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THE RETURN TO PROTECTIONISM*

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After decades of supporting free trade, in 2018 the United States raised import tariffs and major trade partners retaliated. We analyze the short-run impact of this return to protectionism on the U.S. economy. Import and retaliatory tariffs caused large declines in imports and exports. Prices of imports targeted by tariffs did not fall, implying complete pass-through of tariffs to duty-inclusive prices. The resulting losses to U.S. consumers and firms that buy imports was $51 billion, or 0.27% of GDP. We embed the estimated trade elasticities in a general-equilibrium model of the U.S. economy. After accounting for tariff revenue and gains to domestic producers, the aggregate real income loss was $7.2 billion, or 0.04% of GDP. Import tariffs favored sectors concentrated in politically competitive counties, and the model implies that tradeable-sector workers in heavily Republican counties were the most negatively affected due to the retaliatory tariffs. *JEL* Code: F1.

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I. Introduction

After more than a half-century of leading efforts to lower international trade barriers, in 2018 the United States enacted several waves of tariff increases on specific products and countries. Import tariffs increased from 2.6% to 16.6% on 12,043 products covering $303 billion (12.7%) of annual U.S. imports. In response, trade partners imposed retaliatory tariffs on U.S. exports. These countermeasures increased tariffs from 7.3% to 20.4% on 8,073 export products covering $127 billion (8.2%) of annual U.S. exports.

This return to protection is unprecedented in the postwar era because of the sizes of the countries involved, the magnitudes of the tariff increases, and the breadth of tariffs across sectors. What were the short-run effects on the U.S. economy? Classical trade theory dictates that the effects depend on the incidence of tariffs. Consumers and firms who buy foreign products lose from higher tariffs. Reallocations of expenditures into or away from domestic products induced by the United States and retaliatory tariffs may lead to changes in U.S. export prices relative to import prices—that is, terms-of-trade effects—and generate tariff revenue. The trade war may have distributional consequences across sectors and thus across regions with different patterns of specialization.

Very little is known about tariff incidence, despite its central role in policy analysis. In this article, we estimate the impacts of tariffs on U.S. trade quantities and prices. We estimate a U.S. demand system that accommodates reallocations across imported varieties (defined as country-product pairs), across imported products (defined as 10-digit Harmonized System product codes), and between imported and domestic products within a sector (defined as a 4-digit NAICS industry code). We combine this system with foreign export supply curves for each variety. The estimation leverages the property that if changes in tariffs are uncorrelated with demand and supply shocks, then a tariff can be used to simultaneously instrument both the import demand and foreign export supply curves.[1] We exploit panel variation at the variety level and aggregate tariffs to construct instruments that identify elasticities of substitution at the product and sector levels. Tests for

1. This estimation approach was first applied by Romalis (2007) to study the effects of NAFTA and recently formalized by Zoutman, Gavrilova, and Hopland (2018).

preexisting trends, tariff anticipation, and an event-study framework validate using tariffs as a source of identification.

We find large declines in imports when the tariffs were implemented. Imports of varieties targeted by U.S. tariffs fell on average 31.7%; imports of targeted products fell 2.5%; and imports in targeted sectors fell 0.2%. The event study reveals no differential change in before-duty import prices between targeted and untargeted source countries exporting the same product. These results imply that we cannot reject horizontal foreign export supply curves. We estimate elasticities of substitution across origins (i.e., varieties) within a product, across imported products, and between domestic goods and imports within a sector of 2.53, 1.53, and 1.19, respectively.

On the export side, we find that retaliatory tariffs resulted in a 9.9% decline in U.S. exports within products. We estimate a roughly unitary elastic foreign demand for U.S. varieties (1.04) and also find complete pass-through of retaliatory tariffs to foreign consumers. As with the import side, we demonstrate that these elasticities are not confounded by preexisting trends or anticipation of the retaliations.

The findings imply complete pass-through of tariffs to duty-inclusive import prices, a finding that is systematic across products with heterogeneous characteristics. The resulting real income loss to U.S. consumers and firms that buy imports can be computed as the product of the import share of value added (15%), the fraction of U.S. imports targeted by tariff increases (13%), and the average increase in tariffs among targeted varieties (14%). This decline is $51 billion, or 0.27% of GDP.

These results have two important caveats. First, our analysis considers short-run effects, but relative prices could change over longer horizons. Second, our estimation controls for country-time and product-time effects and therefore is unable to capture import price declines from relative wage changes across countries or sectors.[2] In other words, the results do not imply that the United States is a small open economy unable to affect world prices, as terms-of-trade effects could have occurred through wage adjustments at the country-sector level.

We combine the previously estimated parameters with a supply-side model of the U.S. economy to gauge some of these

2. Influential work by Bagwell and Staiger (1999) demonstrates that trade agreements serve to deal with terms-of-trade externalities.

effects. The model imposes upward-sloping industry supply curves in the United States and predicts changes in sector-level prices because of demand reallocation induced by tariffs. We impose perfect competition, flexible prices, and flexible adjustment of intermediate inputs. To assess regional effects, we assume immobile labor and calibrate the model to match specialization patterns across U.S. counties.[3] In the model, U.S. tariffs reallocate domestic demand onto U.S. goods, raising total demand and therefore U.S. export prices, while retaliatory tariffs have the opposite effect. These price changes are qualitatively consistent with suggestive evidence that U.S. tariffs led to increases in the PPI and that sector-level export prices fell with retaliatory tariffs.

We obtain a ballpark estimate of the aggregate and regional effects of the 2018 tariff waves. We estimate producer gains of \$9.4 billion, or 0.05% of GDP. Adding up these gains, tariffs revenue, and the losses from higher import costs yields a short-run loss of the 2018 tariffs on aggregate real income of \$7.2 billion, or 0.04% of GDP. Hence, we find substantial redistribution from buyers of foreign goods to U.S. producers and the government, but a small net loss for the U.S. economy as a whole (which is not statistically significant at conventional levels after accounting for the parameters' standard errors). Although we cannot reject the null hypothesis that the aggregate losses are 0, the results strongly indicate large consumer losses from the trade war. If trade partners had not retaliated, the economy would have experienced a modest (and also not statistically significant) gain of \$0.5 billion.

The small net effect also masks heterogeneous impacts across regions driven by patterns of specialization across sectors. If capital and labor are regionally immobile—a reasonable assumption over this short time horizon—sectoral heterogeneity in U.S. and foreign tariffs generates unequal regional effects. Our counterfactuals imply that all counties experienced reductions in tradeable real wages. Using the model, we find a standard deviation of real

3. Our model-based calculations abstract from imperfect competition in international transactions, although incorporating variable markups would imply incomplete pass-through, which we do not observe. We measure input-output linkages at the four-digit industry level observed in BEA IO tables and impose unitary elasticities as in Caliendo and Parro (2015). The aggregate effects could be larger under tariff uncertainty (Handley and Limão 2017) or different assumptions on the input-output structure (Antràs and De Gortari 2017; Baqaee and Farhi 2019). See Freund et al. (2018), Altig et al. (2018), and Bellora and Fontagné (2019) for analyses that incorporate some of these forces in the context of the 2018 trade war.

wages in the tradeable sectors across counties of 0.5%, relative to an average decline of 1.0%.

We show that U.S. import protection was biased toward products made in electorally competitive counties, as measured by their 2016 presidential vote share, suggesting a potential ex ante electoral rationale for the pattern of tariffs increases. This structure of U.S. protection is consistent with the view that trade policies determined by electoral competition tend to favor voters who are likely to be closer to an indifference point between candidates (Mayer 1984; Dixit and Londregan 1996; Grossman and Helpman 2005). In contrast, retaliations disproportionately targeted agricultural sectors, which tend to be concentrated in Republican-leaning counties. The model-based results suggest that tradeable sector workers in heavily Republican counties were the most negatively affected because of this pattern of tariff retaliations.

A large literature studies the effects of changes in trade costs or foreign shocks through empirical and quantitative methods (e.g., Eaton and Kortum 2002; Arkolakis, Costinot, and Rodríguez-Clare 2012; Autor, Dorn, and Hanson 2013). We focus instead on trade policy, and tariffs in particular, because they are the primary policy instrument of the 2018 trade war.

One approach to studying the impacts of trade policy uses ex post variation in tariffs across sectors to assess effects on sectors (e.g., Attanasio, Goldberg, and Pavcnik 2004), regions (e.g., Topalova 2010; Kovak 2013; Dix-Carneiro and Kovak 2017), firms (e.g., Amiti and Konings 2007; Goldberg et al. 2010; Bustos 2011), or workers (e.g., Autor et al. 2014; McCaig and Pavcnik 2018). A complementary approach uses quantitative models to simulate aggregate effects of tariffs, such as the Nash equilibrium of a global trade war (Ossa 2014) or regional trade liberalizations (e.g., Caliendo and Parro 2015; Caliendo et al. 2015).[4]

A key challenge in the empirical literature is to address the potential endogeneity of tariff changes, and we devote significant attention to these concerns in our analysis. In quantitative models, the parameterization of how trade volumes change with trade policy plays a key role, and we use the observed changes in tariffs to estimate these trade elasticities.[5]

4. Goldberg and Pavcnik (2016) and Ossa (2016) survey the recent literature studying the impacts of trade policy.

5. Some papers use time-series variation in tariffs to estimate trade elasticities; see Romalis (2007) and Spearot (2013, 2016). Hillberry and Hummels (2013)

Finally, our finding of complete pass-through deserves some discussion.[6] Amiti, Redding, and Weinstein (2019) and Cavallo et al. (2019) also find complete tariff pass-through to border prices in this trade war, and Flaaen, Hortaçsu, and Tintelnot (2019) estimate high tariff pass-through to retail prices for washing machines. Yet a large body of literature has estimated incomplete pass-through, in particular for exchange rates (e.g., Goldberg and Knetter 1997). An exception is Feenstra (1989), who finds symmetry in the pass-through between tariffs and exchange rate movements. Several hypotheses could reconcile our findings with the exchange rate pass-through literature. The persistence of the tariff shocks may cause before-duty import prices to eventually decline as time elapses. Our results are also consistent with incomplete exchange rate pass-through if import prices are sticky and denominated in dollars (Gopinath, Itskhoki, and Rigobon 2010). Inspecting the precise mechanism underlying the complete tariff pass-through finding deserves further exploration in future research.

The remainder of the article is structured as follows. Section II summarizes the data used for the analysis. Section III outlines the demand-side framework that guides the estimation of the elasticities and discusses the identification strategy. Section IV presents the empirical results. Section V presents the model-based aggregate and distributional effects. Section VI concludes.

II. Data and Timeline

This section describes the data, provides a timeline of key events, and presents an event study of the impact of tariffs. The details about the data set construction are available in Online Appendix A.

and Head and Mayer (2014) review alternative approaches typically used to estimate demand elasticities, including gravity estimates of the relationship between trade and prices or proxies of marginal costs (e.g., Eaton and Kortum 2002; Atkin and Donaldson 2015; Simonovska and Waugh 2014; Donaldson 2018) or GMM identification via heteroskedasticity of supply and demand shocks (e.g., Feenstra 1994; Broda, Limão, and Weinstein 2008). Our elasticities are lower than those obtained from cross-sectional variation but in the range of estimates from time-series estimation (see Hillberry and Hummels 2013).

6. The few papers studying the effect of tariffs on import prices include Irwin (2014) for U.S. sugar duties in the late nineteenth and early twentieth centuries, Winkelmann and Winkelmann (1998) for 1980s tariff reductions in New Zealand, and Feenstra (1989) for U.S. duties on Japanese compact trucks in the 1980s.

II.A. Data

We build a monthly panel data set of U.S. statutory import tariffs using public schedules from the U.S. International Trade Commission (USITC). Prior to 2018, the USITC released annual "baseline" tariff schedules in January and a revised schedule in July. In 2018, by contrast, the USITC issued 14 schedule revisions, reflecting a rapid series of tariff increases. These ad valorem tariff increases were predominantly set at the eight-digit Harmonized System (HS) level and were swiftly implemented within three weeks following a press release by the Office of the U.S. Trade Representative.[7] Because we work with monthly data and the tariffs were implemented in the middle of months, we scale the tariff increases by the number of days of the month they were in effect.

We compile retaliatory tariffs on U.S. exports from official documents released by the Ministry of Finance of China, the Department of Finance of Canada, the Office of the President of Mexico, and the World Trade Organization (covering the EU, Russia, and Turkey). These tariffs were entirely ad valorem and went into effect shortly after the announcement dates. To construct the retaliatory tariffs, we use the annual WTO database of Most Favored Nation (MFN) tariff rates and compute the retaliatory tariff rate for each country-product as the sum of the MFN rate and the announced tariff rate change. We measure export tariffs at the HS-6 level, because HS-8 codes are not directly comparable across countries. As with the import tariffs, we scale the retaliations based on the day of the month they go into effect.

We use publicly available monthly administrative U.S. import and export data from the U.S. Census Bureau that record values and quantities of trade flows at the HS-10 level, which we refer to as products.[8] Country-product pairs are referred to as varieties. Our sample period covers 2017:1 to 2019:4, and covers the universe of HS-10 codes and countries. For imports, we directly observe the value of duties collected. Unit values are constructed as the ratio of values to quantities, and duty-inclusive unit values are constructed as $\frac{(\text{value} + \text{duties})}{\text{quantity}}$. We do not observe the duties collected by foreign governments on U.S. exports, so we construct duty-inclusive unit values for exports as the unit value multiplied by (1 plus) the ad valorem retaliatory statutory rate.

