difference analysis; that is, the difference between war-affected and war-unaffected products, the difference between US and non-US destinations, and the difference between the pre- and post-period of the trade war. Specifically, the triple-difference estimation specification is

$$\ln y_{igt} = \beta Treatment_g \times Treatment_i \times Post_{it} + \lambda_{gi} + \lambda_{it} + \lambda_{gt} + \varepsilon_{it}, \tag{5}$$

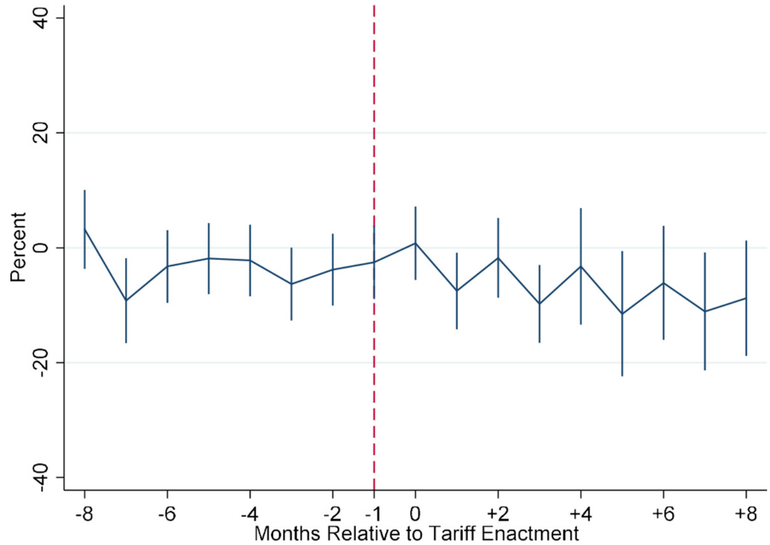


Fig. 4. Event-study estimates for export value (in logarithm) to the whole world.
Notes: This figure plots event-time dummies for affected products relative to unaffected products. Error bars show 95% confidence intervals. Regressions include HS-6-digit-product month fixed effect, HS-6-digit-product Spring Festival fixed effect, time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, time fixed effect, and Chinese retaliatory tariffs. We delete the unmatched HS-8-digit products between Chinese and US classifications whose tariffs are missing. Event periods before −9 are dropped, and event periods ≥ 8 are binned.

Table 3
Exporting behavior to the whole world.

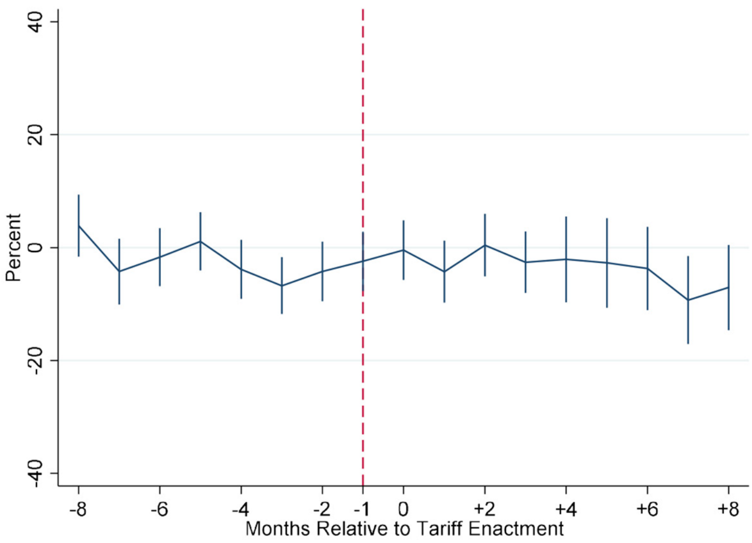
	(1) ln*export*	(2) ln*quantity*	(3) ln*price*
$Treatment_i * Post_{it}$	−0.0195	−0.0084	−0.0111
	(0.0189)	(0.0205)	(0.0141)
Chinese retaliatory tariffs	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y
Time FE	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y
Observations	161,255	161,255	161,255
adj. R^2	0.9312	0.9610	0.9695

Notes: (1) In columns (1) to (3), dependent variables are the logarithm of export volume (ln*export*), the logarithm of export quantity (ln*quantity*), and the logarithm of the average export price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS 6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

where $\ln y_{igt}$ measures the outcome of interest (e.g., total exports, export quantity, or export price) for HS 8-digit product i to country g in time (year-month) t; $Treatment_g$ equals 1 if country g is the US, and 0 otherwise; $Treatment_i$ denotes whether product i was subject to additional tariffs imposed by the US; and $Post_{it}$ indicates the post-war period of product i. The inclusion of two-way fixed effects λ_{gi}, λ_{it}, λ_{gt} allows us to flexibly control for all potential omitted variables at country-product level, product-month level, and country-month level. Standard errors are clustered at country-product level to address potential heteroskedasticity and serial correlation. Estimation results are reported in Table A10 in the Appendix. Clearly, we find negative and significant estimated coefficients for export value and export quantity and almost zero effect for export price, which is consistent with the results in Table 2.

Fourth, to further address potential bias from product-level omitted variables, we include the interactions between HS 6-digit product fixed effects and time fixed effects in the benchmark eq. (1). Estimation results are reported in Table A11 in the Appendix. Despite the reduction in magnitude, we continue to find negative and significant estimated coefficients for export value and export quantity, but not for export price. These results further confirm that our findings are not biased due to any aggregate product-level shocks.

(a) Export quantity (in logarithm)



(b) Export price (in logarithm)

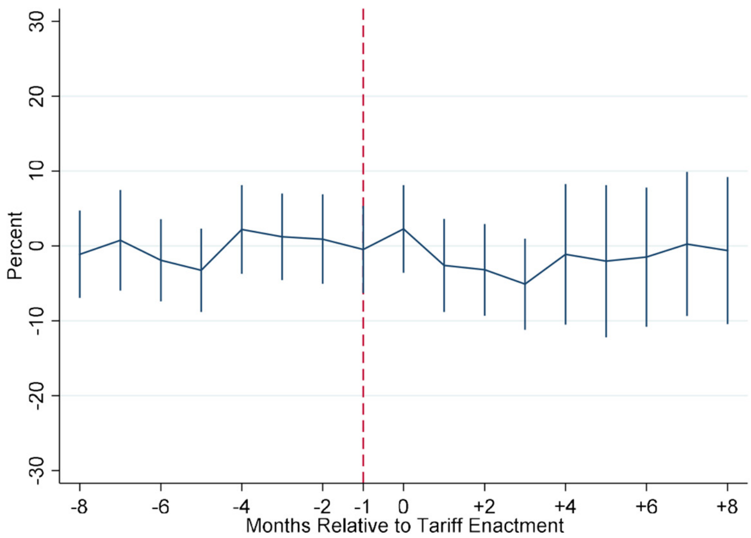
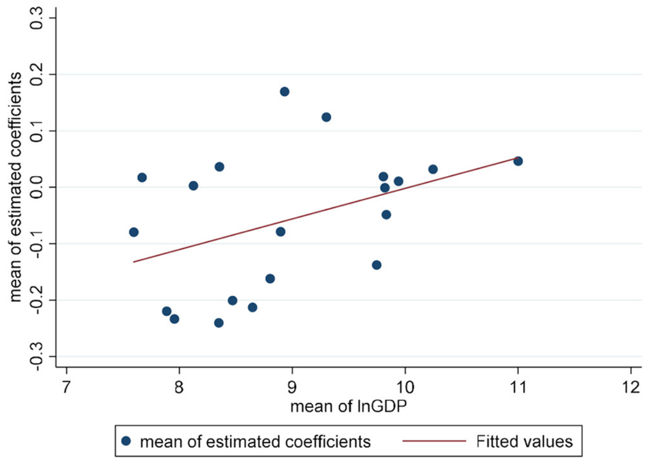


Fig. 5. Event-study estimates for export quantity and price (in logarithm) to the world.
Notes: These figures plot event-time dummies for affected products relative to unaffected products. Error bars show 95% confidence intervals. Regressions include HS-6-digit-product month fixed effect, HS-6-digit-product Spring Festival fixed effect, time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, time fixed effect, and Chinese retaliatory tariffs. We delete the unmatched HS-8-digit products between Chinese and US classifications whose tariffs are missing. Event periods before −9 are dropped, and event periods ≥ 8 are binned.