7. We ignore a small number of changes in import tariffs in 2018:1, 2018:7, and 2019:1 that are the result of preexisting treaty commitments. Thus, we use only the tariff changes due to the trade war as identifying variation.

8. These data are available at https://usatrade.census.gov/.

We define sectors as NAICS-4 codes. We use the Federal Reserve G17 Industrial Production Index as a measure of domestic sector output, and the BLS PPI, MPI, and XPI indices of producer prices, import prices, and export prices, respectively. These sector-level panels are available at a monthly frequency. We use the 2016 Bureau of Economic Analysis (BEA) annual "use" tables from the national input-output (I-O) accounts to construct I-O linkages between sectors.

To analyze regional exposure, we use the Census County Business Patterns (CBP) database, which provides annual industry employment and wage data at the county-by-sector level for all nonfarm sectors. For county-level data covering the farm sector, we use the BEA Local Area Personal Income and Employment database. From both data sources, we use 2016 data to compute the industry employment share of each county. Finally, we obtain county-level demographic statistics from the 2016 five-year American Community Survey and county-level voting data from the U.S. Federal Election Commission.

II.B. Timeline

Table I provides a timeline of events, and Figure I plots the tariff increases. Table I, Panel A reports the total scope of affected imports and shows that U.S. import tariffs targeted 12,043 distinct HS-10 products. In 2017, these imports were valued at $303 billion, or 12.7% of imports. The average statutory tariff rate increased from 2.6% to 16.6%. An important feature of these tariffs is that they were discriminatory across countries, which allows us to exploit variation in tariff changes across varieties within products.[9]

The first wave of tariff increases began in February 2018, when the United States increased tariffs on $8 billion of solar panel and washing machine imports. A second wave of tariffs, implemented in March 2018, targeted iron, aluminum, and steel products. The largest tranches of import tariffs targeted approximately $247 billion worth of imports from China. In March 2018

9. The United States authorized the tariffs through Section II.A of the Trade Act of 1974, Section III.A of the Trade Act of 1974, and Section II.B of the Trade Expansion Act of 1962. These laws permit the president to apply protectionist measures under different justifications, including "serious injury" to domestic industries, threats to national security, or retaliations for allegations of unfair trade practices.

TABLE I
THE 2018 TRADE WAR

Tariff wave	Date enacted	Products	2017 imports		Tariff (%)	
		(# HS-10)	(mil US$)	(%)	2017	2018
Panel A: Tariffs on U.S. imports enacted by the United States in 2018						
Solar panels	Feb 7, 2018	8	5,782	0.2	0.0	30.0
Washing machines	Feb 7, 2018	8	2,105	0.1	1.3	32.2
Aluminum	Mar–Jun, 2018	67	17,685	0.7	2.0	12.0
Iron and steel	Mar–Jun, 2018	753	30,523	1.3	0.0	25.0
China 1	Jul 6, 2018	1,672	33,510	1.4	1.3	26.2
China 2	Aug 23, 2018	433	14,101	0.6	2.7	27.0
China 3	Sep 24, 2018	9,102	199,264	8.3	3.3	12.9
Total		12,043	302,970	12.7	2.6	16.6
Panel B: Retaliatory tariffs on U.S. exports enacted by trading partners in 2018						
China	Apr–Sep, 2018	7,474	92,518	6.0	8.4	18.9
Mexico	Jun 5, 2018	232	6,746	0.4	9.6	28.0
Turkey	Jun 21, 2018	244	1,554	0.1	9.7	31.8
European Union	Jun 22, 2018	303	8,244	0.5	3.9	29.2
Canada	Jul 1, 2018	325	17,818	1.2	2.1	20.2
Russia	Aug 6, 2018	163	268	0.0	5.2	36.8
Total		8,073	127,149	8.2	7.3	20.4

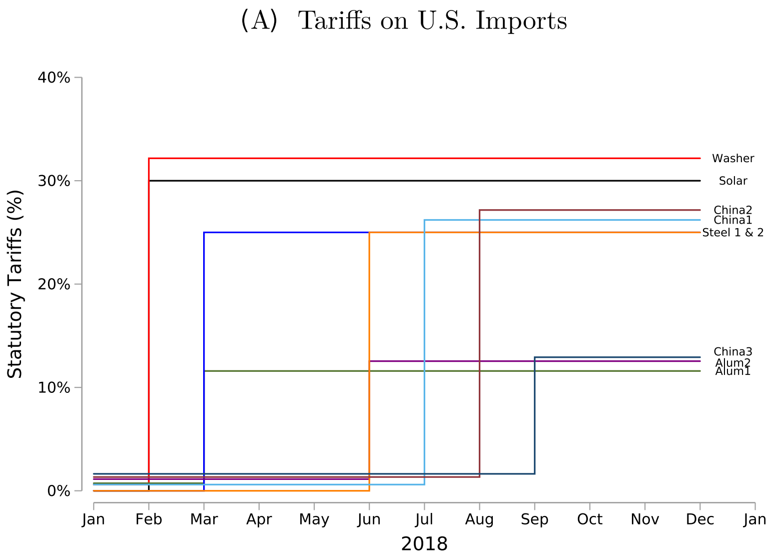
Notes. Panels display unweighted monthly HS-10 country average statutory tariff rates. 2017 tariff rates are computed as the annual average; 2018 tariff rates are computed using data from December 2018. Total tariff rates are computed as the trade-weighted average of table row values. The denominator for import (export) share is the total 2017 annual US$ value of all U.S. imports (exports). The U.S. government announced import tariffs on aluminum and steel products on March 23 but granted exemptions for Canada, Mexico, and the European Union; those exemptions were lifted on June 1. The dates of Chinese retaliations are April 6, July 2, August 23, and September 24. See the text for data sources.

the United States implemented tariffs on approximately $50 billion of Chinese imports, and the scope and value of targeted Chinese products expanded with subsequent tariff waves implemented in July and September. Rows 5–7 indicate that tariffs on China targeted 11,207 imported products worth $247 billion, and increased tariffs, on average, from 3.0% to 15.5%. A total of 48.8% of imports from China were targeted with tariff increases.

Table I, Panel B reports the retaliatory tariffs imposed on U.S. exports by trade partners. Canada, China, Mexico, Russia, Turkey, and the EU enacted retaliatory tariffs against the United States, and collectively these retaliations covered $127 billion (8.2%) of annual U.S. exports across 7,763 products. The average statutory tariff rate on these exports increased from 7.3% to 20.4%.

II.C. Structure of Protection across Sectors

Table II reports summary statistics for targeted import and export varieties across NAICS-3 codes. For imports, we report the



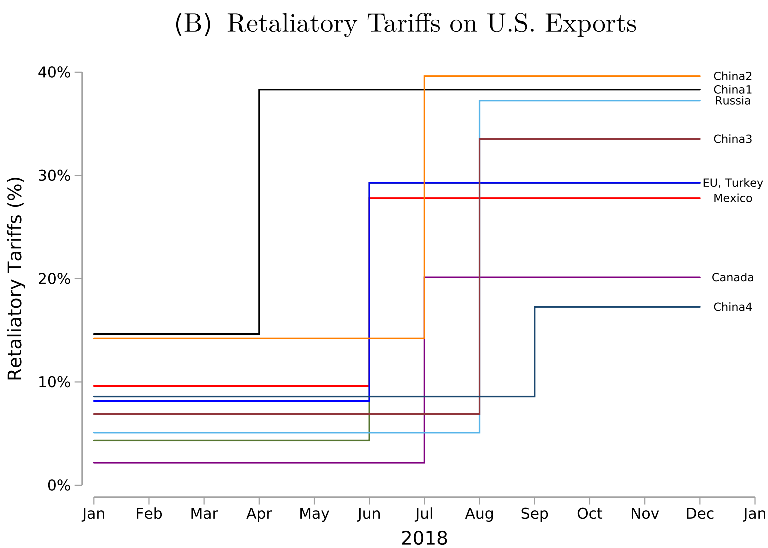


FIGURE I

Trade War Timeline

Figure shows the unweighted average tariff rate of targeted import and export varieties for each tariff wave before and after they are targeted. Import tariffs are constructed from U.S. International Trade Commission (USITC) documents, and retaliatory tariffs are constructed using official documents from foreign finance and trade ministries.

TABLE II

SECTOR VARIATION IN TARIFF RATE CHANGES FOR TARGETED IMPORT VARIETIES AND EXPORT PRODUCTS BY NAICS-3 CODE

		Imports (U.S. tariffs)				Exports (retaliatory tariffs)			
				Δ Tariffs				Δ Tariffs	
Sector (1)	NAICS-3 (2)	# Products (3)	# Varieties (4)	Mean (5)	Std. dev. (6)	# Products (7)	# Varieties (8)	Mean (9)	Std. dev. (10)
Crop and animal production	111-2	456	456	0.10	0.00	303	380	0.24	0.11
Forestry and logging	113	71	71	0.10	0.00	79	79	0.12	0.07
Fishing, hunting, and trapping	114	486	486	0.10	0.00	247	247	0.24	0.03
Oil and gas extraction	211	17	17	0.10	0.00	8	8	0.22	0.07
Mining (except oil and gas)	212	103	103	0.10	0.00	89	92	0.10	0.05
Food	311	732	732	0.10	0.00	622	1,014	0.17	0.09
Beverage and tobacco products	312	64	64	0.10	0.00	55	379	0.23	0.06
Textile mills	313	1,502	1,502	0.10	0.00	468	494	0.12	0.06
Textile product mills	314	176	176	0.10	0.00	122	235	0.16	0.08
Apparel	315	92	92	0.10	0.00	325	1,082	0.20	0.07
Leather and allied products	316	237	237	0.10	0.00	196	357	0.16	0.08
Wood products	321	424	424	0.10	0.00	194	194	0.10	0.03
Paper	322	335	335	0.12	0.05	239	388	0.12	0.07
Printing and related activites	323	14	14	0.10	0.00	46	74	0.13	0.09

TABLE II
(CONTINUED)

		Imports (U.S. tariffs)				Exports (retaliatory tariffs)			
				Δ Tariffs				Δ Tariffs	
Sector (1)	NAICS-3 (2)	# Products (3)	# Varieties (4)	Mean (5)	Std. dev. (6)	# Products (7)	# Varieties (8)	Mean (9)	Std. dev. (10)
Petroleum and coal products	324	74	74	0.13	0.06	64	64	0.23	0.05
Chemical	325	1,730	1,730	0.12	0.05	1,159	1,411	0.12	0.08
Plastics and rubber products	326	251	251	0.15	0.07	171	196	0.10	0.07
Nonmetallic mineral products	327	354	354	0.11	0.03	225	632	0.18	0.08
Primary metal	331	1,147	14,093	0.19	0.07	495	1,738	0.20	0.07
Fabricated metal products	332	583	852	0.14	0.06	404	1,236	0.18	0.09
Machinery	333	1,344	1,344	0.20	0.07	1,075	1,218	0.11	0.06
Computer and electronic products	334	617	878	0.21	0.07	458	506	0.11	0.07
Electrical equipment and appliances	335	414	594	0.18	0.08	326	656	0.16	0.08
Transportation equipment	336	429	429	0.15	0.07	273	680	0.21	0.08
Furniture and related products	337	160	160	0.10	0.01	37	244	0.21	0.07
Miscellaneous	339	231	231	0.13	0.06	393	608	0.16	0.09
Total		12,043	25,699	0.12	0.03	8,073	14,212	0.17	0.07

Notes. Table shows the mean and standard deviation of tariff increases across 3-digit NAICS sectors. A tariff change of 0.10 indicates a 10 percentage point increase. Sectors with the same number of targeted varieties and products in columns (3) and (4) reflect import tariffs exclusively targeting Chinese products. Means and standard deviations in the final row are computed as the simple average of table row values. Import tariffs are constructed from U.S. International Trade Commission (USITC) documents, and retaliatory tariffs are constructed using official documents from foreign finance and trade ministries.

number of targeted HS-10 products and varieties and the means and standard deviations of tariff increases across targeted varieties within NAICS-3 codes. In sectors where only China was targeted, the number of targeted products equals the number of targeted varieties. The table also reports the corresponding statistics for the retaliatory tariffs on U.S. exports.

The table conveys three facts. First, U.S. sectors that receive the most protection are primary metals, machinery, computer products, and electrical equipment and appliances. These sectors contain a large share of intermediate inputs, make up a large share of targeted varieties and products, and saw steep tariff increases relative to most other sectors.[10] Second, U.S. trade partners concentrated retaliatory tariffs on different sets of products and sectors; the sector-level correlation between import and retaliatory tariffs is 0.46. For example, retaliatory tariff increases on U.S. agriculture exports are on average more than double the U.S. tariff increases in the crop, fishing, and beverage and tobacco sectors. Third, column (5) shows that the mean tariff increases on targeted import varieties are similar across sectors, and column (6) shows that the standard deviation of U.S. tariff changes within sectors is low (and most often 0).

Since Johnson (1953), an extensive literature on optimal tariffs has argued that governments can maximize national income by setting higher tariffs on sectors with more inelastic foreign export supply, and Broda, Limão, and Weinstein (2008) offer empirical support. However, the tariff changes observed in the 2018 trade war are highly similar across sectors. Online Appendix Figure A.1 illustrates this point by plotting the distribution of tariff changes for targeted varieties. The left panel shows that during the trade war, the United States applied only five tariff rate changes to targeted varieties: 10%, 20%, 25%, 30%, and 50%. Virtually all varieties (99.8%) were hit with either 10% or 25% tariff changes. The right panel shows that most of the retaliatory rate increases were concentrated at 10% or 25% as well. These patterns suggest that neither the United States nor retaliating countries were likely driven by a terms-of-trade rationale, because in that case we would expect tariff changes to vary across sectors.

10. Online Appendix Table A.1 provides a breakdown of the targeted products by final versus intermediate goods. For this table, we manually construct a match of HS-10 products to BLS Consumer Price Index product codes. This match suggests that 87% of targeted products within these sectors are intermediate goods (in value), compared with 72% of targeted products in all other sectors.

Online Appendix Figure A.2 plots average 2018 sector-level tariff rates against the foreign export supply elasticities estimated by Broda, Limão, and Weinstein (2008) and reveals a negative (and statistically insignificant) relationship (the correlation is −0.10).

This lack of variation across sectors also suggests that the tariff changes are unlikely to have been driven by sector-specific interest groups. Explanations in this tradition argue that sectors make political campaign contributions and engage in costly lobbying activities to secure import protection from policy makers (Grossman and Helpman 1994; Goldberg and Maggi 1999). However, these explanations also rely on variation in protection across sectors. Online Appendix Figure A.3 plots financial campaign contributions made to candidates for the U.S. House of Representatives in the 2016 election against tariff changes at the sector level and reveals a negative, rather than a positive, correlation. Although this evidence is only suggestive, it appears unlikely that campaign contributions were the main determinant of the U.S. tariff structure in the trade war.

II.D. Event Study

We visualize the effects of the tariff war on trade using an event-study framework. To assess impacts, we compare the trends of targeted varieties (those directly affected by a tariff increase) to varieties not targeted in the following specification:

$$\ln y_{igt} = \alpha_{ig} + \alpha_{gt} + \alpha_{it} + \sum_{j=-6}^{6} \beta_{0j} I\left(event_{igt} = j\right) \\ + \sum_{j=-6}^{6} \beta_{1j} I\left(event_{igt} = j\right) \times target_{ig} + \epsilon_{igt}. \tag{1}$$

This specification includes variety (α_{ig}), country-time (α_{it}), and product-month (α_{gt}) fixed effects. Varieties targeted by tariffs are captured by the $target_{ig}$ dummy. The inclusion of α_{gt} fixed effects implies that the β_{1j} coefficients are identified using variation between targeted and nontargeted varieties in product-time. The event time coefficients are captured by the indicator variables. In these specifications, we assign the event date of targeted varieties to be the nearest full month to the actual event date, using the 15th of the month as the cutoff date.[11] Nontargeted varieties in

11. The event date varies by both product and country because some varieties in the same product code are targeted before others. For example, the United

the same HS-10 product as a targeted variety are assigned the earliest event date within that product code. For all other nontargeted varieties, we assign the event date to be the earliest month of a targeted variety within the same NAICS-4 sector. If a nontargeted variety does not share the same NAICS-4 as any targeted varieties, we sequentially use NAICS-3 and NAICS-2 codes and otherwise assign the event month to be the earliest month of the trade war (February 2018 for imports and April 2018 for exports). We bin event times $\geqslant 6$ together and exclude event time $\leqslant -7$. For import outcomes, standard errors are clustered by country and HS-8, because these are generally the levels at which the tariffs are set.[12] For export outcomes, standard errors are clustered by HS-6 and country; here, we use HS-6 because that is the finest level at which product codes are comparable across countries and the level at which we code the retaliatory tariffs. We plot the β_{1j} dummies that capture the relative trends of targeted varieties.

Figure II reports the impacts on imported varieties. The top two panels trace the impact of tariffs on import values and quantities, and the bottom panels show the effects on unit values, exclusive and inclusive of duties. On impact, we detect large declines in imports. Import values decline on average by 20% and quantities decline by 23%.[13] In the bottom left panel, before-duty unit values do not change. However, duty-inclusive unit values increase sharply for targeted varieties. These two panels provide initial evidence of complete pass-through of the tariffs to import prices at the variety level.

The event study also addresses concerns of tariff anticipation that would complicate the elasticity estimates. The figure

States imposed steel tariffs on Canada, Mexico, and the EU three months after imposing steel tariffs on other countries.

12. In a small number of cases, tariffs vary within HS-8 codes at the HS-10 level. See Online Appendix A.

13. The figure reveals a temporary increase in import values and quantities in event period +2 for targeted varieties. In Online Appendix B we show that this increase is driven by imports in December 2018 as a result of a September 2018 announcement that the United States would increase tariffs on $200 billion of already targeted Chinese varieties from 10% to 25% on January 1, 2019. A plausible reason we observe large anticipation effects only in this instance is that, unlike in previous U.S. tariff waves, the January 2019 escalation was announced long in advance and was perceived to be credible given the previous tariff waves. The United States ultimately implemented this threat in May 2019, which is beyond our sample period.

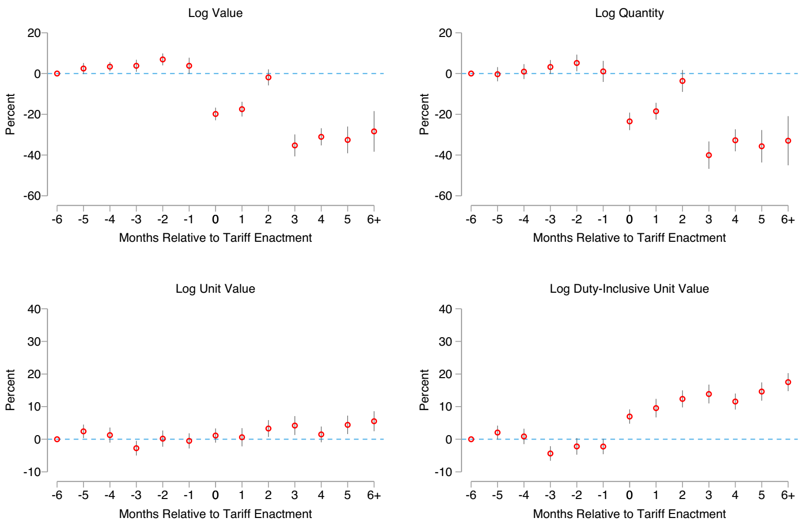


FIGURE II

Variety Event Study: Imports

Figure plots event time dummies for targeted varieties relative to untargeted varieties. Regressions include country-product, product-time, and country-time fixed effects. Standard errors are clustered by country and HS-8. Event periods before -6 are dropped, and event periods $\geqslant 6$ are binned. Error bars show 95% confidence intervals. In Online Appendix B we provide evidence that the temporary surge in imports during event period 2 reflects an anticipation response to additional tariff threats on a subset of Chinese varieties. Sample: monthly variety-level import data are from U.S. Census. The sample period is 2017:1 to 2019:4.

reveals anticipatory effects occurring before the tariff changes, but they are quantitatively small. Hence, the concern that importers shifted forward their purchases to avoid paying tariffs is mild. Below, we further assess tariff anticipation through dynamic specifications.

Figure III reports the impacts of the retaliatory tariffs on U.S. exports. The patterns are similar to what we observe for imports. We find that at the month of implementation, export values decline on average by 24% and quantities fall by 25%. Again, we observe no change in the before-duty unit values, suggesting complete pass-through of the retaliatory tariffs to foreigners' imports of U.S. varieties. We also observe no clear pattern of anticipation for U.S. exports.

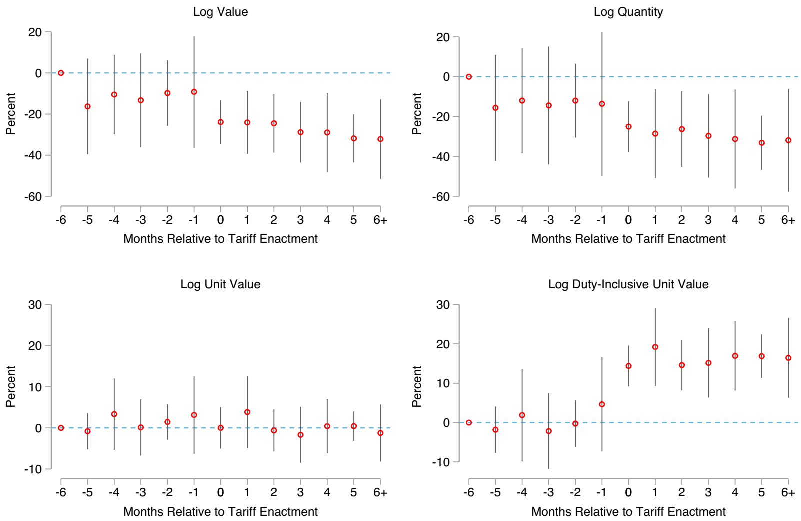


FIGURE III

Variety Event Study: Exports

Figure plots event time dummies for targeted varieties relative to untargeted varieties. Regressions include country-product, product-time, and country-time fixed effects. Standard errors are clustered by country and HS-6. Event periods before -6 are dropped, and event periods $\geqslant 6$ are binned. Error bars show 95% confidence intervals. Sample: monthly variety-level export data are from U.S. Census. The sample period is 2017:1 to 2019:4.

III. TRADE FRAMEWORK AND IDENTIFICATION

Here we describe the trade framework that guides the estimation. We defer supply-side and general-equilibrium assumptions to Section V.

III.A. U.S. Import Demand

There are S traded sectors corresponding to four-digit NAICS sectors (collected in the set $\mathcal{S}$ and indexed by s). Within each traded sector, aggregate demand (from producers and consumers) is structured according to a three-tier CES demand system. In the upper nest there is differentiation between domestic and imported goods. Within each of these two nests of sector s there are G_s products (collected in the set $\mathcal{G}_s$ and indexed by product g) corresponding to an HS-10 level of aggregation. Within the nest of imported products, varieties are differentiated by country of origin. The United States trades with I countries (collected in the set $\mathcal{I}$ and indexed by country i).

The CES utility functions and price indexes are presented in Online Appendix C. This structure gives U.S. import demand in each tier as a function of prices. The value of imports in sector s is

$$P_{Ms}M_s = E_s A_{Ms}\left(\frac{P_{Ms}}{P_s}\right)^{1-\kappa}, \tag{2}$$

where E_s are aggregate U.S. expenditures in sector s from both final consumers and firms, A_{Ms} is an import demand shock, P_{Ms} is the import price index defined in equation (C.7) in Online Appendix C, and P_s is the sector price index defined in equation (C.5).

The value of imports for product g in sector s is

$$p_{Mg}m_g = P_{Ms}M_s a_{Mg}\left(\frac{p_{Mg}}{P_{Ms}}\right)^{1-\eta}, \tag{3}$$

where a_{Mg} is an import demand shock and p_{Mg} is the import price index of product g defined in equation (C.8).

Finally, the quantity imported of product g's variety from country i is

$$m_{ig} = m_g a_{ig}\left(\frac{p_{ig}}{p_{Mg}}\right)^{-\sigma}, \tag{4}$$

where a_{ig} is a demand shock and p_{ig} is the domestic price of the variety ig. The United States imposes ad valorem tariffs τ_{ig} on the CIF price p^*_{ig}, so the domestic price is:

$$p_{ig} = \left(1+\tau_{ig}\right)p^*_{ig}. \tag{5}$$

The previous demand equations depend on three elasticities: across imported varieties within product (σ), across products (η), and between imports and domestic products within a sector (κ).[14]

14. This demand system is also used by Broda, Limão, and Weinstein (2008). In our setting, it is motivated by the available monthly public data: variety- and product-level imports and exports and sector-level domestic production data. With this nesting structure, it is sufficient to observe the import shares of expenditures within each sector s to estimate the elasticities and implement counterfactuals. It

III.B. Foreign Export Supply and Import Demand

Trade partners are represented with export-supply and import-demand curves at the variety level. We allow for import price effects of U.S. trade policy through potentially upward-sloping foreign export supply. The inverse foreign export supply curve is

$$p^*_{ig} = z^*_{ig} m_{ig}^{\omega^*}, \tag{6}$$

where z^*_{ig} is a foreign marginal cost shifter that could also include a bilateral iceberg trade cost. The parameter ω^* is the inverse foreign export supply elasticity. It is a key determinant of the effects of U.S. trade policy, as it drives the magnitude of the reduction in foreign prices when tariffs are imposed. Before-duty import prices p^*_{ig} fall more sharply the larger is ω^*.

Each foreign country demands a quantity x_{ig} of U.S. exports of good g. Foreign import demand for U.S. varieties is similar to equation (4) on the U.S. side but with a potentially different demand shifter and demand elasticity:

$$x_{ig} = a^*_{ig} \left(\left(1 + \tau^*_{ig}\right) p^X_{ig} \right)^{-\sigma^*}, \tag{7}$$

where x_{ig} is the U.S. exports of product g to country i, p^X_{ig} is the export price received by exporters, τ^*_{ig} is the ad valorem tariff set by country i on U.S. exports of good g, and a^*_{ig} is a foreign demand shock.

III.C. Identification

This section discusses the identification strategy for the elasticities and its potential threats.