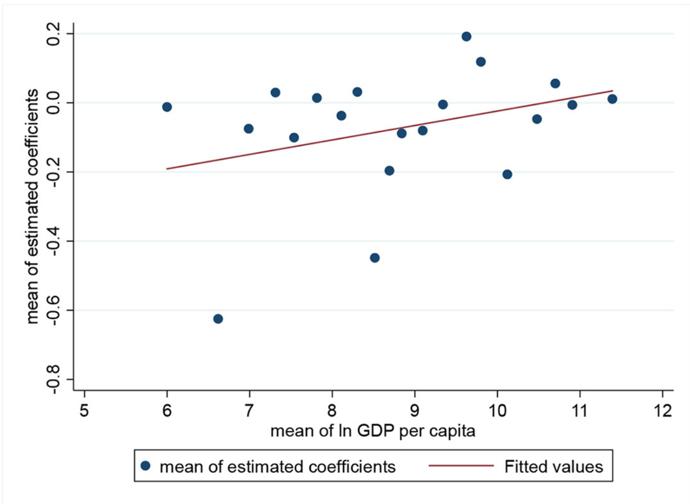
3.2. Trade diversion to other countries

Trade protection in the US may cause Chinese exporters to divert their goods to other countries. To investigate potential trade diversion, we first examine how Chinese exports to the whole world respond to the additional tariffs imposed by the Trump administration. Fig. 4 shows estimates from the event-study analysis (2), along with 95% confidence intervals. We find that the differences in total exports to the world between war-affected and war-unaffected products are relatively flat up to 8 months before the launch of additional tariffs, which lends support to our DD identifying assumption. Meanwhile, the differences remain flat up to 8 months after the imposition of additional tariffs. Regression results using the DD eq. (1) are reported in column (1) of Table 3. We find a small and statistically insignificant estimated coefficient, which further confirms the pattern in Fig. 4. These results suggest that whereas US tariffs significantly reduce Chinese exports to the US, they have little effect on Chinese total exports to the world as a whole.

(a) Country's economic size (ln *GDP*)



(b) Country's economic development (ln *GDP per capita*)



(c) Country's distance from China (ln*distance*)

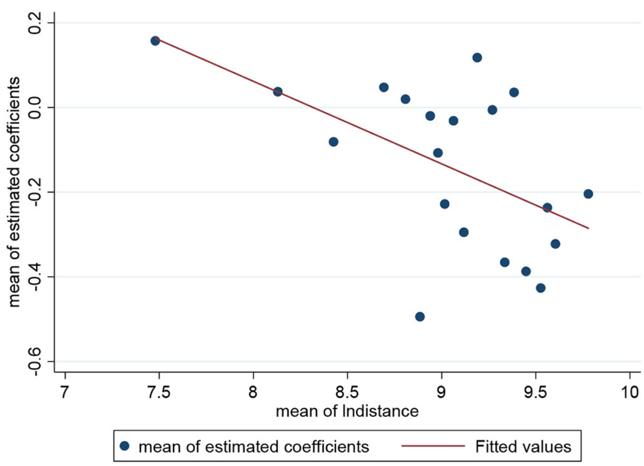


Fig. 6. Trade diversion across countries.
Notes: We implement DD eq. (1) separately for each country to obtain the magnitude of the country-specific estimated coefficients. We divide countries into 20 bins based on the economic size (ln*GDP*), economic development (ln *GDP* per capita), and distance from China (ln*distance*) of each country and calculate the mean of relative country indicators and the mean of the magnitude of the estimated coefficients for each bin. Then, we plot the correlation between the mean of estimated coefficients and the mean of relative country indicators for these 20 bins.

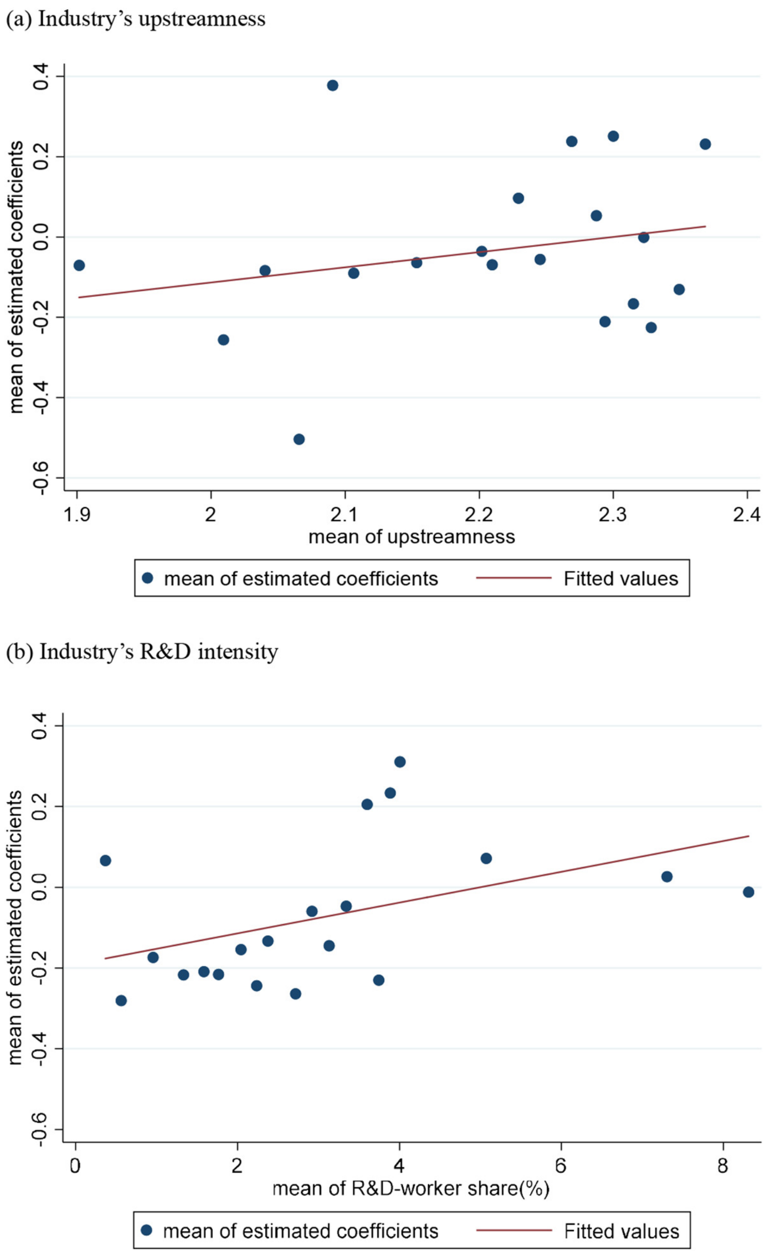
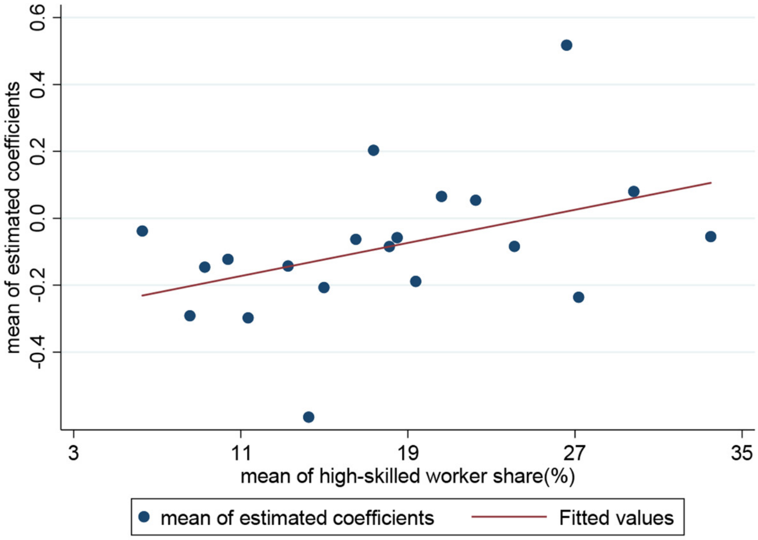


Fig. 7. Trade diversion across industries.
Notes: We implement DD eq. (1) separately for each HS 2-digit product (industry) to obtain the magnitude of the industry-specific estimated coefficients. We divide industries into 20 bins based on industry indicators and calculate the mean of the magnitude of the estimated coefficients for each bin. Then, we plot the correlation between the mean of estimated coefficients and the mean of relative industry indicators for these 20 bins.

In Fig. 5a and Fig. 5b, we further investigate the responses of total export quantity to the world and world average export price to the US tariffs. In both figures, we find flat trends between treated and control products throughout the entire event windows, which suggests the unresponsiveness of world total export quantity and world average export price to the US tariffs. These results are further confirmed by the regression results in columns (2) and (3) of Table 3. Specifically, the estimated coefficients of export quantity and export price are both statistically insignificant and small in magnitude.

To corroborate the story of trade diversion, we examine whether industrial production in China was affected by trade protection in the US. However, the requirement for monthly production data in China is demanding; we are only able to collect monthly data for the total number of firms, total sales, and total number of firms in a loss for 2-digit industries in China during this period from the China Stock Market & Accounting Research Database. We then perform a DD analysis at CIC 2-digit industry level. Specifically, to obtain the degree of trade-war impact at CIC 2-digit industry level, we first aggregate the shock at HS 8-digit

(c) Industry's skill intensity



(d) Industry's labor-income share

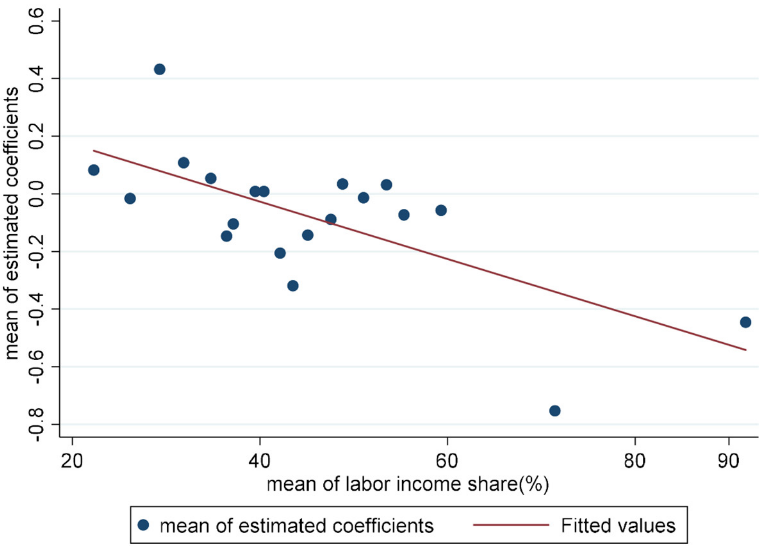


Fig. 7 (*continued*).

product level to HS 6-digit level using export share in 2017 as the weight. We then match the HS 6-digit to the CIC 2-digit industry using the concordance table from Brandt et al. (2017), and calculate the average impact degree at the industry level. Estimation results are reported in Table A12 in the Appendix. We find that sales per firm do not respond significantly to the trade protection of the US, whereas the ratio of firms in loss significantly increases. Combined with the results in Table 3, these results indicate that although the trade war did not significantly reduce sales by Chinese firms, it did cause significant economic loss for firms.

To understand how China diverts its exports from the US to other countries, we first implement DD eq. (1) separately for each country g to obtain the magnitude of the country-specific estimated coefficient. We then correlate these coefficients with country indicators to shed light on the diversion pattern—for example, country size ($\ln GDP_g$), country development degree ($\ln GDP\ per\ capita_g$), and distance from China ($\ln distance_g$). To do so, we divide the countries into 20 bins and calculate the mean of relative country indicators and the mean of estimated coefficients for each bin. Results are plotted in Fig. 6. We find positive correlations for $\ln GDP_g$ and $\ln GDP\ per\ capita_g$ and a negative correlation for $\ln distance_g$. These results suggest that in response to the trade war, China diverts its exports to larger, more developed, and closer countries.

Table 4
Industry factor intensity.

	(1) Capital intensive	(2) Labor intensive	(3) Skilled-labor intensive	(4) Unskilled-labor intensive	(5) R&D intensive	(6) R&D scarce
Panel A: total exports (ln*export*)						
$Treatment_i \times Post_{it}$	−0.0738	−0.2152***	−0.1374***	−0.2140***	−0.1188***	−0.2010***
	(0.0515)	(0.0448)	(0.0385)	(0.0439)	(0.0439)	(0.0368)
Observations	38,773	63,225	59,084	41,397	53,429	48,569
adj. R^2	0.8699	0.9060	0.8955	0.8717	0.8972	0.8764
Panel B: export quantity (ln*quantity*)						
$Treatment_i \times Post_{it}$	−0.0896	−0.1859***	−0.1025**	−0.1832***	−0.0888*	−0.1698***
	(0.0563)	(0.0457)	(0.0425)	(0.0470)	(0.0480)	(0.0397)
Observations	38,773	63,225	59,084	41,397	53,429	48,569
adj. R^2	0.9112	0.9299	0.9167	0.9195	0.9039	0.9272
Panel C: export price (ln*price*)						
$Treatment_i \times Post_{it}$	0.0159	−0.0293	−0.0350	−0.0308	−0.0300	−0.0311
	(0.0372)	(0.0342)	(0.0227)	(0.0347)	(0.0221)	(0.0302)
Observations	38,773	63,225	59,084	41,397	53,429	48,569
adj. R^2	0.9249	0.9258	0.9152	0.9261	0.9080	0.9224
Chinese retaliatory tariffs	Y	Y	Y	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y	Y	Y

Notes: (1) Dependent variables are the logarithm of export volume (ln*export*) for Panel A, logarithm of export quantity (ln*quantity*) for Panel B, and logarithm of the average export price (ln*price*) for Panel C. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS 6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Using the third-wave economic census in 2013 conducted by the National Bureau of Statistics of China, we classify products into capital-intensive and labor-intensive industries by the sample median of the industry's capital-labor intensity (ratio of total capital to total employment), skilled-labor-intensive and unskilled-labor-intensive industries by the sample median of the industry's skilled labor intensity (ratio of workers with college or above degrees), and R&D-intensive and R&D-scarce industries by the sample median of the industry's R&D intensity (ratio of R&D employment to total employment). (4) Standard errors, clustered at product level, are reported in parentheses. (5) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

To gain further understanding of trade diversion, we examine what types of exports could be quickly shipped to other destinations. To this end, we consider four dimensions of products: upstreamness, R&D intensity, skilled-labor intensity, and labor-income share. Similar to the analyses in Fig. 6, we first implement DD eq. (1) using exports to the whole world separately for each HS 2-digit industry, then divide industries into 20 bins to show the correlations. We show the results in Fig. 7. We find strong and positive correlations for upstreamness, R&D intensity, and skilled-labor intensity, but a significantly negative correlation for labor-income share. These results indicate that products in upstream, R&D-intensive, high-capital-income-share and skilled-labor-intensive industries are more likely redirected to other destinations in response to trade protection.