1. U.S. Import and Foreign Export Variety Elasticities (σ, ω^*). We use variation in U.S. import tariffs to estimate the variety import demand and export supply elasticities

does not require information on import shares within each product g, which are not observed in publicly available data but would be required under alternative nesting assumptions. A potential shortcoming is that the imports m_g of any particular product g in sector s affect the domestic expenditures of that same product only through sector-level shifters. Inverting the order of the top two nests does not matter for the estimation of the lowest tier elasticities (σ, σ^*, and ω^*), and it would not matter for the implementation of counterfactuals if κ and η were equal.

simultaneously. The strategy of identifying two elasticities with one instrument was applied by Romalis (2007) in a trade context and studied by Zoutman, Gavrilova, and Hopland (2018) in the context of applications to public finance. Intuitively, tariffs create a wedge between what the importer pays and what the exporter receives. A tariff shifts down the demand curve for any given price received by the exporter, tracing the supply curve. Similarly, a tariff shifts up the supply curve for any given price paid by the consumer, tracing the demand curve. Hence, data on changes in prices, tariffs, and quantities is sufficient to trace both the demand and supply curves simultaneously.

Adding a time subscript and log-differencing over time, equations (4) and (6) can be written as

$$\Delta \ln m_{igt} = \eta^m_{gt} + \eta^m_{it} + \eta^m_{is} - \sigma \Delta \ln p_{igt} + \varepsilon^m_{igt}, \tag{8}$$

$$\Delta \ln p^*_{igt} = \eta^{p^*}_{gt} + \eta^{p^*}_{it} + \eta^{p^*}_{is} + \omega^* \Delta \ln m_{igt} + \varepsilon^{p^*}_{igt}, \tag{9}$$

where, $y = \{p^*, m\}$, the η^y_{gt} are product-time fixed effects, the η^y_{it} are country-time fixed effects, and the η^y_{is} are country-sector fixed effects (s is the sector of product g). For now, suppose that tariffs are uncorrelated with unobserved import demand and export supply shocks entering in the residuals, an issue we return to at the end of this subsection. Then, the import demand elasticity σ is identified by instrumenting the duty-inclusive price Δp_{igt} with the tariff $\Delta \tau_{igt}$ in equation (8). The export supply ω^* is identified by instrumenting imports with $\Delta \tau_{igt}$ in equation (9).[15]

2. Product Elasticity (η). The elasticity η across products is identified by aggregating variety-specific tariffs to the product level. From equation (3), adding a time subscript and log-differencing over time, we have

$$\Delta \ln s_{Mgt} = \psi_{st} + (1 - \eta) \Delta \ln p_{Mgt} + \varepsilon_{Mgt}, \tag{10}$$

where $s_{Mgt} \equiv \frac{p_{Mgt} m_{gt}}{P_{Mst} M_{st}}$ is the import share of product g in sector s. The parameter $\psi_{st} \equiv -(1 - \eta)\Delta \ln (P_{Mst})$ is a sector-time fixed effect that controls for the overall sector import price index, and ε_{Mgt} is a residual that captures the imported product demand shock.

15. Our model assumes flexible prices and abstracts from sticky prices, so we interpret ω^* as the slope of the supply curve.

The elasticity η can be estimated from a regression of changes in import expenditure shares of product g on sector-time fixed effects and changes in the import price index p_{Mgt}.

We build the import price index from the variety-level data accounting for the entry and exit of varieties by applying the variety correction from Feenstra (1994). Combining equations (C.8) and (4) we obtain the following exact expression for the change in the product price index:

$$\Delta \ln p_{Mgt} = \frac{1}{1-\sigma} \ln \left(\sum_{i \in \mathcal{C}_{gt}} s_{igt} e^{(1-\sigma)\Delta \ln\left(p^*_{igt}(1+\tau_{igt})\right)+\Delta \ln a_{igt}} \right)$$

$$- \frac{1}{1-\sigma} \ln \left(\frac{S_{g,t+1}\left(\mathcal{C}_{gt}\right)}{S_{g,t}\left(\mathcal{C}_{gt}\right)} \right), \tag{11}$$

where s_{igt} is the share of continuing variety i in all continuing varieties, $\mathcal{C}_{gt}$ is the set of continuing imported varieties in product g between t and $t+1$, and $S_{g,t}(\mathcal{C})$ is the share of the varieties in the set $\mathcal{C}$ in the total imports of product g at time t.[16] The price index includes two pieces from the estimation in the previous step: the estimated σ and the residuals, which reflect mean-zero demand shocks $\Delta\ln(a_{igt})$.

According to our model, the change in the product price index p_{Mgt} is correlated with the unobserved demand shock ε_{Mgt}. Using the same logic applied at the previous stage that tariffs are uncorrelated with demand shocks, we can instrument $\Delta\ln p_{Mgt}$ using the tariffs. Since using value weights may induce mechanical correlations with the left-hand side of equation (10), we construct an instrument that is a simple average of changes in tariffs across the continuing varieties:

$$\Delta \ln Z_{Mgt} = \ln \left(\frac{1}{N^{\mathcal{C}}_{gt}} \sum_{i \in \mathcal{C}_{gt}} e^{\Delta \ln\left(1+\tau_{igt}\right)} \right), \tag{12}$$

where $N^{\mathcal{C}}_{gt}$ is the number of continuing varieties in product g between t and $t+1$.

3. Import Elasticity (κ). We further aggregate to the top tier within a sector to estimate the elasticity κ between domestic and imported products within sectors. The import expenditures

16. That is, $s_{igt} \equiv \frac{p_{igt} m_{igt}}{\sum_{i' \in \mathcal{C}_{gt}} p_{i'gt} m_{i'gt}}$ and $S_{g,t}(\mathcal{C}) \equiv \frac{\sum_{i' \in \mathcal{C}} p_{i'gt} m_{i'gt}}{\sum_{i' \in \mathcal{I}} p_{i'gt} m_{i'gt}}$.

$P_{Mst}M_{st}$ defined in equation (2), relative to the expenditures in domestically produced goods $P_{Dst}D_{st}$, are a function of the import price index P_{Mst} relative to the price index of domestically produced goods P_{Dst}, defined in equations (C.7) and (C.6):

$$\Delta \ln \left(\frac{P_{Mst} M_{st}}{P_{Dst} D_{st}} \right) = \psi_s + \psi_t + (1-\kappa)\, \Delta \ln \left(\frac{P_{Mst}}{P_{Dst}} \right) + \varepsilon_{st}. \tag{13}$$

The fixed effects and residual components capture demand shocks. We proceed analogously to the previous step to construct the sector import price index, P_{Mst}, and to instrument by aggregating product-level tariff instruments. The import price index of sector s changes according to:

$$\Delta \ln P_{Mst} = \frac{1}{1-\eta} \ln \left(\sum_{g \in \mathcal{C}_t^s} s_{gt} e^{(1-\eta)\Delta \ln p_{gMt} + \Delta \ln(a_{gMt})} \right) - \frac{1}{1-\eta} \ln \left(\frac{S_{t+1}^s \left(\mathcal{C}_t^s\right)}{S_t^s \left(\mathcal{C}_t^s\right)} \right), \tag{14}$$

where s_{gt} is the import share of continuing product g in continuing products imported in sector s, $S_t^s(\mathcal{C})$ is the share of the products in the set $\mathcal{C}$ in imports of sector s at time t, and $\mathcal{C}_t^s$ is the set of continuing imported products in sector s between t and $t+1$.

We construct $\Delta \ln P_{Mst}$ using the residuals $\varepsilon_{Mgt} = \Delta \ln(a_{gMt})$ estimated from equation (10). We instrument for the relative price of imports, $\Delta \ln \left(\frac{P_{Mst}}{P_{Dst}} \right)$, using simple averages:

$$\Delta \ln Z_{Mst} \equiv \ln \left(\frac{1}{N_{st}^{\mathcal{C}}} \sum_{g \in \mathcal{C}_t^s} e^{\Delta \ln Z_{gMt}} \right), \tag{15}$$

where Z_{Mst} is the instrument defined in equation (12) at the product level and $N_{st}^{\mathcal{C}}$ is the number of continuing products in sector s between t and $t+1$.

4. Foreign Import and U.S. Export Variety Elasticities (σ^*, ω). The foreign import demand is estimated using an analogous equation to equation (8). We consider how U.S. exports respond to retaliatory tariffs. From equation (7), decomposing the log change of the foreign demand shifter into a product-time effect η_{gt}^x, a country-time effect η_{it}^x, a country-sector effect η_{is}^x, and a residual

ε^{x}_{igt}, we obtain

$$\Delta \ln x_{igt} = \eta^{x}_{gt} + \eta^{x}_{it} + \eta^{x}_{is} - \sigma^{*} \Delta \ln \left(\left(1 + \tau^{*}_{igt}\right) p^{X}_{igt} \right) + \varepsilon^{x}_{igt}, \tag{16}$$

where p^{X}_{igt} is the before-duty price observed in the United States. If the retaliatory tariffs τ^{*}_{igt} are uncorrelated with foreign import demand shocks ε^{x}_{igt}, we can identify σ^{*} by instrumenting the change in the duty-inclusive price, $p^{X*}_{igt} \equiv p^{X}_{igt}(1 + \tau^{*}_{igt})$, with the change in retaliatory tariffs.

We estimate the U.S. variety inverse export supply curve using a specification analogous to equation (9):

$$\Delta \ln p^{X}_{igt} = \eta^{p}_{gt} + \eta^{p}_{it} + \eta^{p}_{is} + \omega \Delta \ln x_{igt} + \varepsilon^{p}_{igt}, \tag{17}$$

where ω is the inverse export supply elasticity to each destination from the United States, after controlling for the fixed effects. We instrument for changes in exports with the changes in retaliatory tariffs.

5. Threats to Identification. There are three main identification threats when using tariffs to estimate the elasticities.

First, the simultaneous identification of demand and supply requires that the tariff affects importers' willingness to pay. If importers can evade the tariff or do not base their demand on duty-inclusive prices, the tariffs will not cause inward shifts of the import demand curve. In our setting, we do not believe either concern is of first order. Although sales taxes may not be salient to consumers because retail prices are quoted in before-tax prices (e.g., Chetty, Looney, and Kroft 2009), tariffs are paid at the border, and importers observe the after-tariff prices. Tariff evasion is a larger concern in developing countries (e.g., Sequeira 2016).

Second, as previously mentioned, we require that tariff changes are uncorrelated with unobserved import demand and export supply shocks. The system of equations is estimated in first differences and controls flexibly for unobserved demand and supply shocks at each step, which mitigates this concern. The event study figures suggest that targeted import and export varieties were not on statistically different trends prior to the war. In the next section, we implement additional checks for pretrends that support this key identification assumption.

Third, importers may have anticipated looming tariffs in the months before implementation. If they shifted their imports forward, this could bias the elasticities because of a mismatch in the timing of imports and tariff changes.[17] The event study suggests that tariff anticipation is not a concern, and in the next section we implement dynamic specifications that allow lags and leads of tariffs to test formally for anticipation effects.

The identification strategy is not threatened if the tariff changes reflect differences in preferences for redistribution toward specific sectors between the policy makers elected in 2016 and the previous policy makers. Rather, the identification only requires those changes in preferences to be uncorrelated with unobserved shocks to demand and supply over the time period in which the tariff changes take place.

IV. Estimation

This section addresses threats to identification, presents the elasticity estimates, and examines the robustness of the results.

IV.A. Preexisting Trends

To identify the elasticities, tariff changes must be uncorrelated with import demand and export supply shocks. The event studies suggest that targeted varieties were not on different trends prior to the trade war. We further assess concerns about pretrends by correlating import and export outcomes before the 2018 trade war—values, quantities, unit values, and duty-inclusive unit values—with the subsequent tariff changes.

We compute these outcomes as the average monthly change in 2017 and regress them against the changes in the import tariff rates between 2017 and 2018:[18]

$$\overline{\Delta \ln y_{ig,2017}} = \alpha_g + \alpha_{is} + \beta \Delta \ln(1 + \tau_{ig}) + \epsilon_{ig}. \tag{18}$$

These regressions control for HS-10 product (α_g) and country-sector (α_{is}) fixed effects, because the estimating equations derived in Section III.C.1 exploit tariff variation controlling for these fixed

17. Coglianese et al. (2017) emphasize this point in the context of estimating the demand for gasoline.

18. We examine pretrends between the start of the Trump administration in 2017:1 and 2017:12, which pre-dates the first round of the trade war by two months. Online Appendix Table A.2 reports tests for preexisting trends over a longer time horizon by correlating average monthly outcomes between 2013:1 and 2017:12 with the tariff changes during the war. There is no evidence that the import tariff and retaliatory changes were biased toward import or export trends over this longer horizon.