3.3. Heterogeneity analysis

To understand the distributional effects of trade protectionism, we further study the heterogeneity of treatment effects across industries. Specifically, we first examine whether the trade-protection effects are related to a country's comparative advantage. To this end, we examine the differential responses of capital-intensive and labor-intensive industries, skilled-labor-intensive and unskilled-labor-intensive industries, and R&D-intensive and R&D-scarce industries. We also check whether the trade responses vary across the elasticity of substitution, exporting experience, and initial export values.

3.3.1. Industry comparative advantage

Estimation results are reported in Table 4, with Panel A for total exports, panel B for export quantity, and Panel C for export price. First, we study the differences in trade-protection effects between capital-intensive and labor-intensive industries. To this end, in the first step, we obtain the capital-labor ratio for each industry using the third wave of the economic census in 2013 conducted by the National Bureau of Statistics of China, which covers the universe of manufacturing and service industries with a sample of 13 million firms. Then, we classify products into capital-intensive industries, with a capital-labor ratio above the sample median, and labor-intensive industries, with a capital-labor ratio below the sample median. Estimation results are reported in columns (1) and (2) of Table 4, respectively, for the two groups. Estimated coefficients for labor-intensive industries are negative and statistically significant for total exports and export quantity, but the coefficient for export price is small and statistically insignificant. However, none of the estimated coefficients for total exports, export quantity, and export price for capital-intensive

Table 5
Industry revealed comparative advantage.

	(1)	(2)	(3)	(4)
	2017		2016	
	High RCA	Low RCA	High RCA	Low RCA
Panel A: total exports (ln*export*)				
$Treatment_i * Post_{it}$	−0.1780***	−0.0661	−0.1834***	−0.0511
	(0.0418)	(0.0879)	(0.0410)	(0.0864)
Observations	52,763	51,836	53,223	51,394
adj. R^2	0.9022	0.8603	0.9055	0.8573
Panel B: export quantity (ln*quantity*)				
$Treatment_i * Post_{it}$	−0.1610***	−0.1132	−0.1771***	−0.0666
	(0.0421)	(0.0914)	(0.0429)	(0.0880)
Observations	52,763	51,836	53,223	51,394
adj. R^2	0.9270	0.9023	0.9243	0.9041
Panel C: export price (ln*price*)				
$Treatment_i * Post_{it}$	−0.0170	0.0470	−0.0063	0.0155
	(0.0295)	(0.0653)	(0.0275)	(0.0653)
Observations	52,763	51,836	53,223	51,394
adj. R^2	0.9345	0.9146	0.9364	0.9137
Chinese retaliatory tariffs	Y	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y

Notes: (1) Dependent variables are the logarithm of export volume (ln*export*) for Panel A, logarithm of export quantity (ln*quantity*) for panel B, and logarithm of the average export price (ln*price*) for Panel C. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product–time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Based on export data at HS-6-digit-product level in 2016 and 2017 from the UN Comtrade, we calculate the Chinese revealed comparative advantage (RCA) index for each HS-6-digit product and classify products into high-RCA and low-RCA groups by the sample median of the products' RCA index in 2016 and 2017, respectively. (4) Standard errors, clustered at product level, are reported in parentheses. (5) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

industries are statistically and economically significant. This finding implies that the effect of the trade war on labor-intensive industries is much larger than that on capital-intensive industries; that is, the former are more sensitive to trade protection than the latter.

Second, we investigate the differential effects on skilled-labor-intensive and unskilled-labor-intensive industries. To obtain the ratio of skilled labor to total employment for each industry, we again use the third wave of the economic census. Specifically, skilled labor is defined as workers with college degrees or above, and skilled-labor-intensive industries are classified as industries with a skilled-labor ratio above the sample median. Accordingly, unskilled-labor-intensive industries are classified as industries with a skilled-labor ratio below the sample median. Estimation results are reported in columns (3) and (4) of Table 4 for the two groups. Both industries respond significantly to the negative trade shocks in total exports, and much of the decline is explained by quantity rather than price. Regarding the magnitude differences, unskilled-labor-intensive industries have a larger estimated coefficient than skilled-labor-intensive ones, which suggests that the former are more sensitive to trade protection than the latter.

Third, we examine the differential responses of R&D-intensive and R&D-scarce industries. We use the information on R&D personnel in the third wave of the economic census to obtain the intensity of R&D activities for each industry. Specifically, we classify an industry as R&D intensive if its ratio of R&D employment to total employment is above the sample median; R&D-scarce industries are defined as those with a ratio of R&D employment below the sample median. Estimation results are reported in columns (5) and (6) of Table 4. Both industries experience a significant decline in total exports in response to additional tariffs, and export quantity explains most of the decline. Furthermore, the estimated coefficient of R&D-scarce industries is larger than that of R&D-intensive industries, which implies that the former is more sensitive to trade war than the latter.

Note that China has comparative advantage in labor-intensive industries, unskilled-labor-intensive industries, and R&D-scarce industries. These results consistently suggest that Chinese comparative-advantage industries are more responsive to trade protectionism. To further corroborate this claim regarding industry comparative advantage, we formally construct an index of revealed comparative advantage (RCA, i.e., the ratio of China's HS 6-digit exports to China's total exports relative to the corresponding ratio for the world). Estimation results, shown in Table 5, further confirm that industries with a high RCA have strong trade responses, whereas those with a low RCA do not witness significant changes. A possible explanation is that the substitution elasticities of Chinese comparative-advantage industries are high, and these products can be easily substituted.

Table 6
Industry elasticity of substitution.

	(1)	(2)	(3)	(4)	(5)	(6)
	US import demand elasticity at HS-8 digit		US import demand elasticity at HS-6 digit		China export supply elasticity at HS-4 digit	
	High	Low	High	Low	High	Low
Panel A: total exports (ln*export*)						
$Treatment_i * Post_{it}$	−0.1995***	−0.0826*	−0.2199***	−0.1217**	−0.2730***	−0.0861**
	(0.0663)	(0.0438)	(0.0606)	(0.0510)	(0.0569)	(0.0413)
Observations	33,104	37,701	36,082	43,017	42,536	59,801
adj. R^2	0.8747	0.8876	0.8743	0.8914	0.8705	0.9012
Panel B: export quantity (ln*quantity*)						
$Treatment_i * Post_{it}$	−0.2264***	−0.0727*	−0.2370***	−0.0942*	−0.2654***	−0.0813*
	(0.0647)	(0.0440)	(0.0609)	(0.0552)	(0.0628)	(0.0424)
Observations	33,104	37,701	36,082	43,017	42,536	59,801
adj. R^2	0.9275	0.9234	0.9269	0.9146	0.8883	0.9365
Panel C: export price (ln*price*)						
$Treatment_i * Post_{it}$	0.0269	−0.0099	0.0171	−0.0275	−0.0076	−0.0049
	(0.0496)	(0.0316)	(0.0457)	(0.0371)	(0.0314)	(0.0342)
Observations	33,104	37,701	36,082	43,017	42,536	59,801
adj. R^2	0.9369	0.9042	0.9384	0.9088	0.9152	0.9261
Chinese retaliatory tariffs	Y	Y	Y	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y	Y	Y

Notes: (1) Dependent variables are the logarithm of export volume (ln*export*) for Panel A, logarithm of export quantity (ln*quantity*) for Panel B, and logarithm of the average export price (ln*price*) for Panel C. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment-group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Based on US import demand elasticity at HS-8-digit and HS-6-digit-product levels and Chinese export supply elasticity at HS-4-digit-product level provided by Broda and Weinstein (2006), we classify products into high-elasticity and low-elasticity industries by the sample median of elasticity indexes. (4) Standard errors, clustered at product level, are reported in parentheses. (5) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

3.3.2. Industry substitution elasticity

We collect US import demand elasticity at HS 8- and HS 6-digit levels and Chinese export supply elasticity at HS 4-digit level from the data constructed by Broda and Weinstein (2006). Estimation results are reported in Table 6, with Panel A for total exports, Panel B for export quantity, and Panel C for export price. First, we find no price responses for any of the specifications, consistent with our main finding. Second, we find strong responses of export value and export quantity for products with high import demand elasticity and high export supply elasticity, but not for those with low import demand elasticity and low export supply elasticity. These results suggest that only in more elastic products does trade protection cause a significant fall in trade due to the flexibility of demand and supply shifts.

3.3.3. Export experience

We first calculate the average export growth rate at HS 8-digit-product level during the period 2007–2017. The total sample is then classified into two groups: high-export-growth and low-export-growth industries, with respect to the median of average export growth rate. Estimation results are reported in Table 7. Clearly, the total exports and export quantity for products in high-export-growth industries decrease significantly, whereas those in low-export-growth industries decrease less in response to trade protection. Moreover, the export price remains relatively unchanged in response to additional tariffs.

3.3.4. Quantile analysis

To further understand the distributional effects of trade protection, we divide the whole sample into five quantiles based on export values of HS 8-digit products in 2017. Subsample estimation results are reported in Table 8. Several findings emerge from these analyses. First, across all specifications, price responses are statistically and economically insignificant, which confirms the patterns in Fig. A2. Second, in the full sample of transaction-level data, we continue to find significantly negative effects of trade protection on export value and export quantity, which corroborate the results of the aggregate-level analysis. Third, we find no significant responses of export value and export quantity at the lowest quantile, whereas quantiles with initially large export value show significant responses. These results suggest that trade protection has larger effects on products with larger initial export values.

Table 7
Industry export growth rate.

Dependent variable	(1) High ln*export*	(2) Low ln*export*	(3) High ln*quantity*	(4) Low ln*quantity*	(5) High ln*price*	(6) Low ln*price*
$Treatment_i * Post_{it}$	−0.1740***	−0.0936*	−0.1615***	−0.1133**	−0.0125	0.0197
	(0.0376)	(0.0490)	(0.0357)	(0.0511)	(0.0276)	(0.0397)
Chinese retaliatory tariffs	Y	Y	Y	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y	Y	Y
Observations	51,564	41,142	51,564	41,142	51,564	41,142
adj. R^2	0.8825	0.8975	0.9168	0.9397	0.9172	0.9317

Notes: (1) In columns (1) and (2), dependent variables are the logarithm of export volume (ln*export*); in columns (3) and (4), dependent variables are the logarithm of export quantity (ln*quantity*); and in columns (5) and (6), dependent variables are the logarithm of the average export price (ln*price*). The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Based on average export growth rate at HS-8-digit-product level from 2007 to 2017, we classify products into two groups by the sample median of average export growth rate; that is, products that belong to high-growth-rate industries and those that belong to low-growth-rate industries. (4) Standard errors, clustered at product level, are reported in parentheses. (5) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table 8
Heterogeneity across initial export values.

	(1) ln*export*	(2) ln*quantity*	(3) ln*price*
Full sample			
$Treatment_i \times Post_{it}$	−0.0591***	−0.0570***	−0.0021
	(0.0091)	(0.0094)	(0.0050)
Observations	5,427,118	5,427,118	5,427,118
First group: (0,20) quantile			
$Treatment_i \times Post_{it}$	−0.0267	−0.0235	−0.0032
	(0.0460)	(0.0451)	(0.0142)
Observations	143,046	143,046	143,046
Second group: [20, 40) quantile			
$Treatment_i \times Post_{it}$	−0.0228	−0.0128	−0.0100
	(0.0315)	(0.0231)	(0.0188)
Observations	613,817	613,817	613,817
Third group: [40–60) quantile			
$Treatment_i \times Post_{it}$	−0.0441**	−0.0334*	−0.0107
	(0.0185)	(0.0183)	(0.0103)
Observations	1,325,512	1,325,512	1,325,512
Fouth group: [60–80) quantile			
$Treatment_i \times Post_{it}$	−0.0787***	−0.0723***	−0.0064
	(0.0155)	(0.0170)	(0.0083)
Observations	1,939,088	1,939,089	1,939,088
Fifth group: [80–100) quantile			
$Treatment_i \times Post_{it}$	−0.0692***	−0.0710***	0.0018
	(0.0184)	(0.0179)	(0.0095)
Observations	1,404,049	1,404,049	1,404,049
Chinese retaliatory tariffs	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y
Time FE	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y

Notes: (1) In columns (1) to (3), dependent variable are the logarithm of export volume (ln*export*), logarithm of export quantity (ln*quantity*), and logarithm of the average export price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Based on export value at the HS-8-digit-product level in 2017, we classify the transaction-level sample into five groups by the 20th, 40th, 60th, and 80th quantiles. Regression results for the full sample at transaction level are also reported. (4) Standard errors, clustered at product level, are reported in parentheses. (5) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

4. Conclusion

This paper examines the impacts of trade protection on exporting behavior based on several waves of tariff increases launched by the US in 2018 on specific products imported from China. Specifically, we use a DD estimation strategy to compare the outcome variables of Chinese exporters in affected product categories (i.e., that face additional tariffs imposed by the Trump administration) with those of exporters in unaffected product categories (without additional tariffs) before and after the imposition of additional tariffs.

We find a consistently negative and significant (statistically and economically) effect of trade protectionism on Chinese exports to the US and a small and statistically insignificant effect on Chinese exports to the whole world, suggesting that whereas the US tariffs significantly reduce Chinese exports to the US, they have little effect on Chinese total exports to the world. Moreover, in response to the trade war, Chinese exports are more likely to be diverted to countries that are closer and have larger economies. The exports of products in R&D-intensive, skilled-labor-intensive, high-capital-income-share, and upstream industries divert even more. In terms of the magnitude, our results indicate that trade protection has larger short-term trade elasticity than the comparable trade liberalization. We further decompose the effects on total exports into two components—namely, the quantity effect and the price effect—and find that the decrease in Chinese exports to the US caused by the additional tariffs is mostly explained by the decrease in quantity, with prices relatively unchanged. This finding implies that the tariffs on Chinese exports are completely passed through to US consumers.

In addition, we find heterogeneity of responses to trade protectionism across industries in some respects. Specifically, China's comparative-advantage industries are more responsive to trade protectionism, which is implied by the fact that the trade protectionism of the US has a much larger impact on labor-intensive industries than capital-intensive ones, unskilled-labor-intensive industries than skilled-labor-intensive ones, and R&D-scarce industries than R&D-intensive ones. Furthermore, exports in industries with high export growth, large initial export value, and high elasticity of substitution decline more in response to trade protection.

Data availability

Responses of Exporters to Trade Protectionism: Inference from the U.S.-China Trade War (Original data) (Mendeley Data)

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All authors contributed equally to the manuscript and authors are listed in alphabetical order. Lingduo Jiang acknowledges financial support from the National Natural Science Foundation of China (71903029); Yi Lu acknowledges financial support from the National Natural Science Foundation of China (71973078); Hong Song acknowledges financial support from the National Natural Science Foundation of China (72173027); Guofeng Zhang acknowledges financial support from the National Natural Science Foundation of China (72273027) and the Fundamental Research Funds for the Central Universities in UIBE (21YQ01; CXTD10-02).