TABLE III
TESTS FOR PREEXISTING TRENDS

	$\Delta \ln p^*_{ig} m_{ig}$ (1)	$\Delta \ln m_{ig}$ (2)	$\Delta \ln p^*_{ig}$ (3)	$\Delta \ln p_{ig}$ (4)
Panel A: U.S. import trends				
$\Delta_{17-18} \ln(1+\tau_{ig})$	0.12	−0.04	0.18	0.18
	(0.11)	(0.19)	(0.15)	(0.15)
Country × sector FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
R^2	0.14	0.14	0.14	0.14
N	180,744	149,173	149,173	149,173
	$\Delta \ln p^X_{ig} x_{ig}$	$\Delta \ln x_{ig}$	$\Delta \ln p^X_{ig}$	$\Delta \ln p^X_{ig}(1+\tau^*_{ig})$
Panel B: U.S. export trends				
$\Delta_{17-18} \ln(1+\tau^*_{ig})$	0.07	0.11	−0.03	−0.03
	(0.06)	(0.09)	(0.07)	(0.07)
Country × sector FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
R^2	0.11	0.12	0.12	0.12
N	207,840	163,181	163,181	163,181

Notes. Table reports pretrend tests for import (Panel A) and export (Panel B) variety-level trade outcomes. Table reports regressions of the 2017:1–2017:12 average monthly changes in values, quantities, unit values, and tariff-inclusive unit values against the 2018 tariff changes. Standard errors are clustered by country and HS-8 (imports) or HS-6 (exports). Significance: *** .01; ** 0.05; * 0.10.

effects. Standard errors are clustered by country and HS-8 (for imports) or HS-6 (for exports).

The top panel of Table III reports the pretrend tests for imports. We do not observe any statistically significant relationship across import outcomes, suggesting that targeted import varieties were not on differential trends prior to the war. The bottom panel reports the analogous results for U.S. export outcomes and show a similar pattern: prewar export trends are uncorrelated with retaliatory tariffs.

IV.B. U.S. Imports and Foreign Exports at the Variety Level

This subsection estimates the elasticity of variety import demand and foreign export supply following the approach described in Section III.C.1.

Table IV reports the responses of U.S. imports to the tariff changes. Columns (1)–(4) report the results of regressing the four outcomes—values (p^*m), quantities (m), unit values (p^*), and duty-inclusive unit values (p)—on the tariffs. Each specification is run in first differences and includes fixed effects for

TABLE IV

VARIETY IMPORT DEMAND (σ) AND FOREIGN EXPORT SUPPLY (ω^*)

	$\Delta \ln p^*_{igt} m_{igt}$ (1)	$\Delta \ln m_{igt}$ (2)	$\Delta \ln p^*_{igt}$ (3)	$\Delta \ln p_{igt}$ (4)	$\Delta \ln p^*_{igt}$ (5)	$\Delta \ln m_{igt}$ (6)
$\Delta \ln (1+\tau_{igt})$	-1.52^{***}	-1.47^{***}	0.00	0.58^{***}		
	(0.18)	(0.24)	(0.08)	(0.13)		
$\Delta \ln m_{igt}$					−0.00	
					(0.05)	
$\Delta \ln p_{igt}$						-2.53^{***}
						(0.26)
Product × time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × sector FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F					36.5	21.2
Bootstrap CI					[−0.14,0.10]	[1.75,3.02]
R^2	0.13	0.13	0.11	0.11	0.00	—
N	2,993,288	2,454,023	2,454,023	2,454,023	2,454,023	2,454,023

Notes. Table reports the variety-level import responses to import tariffs. Columns (1)–(4) report import values, quantities, before-duty unit values, and duty-inclusive unit values regressed on the statutory tariff rate. Column (5) reports the foreign export supply curve IV regression, $\hat{\omega}^*$, from equation (9); the first stage is column (2). Column (6) reports the import demand curve IV regression, $\hat{\sigma}$, from equation (8); the first stage is column (4). All regressions include product-time, country-time, and country-sector fixed effects. The coefficient in column (4) is not 1 plus the coefficient in column (3) because the duty inclusive unit value is constructed using actual duties collected by U.S. customs data. Standard errors are clustered by country and HS-8. 90% bootstrap confidence intervals are constructed from 1,000 samples. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level import data from 2017:1 to 2019:4.

product-time, country-time, and country-sector pairs. The specification exploits variation in variety-level tariffs over time to identify the elasticities while controlling for seasonality, time-varying country factors (such as exchange rates), and country-sector time trends. Standard errors are two-way clustered by country and HS-8.

Column (1) shows that import values drop sharply with tariff increases. Column (2) shows that the decline in import values is closely matched by a commensurate decline in quantities.

Column (3) indicates no impact of tariff increases on before-duty unit values. This is the key result providing evidence that the incidence of import tariffs is borne by the U.S. economy, which is consistent with the event study in Figure II.[19] The reduced-form

19. The elasticity of the duty-inclusive unit value in column (4) is not 1 plus the coefficient in column (3) because the duty-inclusive value p_{ig} is computed using actual duties collected by U.S. customs rather than imputing from the statutory rate. Online Appendix Table A.3, columns (1)–(4) report regressions of the variables in columns (2)–(5) on the applied tariff instrumented by the statutory rate. It also reveals complete tariff pass-through. In these regressions, the coefficient on duty-inclusive prices (column (5)) is 1 plus the coefficient on the before-duty price

regressions suggest a complete pass-through of tariffs to duty-inclusive import prices.

We report the variety import demand and foreign export supply elasticities $\{\sigma, \omega^*\}$ using the IV equations in equations (8) and (9) in columns (5) and (6). Column (5) reports the supply curve elasticity $\hat{\omega}^*$; the first stage is column (2). The coefficient is small and imprecisely estimated, $\hat{\omega}^* = -0.002$ (*se* 0.05). This estimate implies that we cannot reject a horizontal supply curve and supports the reduced-form evidence of complete pass-through. Column (6) reports the estimated import demand elasticity σ; the first stage is column (4). The estimate implies $\hat{\sigma} = 2.53$ (std. err. = 0.26). The bootstrapped 90% confidence interval, formed from 1,000 samples, is [1.75, 3.02]. With these elasticities, using the solution to the system of supply and demand equations (8) and (9) in columns (5) and (6), the average change in import values of targeted varieties is:

$$\overline{\Delta \ln \left(p^*_{igt} m_{igt}\right)} = -\underbrace{\hat{\sigma}\frac{1+\hat{\omega}^*}{1+\hat{\omega}^*\hat{\sigma}}}_{2.54}\underbrace{\overline{\Delta \ln \left(1+\tau_{igt}\right)}}_{12.5\%} = 31.7\%.$$

IV.C. Product-Level Imports

Table V presents estimates of the product elasticity (η) from equation (10), following the steps described in Section III.C.2. The procedure aggregates the import data to the product-time level, and the regressions are run in first differences controlling for sector-time pair fixed effects, as dictated by the model. Standard errors are clustered at the HS-8 level. We construct the price index from equation (11) using $\hat{\sigma} = 2.53$ and the demand shocks from the import variety demand equation from Table IV, column (6). We build the instrument $\Delta \ln Z_{gMt}$ using equation (12).

Column (1) regresses the change in product shares, $\Delta \ln (s_{Mgt})$, on the instrument $\Delta \ln Z_{Mgt}$ (i.e., the reduced form). Higher product-level tariffs lower the product import share. Column (2) reports the first stage, a regression of the duty-inclusive product-level price index $\Delta \ln (p_{Mgt})$ on the instrument. The sign is consistent with higher tariffs raising the product price index. Column (3) reports the IV estimate, which regresses the change in product shares on the change in the instrumented price index. The

(column (4)) and the coefficient on import quantities (column (3)) is very close to the estimated σ in Table IV, column (4).

TABLE V
PRODUCT ELASTICITY η

	$\Delta\ln s_{Mgt}$ (1)	$\Delta\ln p_{Mgt}$ (2)	$\Delta\ln s_{Mgt}$ (3)
$\Delta\ln Z_{Mgt}$	-0.81^{**}	1.52^{***}	
	(0.39)	(0.40)	
$\Delta\ln p_{Mgt}$			-0.53^{*}
			(0.27)
Sector-time FE	Yes	Yes	Yes
1st-stage F			14.6
$\hat{\eta}$ (se[$\hat{\eta}$])			1.53 (0.27)
Bootstrap CI			[1.15, 1.89]
R^2	0.01	0.10	—
N	371,916	371,916	371,916

Notes. Table reports the product-level import responses to import tariffs. Column (1) reports the reduced-form regression of the imported product's share within sectoral imports, s_{gt}, on the product-level instrument, Z_{gt}. Column (2) reports the first stage: the regression of the product-level import price index P_{gt} on Z_{gt}. Column (3) reports the IV regression with the implied $\hat{\eta}$ and its standard error noted at the bottom of the table in column (3). The product-level import price index is constructed using $\hat{\sigma}$ from column (6) of Table IV according to equation (11), and the instrument is constructed using the statutory tariffs using equation (12). All regressions include sector-time fixed effects. 90% bootstrap confidence intervals are constructed from 1,000 samples. Regressions are clustered by HS-8. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly product-level import data from 2017:1 to 2019:4.

estimate implies $\hat{\eta} = 1.53$ (std. err. $= 0.27$). The bootstrapped confidence interval for η, which accounts for the variance of $\hat{\sigma}$ and the demand shocks from the lowest tier, is [1.15, 1.89].

The reduction in imports of targeted products implies that imports from untargeted origins did not fully offset import declines from targeted origins. Hence, rerouting of imports or reallocation of producers to untargeted countries does not seem to be a first-order force over the time horizon that we consider. We also find that import tariffs did not lower before-tariff product-level prices. We construct the before-duty product-level price index using (11) but excluding duties. This before-duty product-level price index includes a Feenstra variety correction, so it accounts for reallocations towards new source countries. Regressing that index against the tariff instrument $\Delta\ln Z_{gMt}$ with sector-time fixed effects yields a positive coefficient of 0.91 (std. err. $= 0.40$).

We complement this product-level analysis with a reduced-form approach that does not rely on the CES nesting structure. Online Appendix Table A.8 regresses the product-time fixed effects from the variety-level regressions on the product-time component of variety-level tariffs. Consistent with the previous results, we find a decline in product-level imports of targeted

TABLE VI
SECTOR ELASTICITY κ

	$\Delta\ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$ (1)	$\Delta\ln\left(\frac{P_{Mst}}{p_{st}}\right)$ (2)	$\Delta\ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$ (3)
$\Delta\ln Z_{Mst}$	0.30	−1.59	
	(0.36)	(3.49)	
$\Delta\ln\left(\frac{P_{Mst}}{p_{st}}\right)$			−0.19
			(0.49)
Sector FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
1st-stage F			0.2
$\hat{\kappa}$ (se[$\hat{\kappa}$])			1.19 (0.49)
Bootstrap CI			[0.89, 1.71]
R^2	0.24	0.67	—
N	2,041	2,041	2,041

Notes. Table reports the sector-level import responses to import tariffs. The sample is at the sector-time level from 2017:1 to 2019:4. Column (1) reports the reduced-form regression of the imported sector's share within total sectoral expenditures imports, s_{gt}, on the product-level instrument, Z_{gt}. Column (2) reports the first stage: the regression of the product-level import price index P_{gt} on Z_{gt}. Column (3) reports the IV regression with the implied $\hat{\eta}$ and its standard error noted at the bottom of the table in column (3). The sector import price index is constructed using $\hat{\sigma}$ from Table IV, column (6), and $\hat{\eta}$ from Table V, column (3), according to equation (14), and the instrument is constructed using the statutory tariffs using equation (15). All regressions include sector fixed effects. Regressions are clustered by sector. 90% bootstrap confidence intervals are constructed from 1,000 samples. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly sector-level import data from 2017:1 to 2019:4.

products, suggesting that rerouting is not an important concern, and no statistically significant decline in the before-duty import price, suggesting complete pass-through at the product level.[20]

Using this elasticity and the average change in product-level statutory import tariffs, these estimates imply that import values for targeted products within imported sectors fell, on average, 2.5% across targeted products. This number is the average change in import values for targeted products obtained from $\overline{\Delta\ln p_{Mgt}m_{gt}} = -(\hat{\eta}-1)\,\overline{\Delta\ln Z_{gMt}}$, where $\hat{\eta} = 1.53$ and $\overline{\Delta\ln Z_{gMt}} = 4.7\%$.

IV.D. Sector-Level Imports

Table VI reports estimates of the sector elasticity (κ) following the steps described in Section III.C.3. The regressions control for

20. Flaaen, Hortaçsu, and Tintelnot (2019) argue that in response to discriminatory antidumping duties of 2012 and 2016, producers of washing machines reallocated products to untargeted countries with lower marginal costs. Our estimate of the elasticity of substitution within products ($\hat{\sigma} = 2.53$) is far from perfect substitution. As we have argued, we also find a decline in the import share of targeted products and no decline in the before-duty product-level import prices.

sector and time fixed effects, and cluster standard errors at the sector level. As shown in equation (13), estimating this elasticity requires data on changes in imports and domestic expenditures at the sectoral level.

The monthly change in U.S. expenditures on domestically produced goods, $\Delta \ln (P_{Dst} D_{st})$, is not directly observed. We measure it as the difference between the changes in sectoral production and exports. We also need data on the price index of domestically produced goods, $\Delta \ln (P_{Dst})$. We assume that the change in the price index of domestically produced goods equals the change in PPI, $\Delta \ln p_{st}$, plus a mean-0 shock: $\Delta \ln P_{Dst} = \Delta \ln p_{st} + \Delta \ln \varepsilon^{P}_{st}$.[21] Then we can implement equation (13) using the PPI instead of the consumer price index of domestically produced goods, which we do not observe. Hence, our specification uses $\Delta \ln(\frac{P_{Mst}}{p_{st}})$ instead of $\Delta \ln(\frac{P_{Mst}}{P_{Dst}})$ in equation (13). The change in the price index, $\Delta \ln P_{Mst}$, is constructed from equation (14) using the estimated $\hat{\sigma}$ and $\hat{\eta}$ from the previous two steps, and the demand shocks are constructed from these regressions.