Appendix A

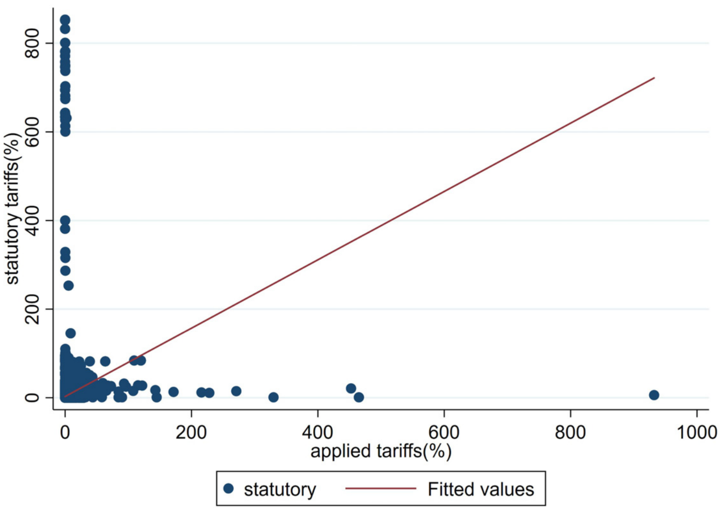


Fig. A1. Scatter plot between statutory tariffs and applied tariffs.
Notes: This figure shows the scatter plot between the US statutory tariffs (%) and applied tariffs (%) on Chinese imports.

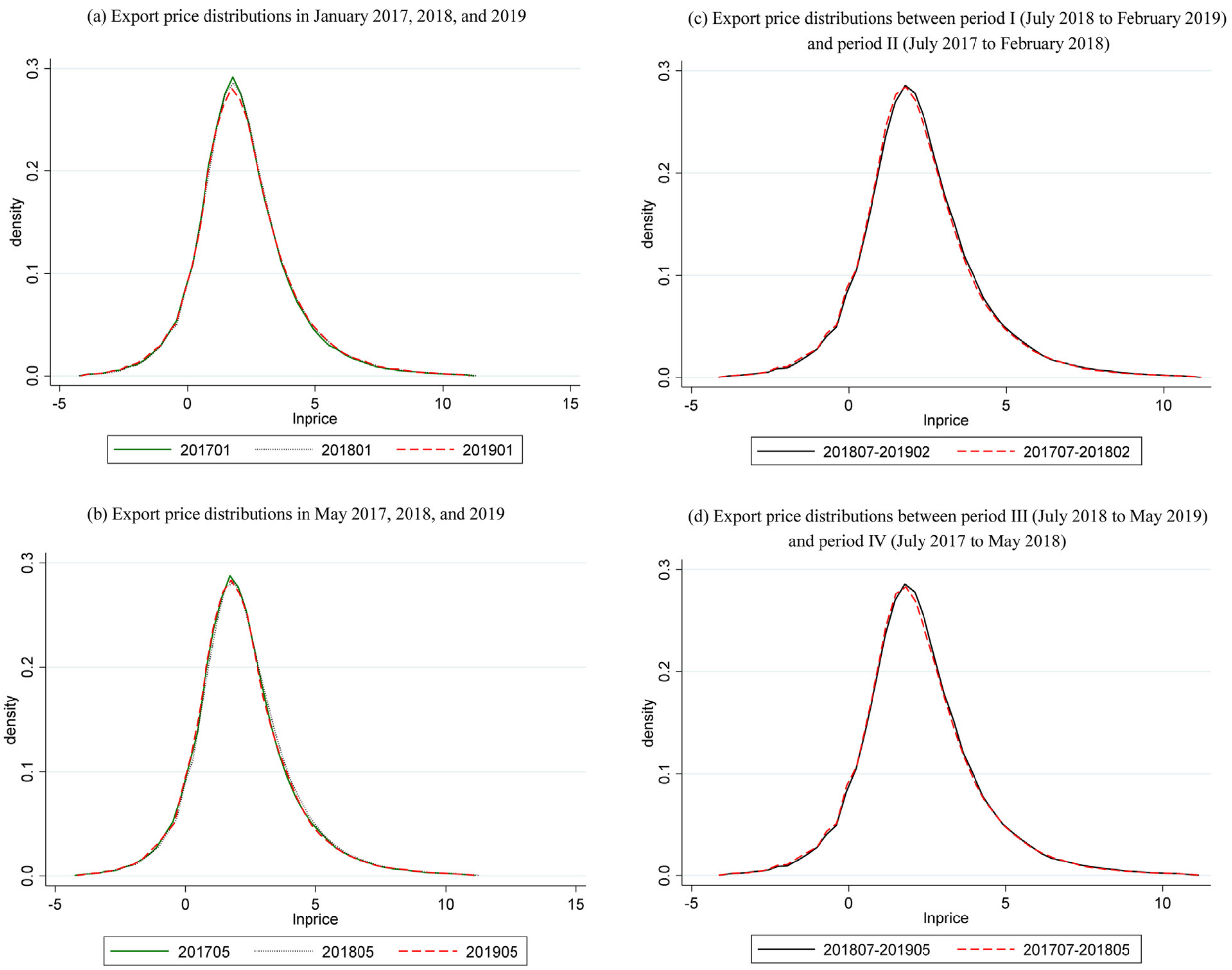
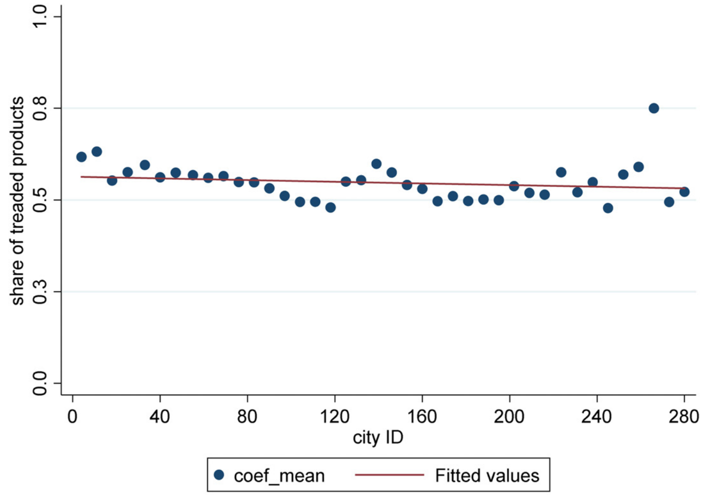


Fig. A2. Export price distributions across time.
Notes: Disaggregated transaction-level data during the period January 2017 to May 2019 are used in Figure A2.

(a) Share of treated products across city groups in 2017



(b) Share of treated products across city groups from January 2017 to May 2019

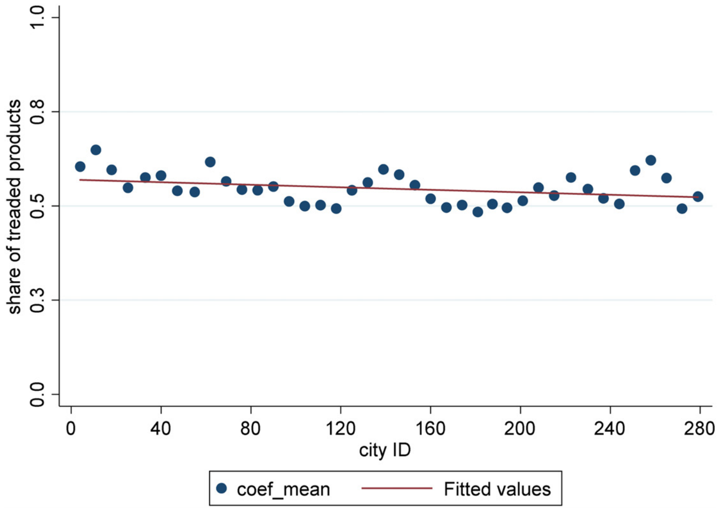


Fig. A3. Location of treated and control products.
Notes: We divide cities into 40 bins and plot the share of treated products for each bin.