Column (1) is the reduced-form specification that projects relative imports on the instrument, column (2) is the first stage, and column (3) is the IV estimate. The coefficient is negative, suggesting that price propagation of the tariff through input-output linkages is strong and causes the domestic PPI to increase but is noisy. The estimate implies a statistically significant $\hat{\kappa} = 1.19$ (std. err. = 0.49). The bootstrapped confidence interval for $\hat{\kappa}$, which takes into account the estimated $\{\hat{\sigma}, \hat{\eta}\}$ and demand shocks from the previous stages, is [0.89, 1.71].

Using this elasticity and the average change in sector-level statutory import tariffs, these estimates imply that import values across targeted sectors fell, on average, 0.2%. This number is the average change in import values for targeted sectors obtained from $\Delta \ln \left(\frac{P_{Mst} M_{st}}{P_{Dst} D_{st}}\right) = (1 - \hat{\kappa}) \Delta \ln Z^{stat}_{Mst}$, where $\hat{\kappa} = 1.19$ and $\overline{\Delta \ln Z_{gMt}} = 1.0\%$.

IV.E. U.S. Exports at the Variety Level

This subsection implements the analysis in Section III.C.A. These regressions examine the change in U.S. export outcomes

21. This assumption is consistent with the production structure we assume in the general-equilibrium model.

at the variety level in response to changes in retaliatory tariffs. The regressions include product-time, destination-time, and destination-sector fixed effects and cluster standard errors by destination country and HS-6.

We first report regressions of the four export outcomes on the retaliatory tariffs in Table VII, columns (1)–(4). We observe a statistically significant decline in both export values and quantities. In column (3) we find no evidence that the retaliatory tariffs, on average, caused U.S. exporters to lower (before-duty) product-level unit values. Rather, column (4) implies that the duty-inclusive export price rises approximately one-for-one with the tariff.

Column (5) reports the IV regression that estimates the U.S. export supply curve at the variety level. This is the analog to the variety-level supply curve in equation (6) on the export side. The first stage is column (2). The estimate is imprecisely measured, and we cannot reject the null that foreigners face a horizontal U.S. export supply curve. Column (6) reports the IV estimate of equation (16). The first stage is column (4). We estimate $\hat{\sigma}^* = 1.04$ (std. err. $= 0.32$). The bootstrapped confidence interval is [0.73, 1.39].

Using the estimated elasticity and the average change in retaliatory tariffs, these estimates imply that U.S. export values for varieties targeted by trade partners fell, on average, 9.9%. This number is the average change in export values for targeted varieties obtained from $\overline{\Delta \ln(p^X_{igt} x_{igt})} = -\hat{\sigma}^* \overline{\Delta \ln(1 + \tau^*_{igt})}$ where $\overline{\Delta \ln(1 + \tau^*_{igt})} = 9.5\%$.

IV.F. Robustness Checks

This section explores the robustness of the results. We first assess concerns that underlying trends or tariff anticipation bias the estimates. We also explore heterogeneity across sectors, compare the pass-through of tariffs to unit values at different time horizons, and examine how the results change with alternative sets of fixed effects.

1. Trends and Dynamic Specifications. Section IV.A documents that preexisting trends and anticipation effects are unlikely to threaten our identification. In this section, we provide further evidence that the elasticities are not sensitive to concerns over preexisting trends or anticipation effects.

TABLE VII

FOREIGN IMPORT DEMAND σ^*

	$\Delta \ln p^X_{igt} x_{igt}$ (1)	$\Delta \ln x_{igt}$ (2)	$\Delta \ln p^X_{igt}$ (3)	$\Delta \ln p^X_{igt}(1+\tau^*_{igt})$ (4)	$\Delta \ln p^X_{igt}$ (5)	$\Delta \ln x_{igt}$ (6)
$\Delta \ln(1+\tau^*_{igt})$	−0.99***	−1.00***	−0.04	0.96***		
	(0.28)	(0.36)	(0.16)	(0.16)		
$\Delta \ln x_{igt}$					0.04	
					(0.16)	
$\Delta \ln p^X_{igt}(1+\tau^*_{igt})$						−1.04***
						(0.32)
Product × time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country × sector FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-stage F					7.8	38.2
Bootstrap CI					[−0.30,0.26]	[0.73,1.39]
R^2	0.07	0.07	0.06	0.06	—	0.51
N	3,306,766	2,564,731	2,564,731	2,564,731	2,564,731	2,564,731

Notes. Table reports the variety-level export responses to retaliatory tariffs. Columns (1)–(4) report reduced-form regressions of export values, quantities, before-duty unit values, and duty-inclusive unit values on $\Delta \ln(1+\tau^*_{igt})$, the change in retaliatory export tariffs. Column (5) reports the IV regression that estimates the U.S. export supply elasticity $\hat{\omega}$; the first stage is column (2). Column (6) reports the IV regression that estimates the foreign import demand elasticity σ^*; the first stage is column (4). All regressions include product-time, country-time, and country-sector fixed effects. Standard errors are clustered by country and HS-6. 90% bootstrap confidence intervals are constructed from 1,000 samples. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level export data from 2017:1 to 2019:4.

The first robustness check controls for trends through panel fixed effects. We reestimate the variety-level specifications to include variety fixed effects and report the analog to Table IV in Online Appendix Table A.4 and the analog to Table VII in Online Appendix Table A.6. We assess long-run trends by reestimating the specifications with variety fixed effects using data from 2013:1 to 2019:4 in Online Appendix Tables A.5 and A.7. The results are essentially unchanged and remain consistent with the prior evidence that preexisting trends are unlikely to be confounding factors.

The second concern is that importers may have anticipated the changes in tariffs and shifted their purchasing decisions forward to avoid the duties. This would imply that even though tariffs have real effects on trade, regressions identified from contemporaneous changes in tariffs may produce biased elasticities. We check for anticipatory and delayed effects by allowing for leads and lags in variety-level reduced-form regressions:

$$\Delta \ln y_{igt} = \alpha_{gt} + \alpha_{it} + \alpha_{is} + \sum_{m=-6}^{m=6} \beta_m^y \big[\ln\big(1+\tau_{ig,t-m}\big) - \ln\big(1+\tau_{ig,t-1-m}\big)\big] + \epsilon_{igt}, \tag{19}$$

where we allow for leads and lags up to six months before and after the tariff changes.[22]

Figure IV reports the cumulative estimated coefficients for import values, quantities, unit values, and duty-inclusive unit values. The results reveal no quantitatively large patterns of tariff anticipation. In addition, the results show no evidence of before-duty price declines occurring after the tariffs are implemented. Finally, the cumulative magnitudes displayed in the figure are quantitatively similar to the reduced-form estimates from the static regressions. These results reassure us that the elasticities are not biased due to anticipation effects and that the variety-level pass-through findings are robust.

The bottom panel of Figure IV reports the results for exported varieties. In this specification, we find some evidence of tariff anticipation as U.S. export values increase in the month before tariffs

22. Because the dynamic specification requires a balanced panel in event time, we replace missing leading and lagged tariff changes with zeros and include indicators for those missing values. This is equivalent to assuming that the price of a variety does not change when we do not observe it in the data.

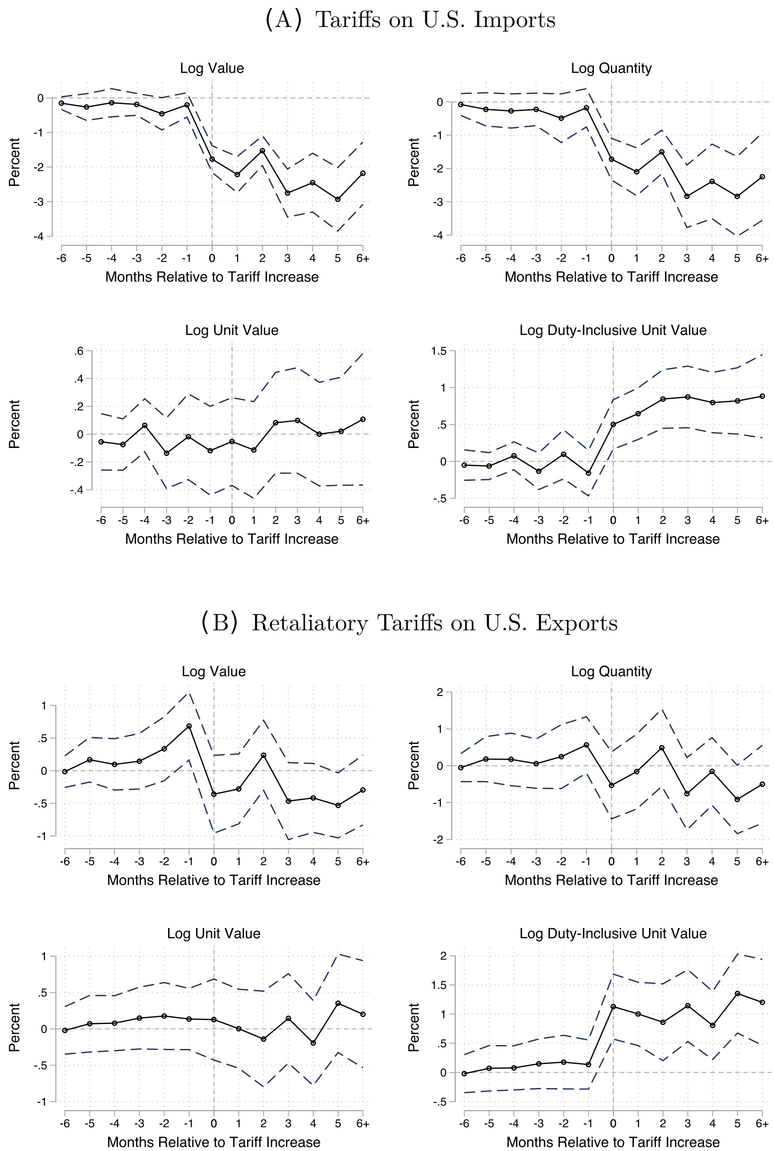


FIGURE IV

Dynamic Specification

FIGURE IV (*Continued*). Figures plot cumulative sum of β coefficients from the regression

$$\Delta \ln y_{igt} = \alpha_{gt} + \alpha_{it} + \alpha_{is} + \sum_{m=-6}^{m=6} \beta_m^y \left[\ln\left(1 + \tau_{ig,t-m}\right) - \ln\left(1 + \tau_{ig,t-1-m}\right)\right] + \epsilon_{igt},$$

where i denotes countries, g denotes products, and t denotes time. Standard errors are clustered by country and HS-8 for imports and by country and HS-6 for exports. Error bands show 95% confidence intervals. Monthly variety-level import and export data are from U.S. Census. The sample period is 2017:1 to 2019:4.

change; however, we do not observe this pattern for export quantities. We also do not observe cumulative declines in before-duty export prices occurring as time elapses after the retaliations are implemented.

2. Heterogeneity. The baseline specifications impose common elasticities across sectors. However, these specifications potentially mask variation in the tariff pass-through result. For example, we may expect more differentiated products or less competitive sectors to exhibit less than complete pass-through. We may also expect demand elasticities to depend on inventories and whether goods are durable, which may allow buyers to postpone sales more easily. Other product characteristics, such as variation in price stickiness or stocks of inventories, could induce heterogeneous pass-through.

In this subsection, we explore this potential heterogeneity by focusing on the complete pass-through finding at the variety level. To do so, we implement reduced-form specifications that regress changes in the import (export) unit values on changes in import (retaliatory) tariffs, controlling for product-time, country-time, and country-sector fixed effects. Each specification interacts the tariff change with different measures of product or sector characteristics that have been used widely in the literature.

Online Appendix Table A.9 reports results from interacting the tariff changes with three different classifications of final versus intermediate goods. The top panel examines the pass-through of the import tariffs to import unit values, and the bottom panel examines pass-through of the retaliatory tariffs to U.S. export unit values. Column (1) uses the Broad Economic Categories (BEC) classification that categorizes sectors according to their end use. Column (2) uses an indicator for whether the HS product matches an entry line item in the BLS Consumer Price Index (CPI). Column (3) uses an indicator for whether each HS-10 product description contains the word “part” or “component.” Although each classification is imperfect, the results do not show statistical differences between final and intermediate goods.

Online Appendix Table A.10 examines interactions across 11 different measures of product or sector characteristics that have been used in the literature: (i) quality ladders from Khandelwal (2010); (ii) markups estimated by De Loecker, Eeckhout, and Unger (forthcoming); (iii) the coefficient of price variation; (iv) elasticities of substitution estimated by Broda and Weinstein (2006); (v) trade elasticities estimated by Caliendo and Parro (2015); (vi) contract intensity measured by Nunn (2007); (vii) inverse frequency of price adjustments from micro-data tabulated by Nakamura and Steinsson (2008) (a higher value indicates less frequent price adjustments); (viii) measures of industry upstreamness by Antràs et al. (2012); (ix) inventory to sales ratios constructed from Census data; (x) differentiation developed by Rauch (1999); and (xi) an indicator for durable goods using the BEC classifications. The top panel reports the results for imports. The pattern across the 11 different metrics, along with the previous table, suggests that there is no meaningful heterogeneity in the complete pass-through result, at least with respect to the characteristics we have examined. Online Appendix Table A.11 reports the results for export unit values. Again we find no systematic evidence of heterogeneity with respect to observable characteristics.

3. Horizons. The variety-level complete pass-through results may be a short-run phenomenon. We assess the incidence of the tariffs at different time horizons by aggregating the data to the two-month, three-month, and four-month levels, taking first differences, and reimplementing the reduced-form regression specifications. The results for before-duty import and export unit values are reported in Online Appendix Table A.12, with the baseline estimates from the monthly data replicated in column (1) of each panel. Even at these medium-term frequencies, we do not observe downward pressure on before-duty unit values in response to the tariff changes.

4. Alternative Fixed Effects. Our baseline set of fixed effects—that is, product-time, country-time, and country-sector fixed effects—control for potentially confounding import demand and export supply shocks. However, if the trade war induces global or country-specific general-equilibrium responses to wages, these fixed effects may mask tariff pass-through effects in our regressions. Online Appendix Table A.13 reports the elasticity of before-duty unit values against the tariff changes controlling for different sets of fixed effects to explore this possibility. The top panel reports the import results and the bottom panel reports the export results, and column (1) of each panel reports the baseline estimates to facilitate comparisons across the alternate specifications. We do not observe any effect of the tariff on before-duty unit values across eight different sets of fixed effects, some of which exclude country-time or product-time fixed effects, in both the import and export data. We also extract the country-time α_{it} fixed effects in the baseline specification and regress them against monthly exchange rates, and do not find a statistically significant relationship (estimate is 0.11, std. err. = 0.19). We also do not find a relationship between the country-time fixed effects and exchange rate changes for China (estimate is 0.04, std. err. = 0.04).

V. Aggregate and Regional Impacts

Before turning to the full model in the next section, it is instructive to perform a few back-of the-envelope calculations using the estimated parameters to gauge the magnitude of the aggregate impacts of the trade war.

First, given complete tariff pass-through, the first-order approximation to the impact on U.S. consumer surplus is the product of three terms: the import share of value added (15%), the fraction of U.S. imports targeted by tariff increases (13%), and the average import price increase among targeted varieties (14%). This calculation implies buyers of imports lost in aggregate 0.27% of GDP, or $50.8 billion at a 2016 annual basis.

Second, under some assumptions the elasticities can be used to compute the impact on aggregate real income. Specifically, in the absence of changes in U.S. import and export prices, starting from free trade, and provided the environment satisfies neoclassical assumptions, the (second-order) approximation to the aggregate equivalent variation is $\frac{1}{2}(\Delta\mathbf{m})'\Delta\tau$, where $\Delta\mathbf{m}$ is the change in the vector of imports and Δt is the change in per unit import tariffs. Using the estimates for the changes in variety-level imports estimated in Section IV.B, and assuming that the fixed effects in those regressions are unresponsive to the tariffs, this calculation yields a real GDP loss of \$11 billion, or 0.059% of GDP.[23]

These approximations are computed assuming complete tariff pass-through. However, our empirical analysis at the variety level does not rule out terms-of-trade effects through changes in prices at the country or sector levels. Also, these calculations do not consider the impacts of retaliatory tariffs. We now combine the previously estimated parameters with a supply side of the U.S. economy. The model imposes upward-sloping industry curves and predicts changes in sector-level prices in the United States due to the demand reallocation induced by import and retaliatory tariffs. Through this channel, it generates additional aggregate and regional effects not captured by the previous measurements.

V.A. General-Equilibrium Structure

We use a static general-equilibrium model of the United States, imposing strong assumptions such as perfect competition, flexible prices, and an input-output structure with unitary elasticities. We implement counterfactuals that keep constant the wages in foreign countries.

The United States is divided into R counties (collected in the set $\mathcal{R}$ and indexed by r). In each region r there are L_r workers. In addition to the traded sectors there is one nontraded sector. Traded sectors are freely traded within the United States but face trade costs internationally.[24] Consumption in county r results from maximizing aggregate utility,

$$\beta_{NT} \ln C_{NT,r} + \sum_{s \in \mathcal{S}} \beta_s \ln C_{sr}, \tag{20}$$

where $C_{NT,\,r}$ is consumption of a homogeneous nontraded good, C_{sr} is consumption of tradeable sector s, and the β's add up to 1.

23. Baqaee and Farhi (2019) show that under these assumptions, this back-of-the-envelope calculation is also the effect on real GDP. In terms of our previous notation, we compute $\frac{1}{2}\sum_s \sum_{g \in \mathcal{G}_s} \sum_i p^*_{gi} m_{gi} \Delta \ln m_{gi} \Delta \tau_{gi}$, where the change in imports of product g from country i is $\Delta \ln m_{gi} = -\hat{\sigma} \Delta \ln \left(1 + \tau_{gi}\right)$ with $\sigma = 2.53$. Using the error in the estimation of $\hat{\sigma}$, the 90% bootstrap confidence interval around this aggregate loss is [−\$13.1 b, −\$7.6 b].

24. The assumption of free internal trade sidesteps the need to pin down the location of production of HS-10 products within the United States, for which we do not have data. It also ensures that the aggregate import demand system that we have previously estimated is consistent with the model we use for simulations. Caliendo et al. (2017) combine input-output linkages with internal trade costs in a quantitative analysis of the U.S. economy.

The price of the nontraded good is $P_{NT,\,r}$ and the price index of sector s is P_s.

Production of tradeable goods in each sector-region uses workers, intermediate inputs, and a fixed factor (capital and structures). Because we are looking at short-run outcomes we assume that the primary factors of production, capital, and labor are immobile across regions and sectors, but intermediate inputs can be freely adjusted. We also consider the implications of perfect labor mobility across sectors.[25] The domestic production of tradeable sector s in region r is

$$Q_{sr} = Z_{sr}\left(\frac{I_{sr}}{\alpha_{I,s}}\right)^{\alpha_{I,s}}\left(\frac{L_{sr}}{\alpha_{L,s}}\right)^{\alpha_{L,s}}, \tag{21}$$

where Z_{sr} is local productivity, I_{sr} is a bundle of intermediate inputs, and L_{sr} is the number of workers. The production share of the fixed factor is $\alpha_{K,\,s} \equiv 1 - \alpha_{I,\,s} - \alpha_{L,\,s}$. Intermediate inputs in sector s are also aggregated using a Cobb-Douglas technology. We let $\alpha_s^{s'}$ be the share of input s' in total sales of sector s. The cost of the intermediates bundle used by sector s is

$$\phi_s \propto \prod_{s' \in \mathcal{S}} P_{s'}^{\frac{\alpha_s^{s'}}{\alpha_{I,s}}}. \tag{22}$$

The owners of fixed factors choose the quantities I_{sr} and L_{sr} to maximize profits Π_{sr}. Letting p_s be the producer price in tradeable sector s and w_{sr} be the wage per worker in sector s and region r, the returns to the fixed factors are:

$$\Pi_{sr} = \max_{Q_{sr}} p_s Q_{sr} - (1 - \alpha_{K,s})\left(\frac{\phi_s^{\alpha_{I,s}} w_{sr}^{\alpha_{L,s}}}{Z_{sr}} Q_{sr}\right)^{\frac{1}{1-\alpha_{K,s}}}, \tag{23}$$

giving the supply curve and the national supply in sector s, $Q_s = \sum_{r \in \mathcal{R}} Q_{sr}$. Nontraded output in region r uses labor: $Q_{NT,\,r} = Z_{NT,\,r} L_{NT,\,r}$, where $L_{NT,\,r}$ is the employment in the nontraded sector in region r.

Production by sector and region, defined in equation (21), is allocated across products at a constant marginal rate of transformation. Letting q_g be the national output of good g in sector s, the feasibility constraint for products in sector s is

$$\sum_{g \in \mathcal{G}_s} \frac{q_g}{z_g} = Q_s, \tag{24}$$

25. The system of equilibrium conditions in changes in Online Appendix D.2 is defined for both immobile and mobile labor.

where z_g is a product-level productivity shock. We assume this production structure because we observe employment by region at the sector level (NAICS-4 in our data) but not at the product level (HS-10 in our data). The model equilibrium does not pin down where each good g is produced, and this information is not needed to implement counterfactuals.[26]

Assuming perfect competition, the price of the domestically produced variety of good g is $p_{Dg} = \frac{p_s}{z_g}$. Given iceberg costs δ_{ig}, the price faced by importer country i of product g is $p^X_{ig} = \delta_{ig} p_{Dg}$. Hence, market clearing in the U.S. variety of product g implies

$$(25) \qquad q_g = \underbrace{\left(a_{Dg} D_s\right) \left(\frac{p_{Dg}}{P_{Ds}}\right)^{-\eta}}_{d_g} + \sum_{i \in \mathcal{I}} \delta_{ig} \underbrace{a^*_{ig} \left(\left(1+\tau^*_{ig}\right) p^X_{ig}\right)^{-\sigma^*}}_{x_{ig}},$$

where d_g is the U.S. demand of product g resulting from the CES structure in Online Appendix C, where a_{Dg} is a demand shock, D_s is the aggregate U.S. consumption of domestic goods in sector s defined in equation (C.2), and P_{Ds} is the price index of domestically produced goods defined in equation (C.6). x_{ig} is the foreign import demand defined in equation (7).

To close the model, we assume that labor income and profits are spent where they are generated. Total tariff revenue R is distributed to each region in proportion b_r equal to its national population share. We allow for aggregate income D derived from ownership of foreign factors, owned by region r also in proportion to its population. By aggregate accounting, D equals the trade deficit. Final consumer expenditures in region r therefore are[27]

$$(26) \qquad X_r = w_{NT,r} L_{NT,r} + \sum_{s \in \mathcal{S}} w_{sr} L_{sr} + \sum_{s \in \mathcal{S}} \Pi_{sr} + b_r \left(D + R\right).$$

A general equilibrium given tariffs consists of import prices p^*_{ig}, U.S. prices p_{Dg}, traded wages w_{sr}, nontraded wages $w_{NT,r}$, and price indices (P_s, P_{Ds}, P_{Ms}, p_{Mg}, ϕ_s) such that (i) given these prices, final consumers, producers, and workers optimize; (ii) local labor markets clear for every sector and region, international

26. This product-level supply structure is consistent with the export variety elasticity $\omega = 0$ estimated in Section IV.E.

27. We now have an explicit expression for the aggregate demand shifters E_s entering previously in the import demand defined in equation (2): $E_s = \sum_{r \in \mathcal{R}} \beta_s X_r + \sum_{r \in \mathcal{R}} \sum_{s' \in \mathcal{S}} \alpha^s_{s'} p_{s'} Q_{s'r}$. The first term adds up the regional expenditures of final consumers, and the second term adds up the regional expenditures of producers in each sector.

markets clear for imports and exports of every variety, and domestic markets for final goods and intermediates clear; and (iii) the government budget constraint is satisfied. The foreign demand and supply shifters z^*_{ig} and a^*_{ig} in equations (6) and (7) are taken as given.

V.B. Implementation

To compute the impacts of the tariffs, we derive a system of first-order approximations to the impact of tariff shocks around the prewar equilibrium. Because the United States predominantly increased tariffs on varieties with initially zero tariffs, we use a higher-order approximation to the change in tariff revenue. The system is fully characterized by equations (D.3)–(D.19) in Online Appendix D.2. In response to a simulated shock to U.S. and foreign tariffs, the system gives the change in every outcome as a function of the elasticities $\{\sigma, \sigma^*, \omega^*, \eta, \kappa\}$ estimated from tariff variation in Section IV, the preference and technology parameters $\left\{\beta_{NT}, \beta_s, \alpha_{L,s}, \alpha_{I,s}, \alpha_s^{s'}\right\}$, distributions of sales and employment across sectors and counties, and imports and exports across varieties. We obtain the nonestimated parameters and variables from input-output (IO) tables from 2016 (the most recent year before the tariff war for which this information is available), the 2016 County Business Patterns database, and the customs data we used in the estimation. Online Appendix D.3 describes the implementation and parameterization in more detail.[28]

V.C. Impact of Tariffs on U.S. Prices

We now explain the mechanisms through which U.S. and retaliatory tariffs induce price effects in the general-equilibrium model. Because we consider the short-run impact of tariffs, we assume no primary factor mobility across sectors and regions. Sector-level quantities only change with intermediate inputs. As a result, the sector-level supply of U.S. goods is upward sloping with the price. At the sector level, the price of U.S. goods is determined by the intersection between the U.S. supply resulting from equation (23) and its world demand (from both the United States and foreign countries) resulting from adding up the right-hand side of equation (25) over all varieties within a sector.

28. Under the "hat algebra" of Dekle, Eaton, and Kortum (2008), the outcomes depend on endogenous variables in exact relative changes. Our solutions are a special case of Baqaee and Farhi (2019).

The United States experiences a terms-of-trade gain in a sector if the price of products in that sector (some of which are exported) increases compared to the price of its imports. U.S. and foreign tariffs affect these prices by shifting world demand. When the United States imposes a tariff on the imports of a particular product from some origin (e.g., wooden kitchen tables from China), U.S. consumers reallocate to the U.S. variety of that product. This reallocation increases the world demand for U.S. production in this sector and reduces world demand for foreign production. Hence, there is a terms-of-trade gain in the furniture sector. Similarly, when a foreign country imposes tariffs on U.S. varieties, foreign consumers reallocate away from U.S. production, lowering the price in the sector where foreign tariffs are imposed.