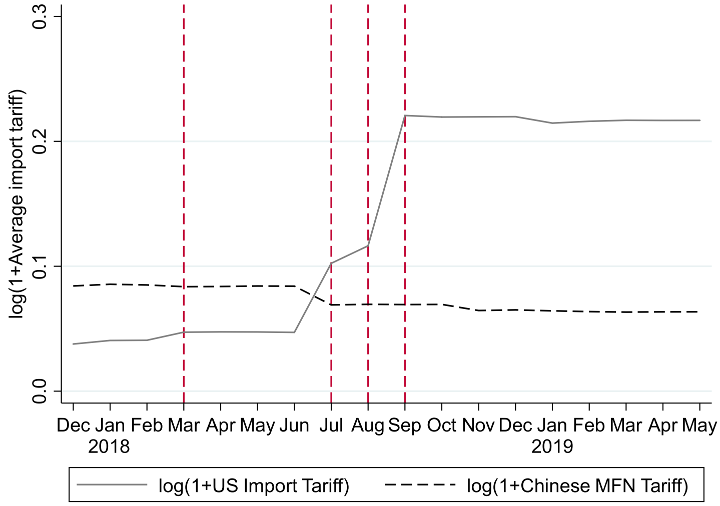


Fig. A4. Average US import tariff on Chinese products and Chinese MFN tariff.
Notes: This figure shows the unweighted average US import tariff on products imported from China and the Chinese MFN tariff during the period December 2017 to May 2019.

Table A1
Export response to the statutory tariff.

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
	ln*export*	ln*quantity*	ln*price*	ln*export*	ln*quantity*	ln*price*
ln (1 + *Statutory Tariff*)	−0.6648***	−0.5036***	−0.1612	−0.6930***	−0.6731***	−0.0199
	(0.1400)	(0.1595)	(0.1091)	(0.1423)	(0.1492)	(0.1042)
Chinese retaliatory tariffs	Y	Y	Y	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y	Y	Y
Observations	105,335	105,335	105,335	105,335	105,335	105,335
adj. R^2	0.8894	0.9203	0.9210	−0.6503	−0.6517	−0.6520

Notes: (1) In columns (1) and (4), dependent variables are the logarithm of export volume (ln*export*); in columns (2) and (5), dependent variables are the logarithm of export quantity (ln*quantity*); and in columns (3) and (6), dependent variables are the logarithm of the average export price (ln*price*). The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A2
Export response to the applied tariff.

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
	ln*export*	ln*quantity*	ln*price*	ln*export*	ln*quantity*	ln*price*
ln (1+ *Applied Tariff*)	−0.5417***	−0.4630***	−0.0787	−1.9909***	−1.9102***	−0.0807
	(0.1778)	(0.1783)	(0.1125)	(0.4145)	(0.4336)	(0.2994)
Chinese retaliatory tariffs	Y	Y	Y	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y	Y	Y
Observations	104,477	104,477	104,477	104,477	104,477	104,477
adj. R^2	0.8885	0.9203	0.9207	−0.6539	−0.6534	−0.6502

Notes: (1) In columns (1) and (4), dependent variables are the logarithm of export volume (ln*export*); in columns (2) and (5), dependent variables are the logarithm of export quantity (ln*quantity*); and in columns (3) and (6), dependent variables are the logarithm of the average export price (ln*price*). The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Data on US applied tariffs on Chinese HS-8-digit products are from Fajgelbaum et al. (2020). (4) Standard errors, clustered at product level, are reported in parentheses. (5) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A3
Excluding outliers of tariffs.

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
	ln*export*	ln*quantity*	ln*price*	ln*export*	ln*quantity*	ln*price*
Panel A: excluding outliers of statutory tariffs						
ln(1+ *Statutory Tariff*)	−0.6309***	−0.5737***	−0.0572	−0.6822***	−0.6529***	−0.0294
	(0.1322)	(0.1244)	(0.0947)	(0.1476)	(0.1546)	(0.1088)
Observations	103,892	103,892	103,892	103,892	103,892	103,892
adj. R^2	0.8904	0.9116	0.9192	−0.6538	−0.6550	−0.6551
Panel B: excluding outliers of applied tariffs						
ln(1+ *Alpplied Tariff*)	−0.6971***	−0.6393***	−0.0578	−2.0004***	−1.9695***	−0.0309
	(0.2515)	(0.2334)	(0.1808)	(0.4283)	(0.4476)	(0.3107)
Observations	103,135	103,135	103,135	103,135	103,135	103,135
adj. R^2	0.8891	0.9113	0.9184	−0.6560	−0.6566	−0.6547
Chinese retaliatory tariffs	Y	Y	Y	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y	Y	Y

Notes: (1) In columns (1) and (4), dependent variables are the logarithm of export volume (ln*export*); in columns (2) and (5), dependent variables are the logarithm of export quantity (ln*quantity*); and in columns (3) and (6), dependent variables are the logarithm of the average export price (ln*price*). The independent variables are ln(1+ *Statutory Tariff*) for Panel A and ln(1+ *Alpplied Tariff*) for Panel B. Results of OLS estimation are reported in columns (1)–(3), and results of the second stage of IV estimation are reported in columns (4)–(6). (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A4
US import responses to the trade war.

	(1)	(2)	(3)
	ln*import*	ln*quantity*	ln*price*
$Treatment_i \times Post_{it}$	-0.9302^{***}	-1.0437^{***}	0.1135
	(0.1105)	(0.2087)	(0.1917)
Chinese retaliatory tariffs	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y
Time FE	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y
Observations	99,183	99,183	99,183
adj. R^2	0.9008	0.9000	0.8989

Notes: (1) In columns (1) to (3), dependent variables are the logarithm of import volume of the US from China (ln*import*), logarithm of import quantity (ln*quantity*), and logarithm of the average import price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction between the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A5
Wage response to the trade war.

	(1)	(2)
	ln*wage*	ln*wage*
Treated-product share	−0.0328	
	(0.0306)	
*Weighted Treatment***Post*		−0.0041
		(0.0176)
City FE	Y	Y
Year FE	Y	Y
Province-year FE	Y	Y
N	806	826
adj. R^2	0.9370	0.9375

Notes: (1) The dependent variable is the logarithm of city-level wage (ln*wage*). In column (1), the independent variable, *Treated-product share*, is the share of treated products at the city level; and in column (2), the independent variable, *Weighted Treatment***Post*, is the weighted trade shocks aggregated from product level to city level using the city-product export share in 2017 as the weight. (2) Regressions include city fixed effect, year fixed effect and province-year fixed effect. (3) Standard errors, clustered at city level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A6
Dynamic effects of the trade war.

	(1)	(2)	(3)
	ln*export*	ln(1 + *Statutory Tariff*)	Coefficients Ratio
$Treatment_i \times Post0_{it}$	−0.0129	0.2322***	−0.0556
	(0.0464)	(0.0018)	
$Treatment_i \times Post1_{it}$	−0.1350***	0.2254***	−0.5989
	(0.0483)	(0.0019)	
$Treatment_i \times Post2_{it}$	0.0219	0.2362***	0.0927
	(0.0519)	(0.0025)	
$Treatment_i \times Post3_{it}$	−0.2907***	0.2387***	−1.2178
	(0.0537)	(0.0027)	
$Treatment_i \times Post4_{it}$	−0.3654***	0.2545***	−1.4358
	(0.0554)	(0.0031)	
$Treatment_i \times Post5_{it}$	−0.2454***	0.2536***	−0.9677
	(0.0575)	(0.0033)	
$Treatment_i \times Post6_{it}$	−0.2904***	0.2507***	−1.1584
	(0.0570)	(0.0034)	
$Treatment_i \times Post7_{it}$	−0.2784***	0.2507***	−1.1105
	(0.0584)	(0.0035)	
$Treatment_i \times Post8_{it}$	−0.3452***	0.2660***	−1.2977
	(0.0588)	(0.0040)	
Chinese retaliatory tariffs	Y	Y	
HS-8-digit-product FE	Y	Y	
Time FE	Y	Y	
HS-6-digit-product×month FE	Y	Y	
HS-6-digit-product×SF FE	Y	Y	
HS-6-digit-product time trend	Y	Y	
Observations	105,335	105,335	
adj. R^2	0.8895	0.9563	

Notes: (1) In columns (1) and (2), dependent variables are the logarithm of export volume (ln*export*) and logarithm of (1 + *Statutory Tariff*), respectively. The coefficients ratio in column (3) is the ratio of estimated coefficients between column (1) and column (2). The independent variable, $Treatment_i \times Post1_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and the indicator that implies one period after the trade war. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A7
Dropping products subject to specific or compound tariffs.

	(1)	(2)	(3)
	ln*export*	ln*quantity*	ln*price*
$Treatment_i \times Post_{it}$	−0.1544***	−0.1545***	0.0002
	(0.0347)	(0.0365)	(0.0260)
Chinese retaliatory tariffs	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y
Time FE	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y
Observations	99,300	99,300	99,300
adj. R^2	0.8879	0.9208	0.9255

Notes: (1) In columns (1) to (3), dependent variables are the logarithm of export volume (ln*export*), logarithm of export quantity (ln*quantity*), and logarithm of the average export price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A8
Chinese MFN tariff response to the trade war and its impact on import behavior.

	(1)	(2)	(3)	(4)
	ln (1+ CHN MFN *Tariff*)	ln*import*	ln*quantity*	ln*price*
$Treatment_i \times Post_{it}$	−0.0516***			
	(0.0037)			
ln (1+ CHN MFN *Tariff*)		−0.1044***	−0.0935**	−0.0109
		(0.0339)	(0.0412)	(0.0252)
ln (1 + USA *Import Tariff*)		−0.2212	−0.0277	−0.1934
		(0.1987)	(0.2238)	(0.1689)
ln (1 + CHN *Retaliatory Tariff*)		−0.2652	−0.3501	0.0849
		(0.2927)	(0.3323)	(0.1814)
HS-8-digit-product FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y	Y
Observations	130,248	130,248	130,248	130,248
adj. R^2	0.9728	0.9082	0.9375	0.9567

Notes: (1) In columns (1) to (4), dependent variables are the logarithm of (1+ CHN MFN *Tariff*), logarithm of import volume (ln*import*), logarithm of import quantity (ln*quantity*), and logarithm of the average import price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A9
Including Chinese MFN tariffs as an additional control.

	(1)	(2)	(3)
	ln*export*	ln*quantity*	ln*price*
$Treatment_i \times Post_{it}$	−0.1551***	−0.1527***	−0.0024
	(0.0341)	(0.0358)	(0.0250)
ln (1+ CHN MFN *Tariff*)	−0.0787*	−0.0520	−0.0268
	(0.0445)	(0.0435)	(0.0280)
Chinese retaliatory tariffs	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y
Time FE	Y	Y	Y
HS-6-digit-product×month FE	Y	Y	Y
HS-6-digit-product×SF FE	Y	Y	Y
HS-6-digit-product time trend	Y	Y	Y
Observations	104,876	104,876	104,876
adj. R^2	0.8895	0.9205	0.9256

Notes: (1) In columns (1) to (3), dependent variables are the logarithm of export volume (ln*export*), logarithm of export quantity (ln*quantity*), and logarithm of the average export price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, a vector of product-specific seasonalities (HS-6-digit-product month fixed effect), Chinese Spring Festival (HS-6-digit-product SF fixed effect), time trend of the HS-6-digit-product factors (HS-6-digit-product time trend), HS-8-digit-product fixed effect, and time fixed effect. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A10
Triple-difference analysis including country variations.

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	IV	IV	IV
	ln*export*	ln*quantity*	ln*price*	ln*export*	ln*quantity*	ln*price*
$Treatment_g \times Treatment_i \times Post_{it}$	−0.1703***	−0.1735***	0.0031			
	(0.0107)	(0.0111)	(0.0054)			
$\ln(1 + Statutory\ Tariff_{git})$				−1.0324***	−1.0515***	0.0191
				(0.0667)	(0.0692)	(0.0325)
Country×time FE	Y	Y	Y	Y	Y	Y
HS-8-digit-product×time FE	Y	Y	Y	Y	Y	Y
HS-8-digit-product×country FE	Y	Y	Y	Y	Y	Y
N	5,396,652	5,396,652	5,396,652	5,396,652	5,396,652	5,396,652
adj. R^2	0.7801	0.8499	0.8724	−0.0004	−0.0003	−0.0001

Notes: (1) In columns (1) and (4), dependent variables are the logarithm of export volume (ln*export*); in columns (2) and (5), dependent variables are the logarithm of export quantity (ln*quantity*); and in columns (3) and (6), dependent variables are the logarithm of the average export price (ln*price*). The independent variable, $Treatment_g \times Treatment_i \times Post_{it}$, representing the effect of trade protectionism, is an interaction of the treatment-country dummy, treatment-product dummy, and the post-war indicator of product *i*. (2) Regressions include country time fixed effect, HS-8-digit-product time fixed effect, and HS-8-digit-product country fixed effect. (3) $Statutory\ Tariff_{git}$ denotes the MFN import tariffs of country g on product i of China in time t. (4) Standard errors, clustered at country-product level, are reported in parentheses. (5) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A11
Control product-level omitted variables.

	(1)	(2)	(3)
	ln*export*	ln*quantity*	ln*price*
$Treatment_i \times Post_{it}$	−0.1697***	−0.1785***	0.0088
	(0.0414)	(0.0480)	(0.0369)
Chinese retaliatory tariffs	Y	Y	Y
HS-8-digit-product FE	Y	Y	Y
HS-6-digit-product×time FE	Y	Y	Y
Observations	102,736	102,736	102,736
adj. R^2	0.8842	0.9159	0.9247

Notes: (1) In columns (1) to (3), dependent variables are the logarithm of export volume (ln*export*), logarithm of export quantity (ln*quantity*), and logarithm of the average export price (ln*price*), respectively. The independent variable, $Treatment_i \times Post_{it}$, which represents the effect of trade protectionism, is an interaction of the treatment group (subject to the additional tariffs imposed by the US) dummy and a post-war indicator. (2) Regressions include *Chinese retaliatory tariffs*, HS-8-digit-product fixed effect, and HS-6-digit-product time fixed effects. (3) Standard errors, clustered at product level, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5%, and 10% level, respectively.

Table A12
Industrial-production response to the trade war.

	(1)	(2)
	sales per firm	*ratio of firms in a loss*
Weighted Treatment×Post	5.8895	0.0169***
	(7.9833)	(0.0056)
CIC-2-digit-industry FE	Y	Y
Time FE	Y	Y
Observations	984	984
adj. R^2	0.8071	0.8750

Notes: (1) In columns (1) and (2), dependent variables are the *sales per firm* (=*total sales*/ *total firms*) and the *ratio of firms in a loss* (=*firms in a loss*/ *total firms*), respectively. The independent variable, *Weighted Treatment×Post*, represents the trade shocks aggregated at CIC-2-digit-industry level. (2) Regressions include CIC-2 digit-industry fixed effect and time fixed effect. (3) Standard errors, clustered at CIC-2-digit industry, are reported in parentheses. (4) ***, **, and * represent significance at the 1%, 5% and 10% level, respectively.

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