The extent of price changes due to tariffs depends on the elasticities of U.S. and foreign demands, which we have estimated, and on the the sector-level elasticities of U.S. supply, which we have imposed through the model assumptions and the calibration. Online Appendix D.4 discusses in more detail the determinants of sector-level prices in the general equilibrium model.

The terms-of-trade effects implied by the model operate at the sector level and are therefore not captured by our previous empirical analysis. Qualitatively, these terms-of-trade effects are corroborated by an analysis of sector-level producer, export, and import price indices published by the Bureau of Labor Statistics. Online Appendix Table A.14 reports regressions of each price index on a simple average of import and retaliatory tariffs within sector. The table shows that (i) the PPI increases with sector-level import tariffs; (ii) U.S. export prices fall with retaliatory tariffs; and (iii) there are no impacts of the tariffs on sector-level import prices, which is consistent with the evidence in the previous empirical sections and with our model assumptions.

V.D. Aggregate Impacts

We use the model to quantify the impacts of the tariff war. For each primary factor (capital and labor), the equivalent variation is the change in income at initial prices (before the tariff war) that would have left that factor indifferent with the changes in tariffs that took place. Adding up the equivalent variations across all primary factors (capital and labor in each region), we obtain the aggregate equivalent variation EV, or change in aggregate real income. This term can be written as a function of initial trade

TABLE VIII
AGGREGATE IMPACTS

	EV^M (1)	EV^X (2)	ΔR (3)	EV (4)
2018 trade war				
Change ($ b)	−51.0	9.4	34.3	−7.2
	[−54.8,−47.2]	[4.1,15.6]	[32.3,36.1]	[−14.4,0.8]
Change (% GDP)	−0.27	0.05	0.18	−0.04
	[−0.29,−0.25]	[0.02,0.08]	[0.17,0.19]	[−0.08,0.00]
2018 U.S. tariffs and no retaliation				
Change ($ b)	−50.9	16.6	34.8	0.5
	[−52.9,−49.0]	[13.2,20.3]	[32.8,36.5]	[−4.0,5.7]
Change (% GDP)	−0.27	0.09	0.19	0.00
	[−0.28,−0.26]	[0.07,0.11]	[0.18,0.20]	[−0.02,0.03]

Notes. Table reports the aggregate impacts in column (4) and the decomposition into EV^M, EV^X, and tariff revenue (ΔR) in columns (1)–(3). The top panel reports the effects from the 2018 trade war. The bottom panel simulates a hypothetical scenario where trade partners do not retaliate against U.S. tariffs. The first row in each panel reports the overall impacts of each term in billions of US$. The third row scales by 2016 GDP. These numbers are computed using the model described in Section V with $\{\hat{\sigma} = 2.53, \hat{\eta} = 1.53, \hat{\kappa} = 1.19, \hat{\omega}^* = -0.00, \hat{\sigma}^* = 1.04\}$. Bootstrapped 90% confidence intervals based on 1,000 simulations of the estimated parameters are reported in brackets.

flows and price and revenue changes (Dixit and Norman 1980):

$$EV = \underbrace{-\mathbf{m}'\Delta\mathbf{p}^M}_{EV^M} + \underbrace{\mathbf{x}'\Delta\mathbf{p}^X}_{EV^X} + \Delta R, \tag{27}$$

where $\mathbf{m}$ is a column vector with the imported quantities of each variety before the war, $\mathbf{x}$ collects the quantities exported of each product to each destination, $\Delta\mathbf{p}^M$ are changes in duty-inclusive import prices, and $\Delta\mathbf{p}^X$ are changes in export prices.[29] EV^M is the increase in the duty-inclusive cost of the prewar import basket, EV^X is the increase in the value of the prewar export basket, and ΔR is the change in tariff revenue. The pre–tariff war levels of imports and exports in equation (27) are directly observed, while the estimated model gives the responses of import and export prices to the simultaneous change in U.S. and retaliatory tariffs.

The top panel of Table VIII shows each of the components of EV in response to the 2018 U.S. and retaliatory tariff waves of the trade war. The first row of each panel reports the monetary equivalent on an annual basis at 2016 prices, and the

29. In our previous notation, $\mathbf{m}'\Delta\mathbf{p}^M \equiv \sum_{s\in\mathcal{S}}\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}} m_{ig}\Delta p_{ig}$ and $\mathbf{x}'\Delta\mathbf{p}^X \equiv \sum_{s\in\mathcal{S}}\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}} x_{ig}\Delta p_{ig}^X$.

second row reports numbers relative to GDP. The point estimates are calculated using the model elasticities estimated in Section IV, $\{\hat{\sigma} = 2.53, \hat{\eta} = 1.53, \hat{\kappa} = 1.19, \hat{\omega}^* = -0.002, \hat{\sigma}^* = 1.04\}$, and bootstrapped confidence intervals are computed for each component using the 1,000 bootstrapped parameter estimates.

The first column, which reports EV^M, shows that U.S. buyers of imports lost in aggregate \$51 billion (0.27% of GDP). Because our estimation finds a foreign supply elasticity ω^* very close to 0, this number remains very close (but not identical since ω^* is not exactly 0) to the number we reported at the beginning of this section. Using the error around our parameter estimates, we can reject the null hypothesis that EV^M is 0.

The second column shows the EV^X component. This second term depends on the export price changes implied by the general equilibrium model. Export prices increase if the reallocation of domestic and foreign demand into U.S. goods induced by tariffs is stronger than the reallocations away from these goods. As discussed in the last subsection, the intensity of these reallocations depend on the combination of the estimated elasticities and the supply-side model assumptions.

We estimate a (statistically significant) increase of EV^X of \$9.4 billion (0.05% of GDP). This aggregate number equals a model-implied 0.7% increase in the export price index times a 7.4% observed share of exports of manufacturing and agricultural sectors in GDP. Because import prices essentially do not change, these export price changes mean terms-of-trade improvements at the country level. The model predicts a 0.1% average (nominal) wage increase for tradeable sector workers in the United States relative to its trade partners.

The final component of the decomposition is the increase in tariff revenue. The model matches a tariff revenue share of 0.2% of GDP and yields an increase in tariff revenue of \$34.3 billion, or 0.18% of GDP. This increase is larger than the \$29.1 billion increase in actual tariff revenue between 2017 and 2018. It is not exactly the same because the model isolates the revenue increases solely from tariffs (as opposed to other shocks).

These numbers imply large and divergent consequences of the trade war on consumers and producers. However, the effects approximately balance out, leading to a small aggregate loss for the United States as a whole. Column (4) sums the three components of EV to obtain the aggregate impacts of the war on the U.S. economy. We estimate an aggregate loss of \$7.2 billion, or 0.04% of

GDP. Although we cannot reject the null that the aggregate losses are 0, we can conclude that the consumer losses from the trade war were large.[30]

The second panel reports the aggregate outcomes of a hypothetical scenario where foreign trade partners did not retaliate against the United States. In this scenario, the export price index would have increased by 1.2% and the aggregate impact would have resulted in a modest gain to the U.S. economy of $0.5 billion (also not statistically significant). The difference operates through export prices: by lowering demand for U.S. exports, our computations imply a 75.9% larger producer gain without retaliation.

V.E. Regional Effects

We now examine the distributional impacts of the trade war across regions. Tariffs raise the price of consumption for everyone but also benefit workers in protected sectors through the producer and export price increases we previously discussed. At the same time, tariffs increase the costs of intermediate inputs, which were heavily targeted (see Online Appendix Table A.1) and are used more intensively by some regions than others. The ultimate regional impact also depends on the structure of the retaliatory tariffs.

We examine real wages implied by the model. There are three reasons we do not examine county-level wages directly. First, monthly earnings data are available only at the sector level and for a subset of sectors. Second, even if such data were available, the model would still be necessary to construct the impact of the tariffs on the level of wages. Online Appendix D illustrates that the wage effects are a complex function of shocks in general equilibrium. Third, the model allows us to compare wages under different counterfactual scenarios, such as shutting down foreign retaliations.

Figure V illustrates large variation in exposure to the trade war across counties in the United States. The top panel shows county-level exposure to U.S. tariffs, and the bottom panel shows county-level exposure to retaliatory tariffs. We construct the county-level exposure of tradeable sectors by first computing the trade-weighted import and retaliatory tariff changes by

30. We find similar results assuming mobile labor across sectors. In that case, the overall loss is \$4 billion, with the breakdown for $\{EV^M, EV^X, \Delta R\}$ as $\{\$-51b, \$12.7b, \$34.3b\}$.

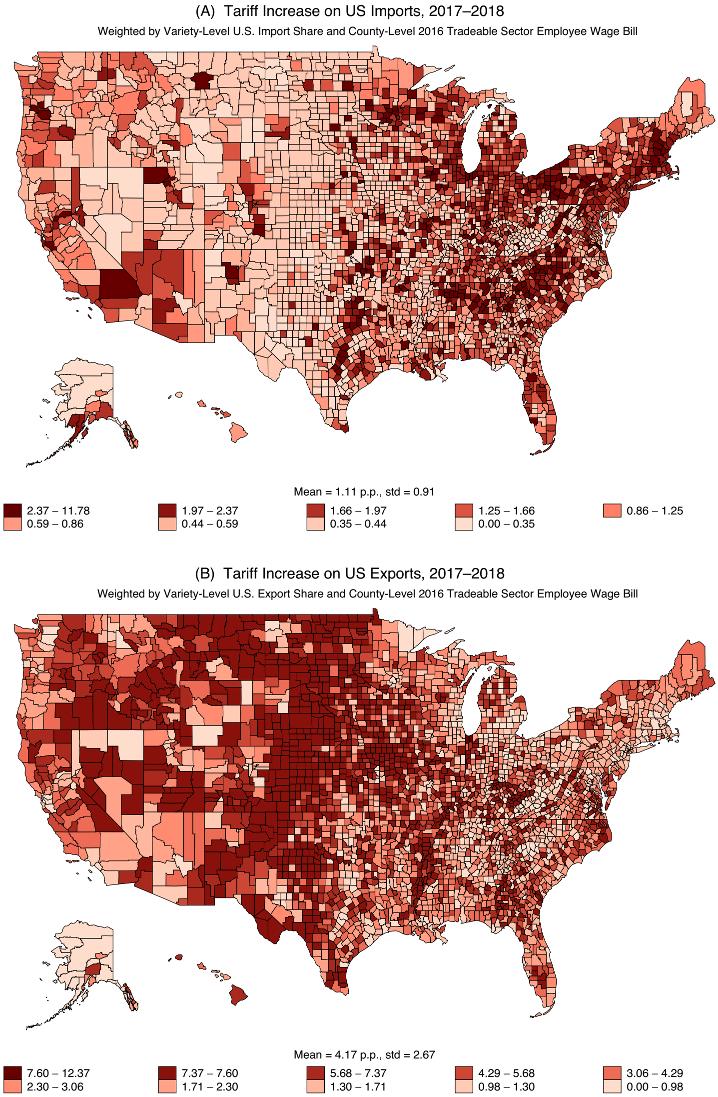


FIGURE V

Regional Variation in U.S. and Retaliatory Tariffs

Figure shows county-level exposure to U.S. import tariff changes (Panel A) and retaliatory tariff changes (Panel B) due to the trade war, weighted by variety-level 2013–17 U.S. trade shares (constructed from Census data) and by 2016 county-level tradeable sector employee wage bill (constructed from County Business Patterns). Darker shades indicate higher tariff exposure. Values indicate percentage point tariff increases.

NAICS sector and then mapping them to counties based on counties' employment structure.[31] The maps show a clear contrast between the regional structure of U.S. protection and retaliation. The Great Lakes region of the Midwest and the industrial areas of the Northeast received higher tariff protection, while rural regions of the Midwestern plains and Mountain West received higher tariff retaliation.

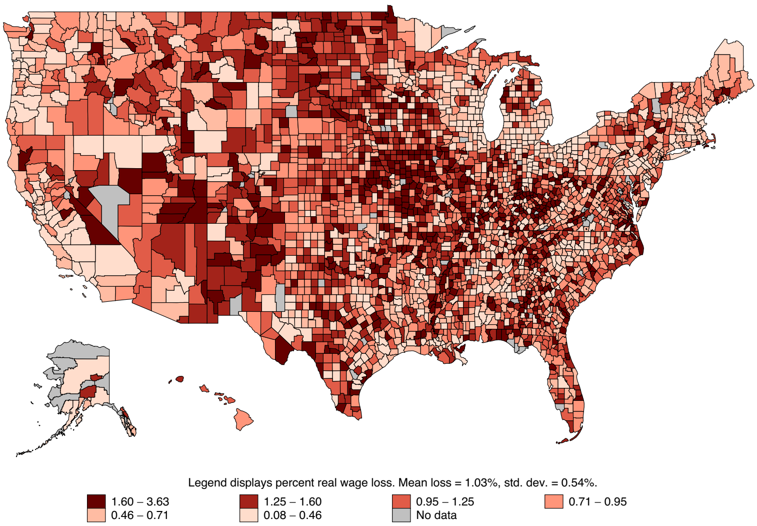
We construct the model-implied effects across counties in response to the tariff war.[32] On average across counties, the nominal wages for workers in tradeable sectors increase by 0.1% (std. dev. = 0.4%). However, these income gains at initial prices are more than offset by a higher cost of living, as the CPI of tradeable goods increases by 1.1% on average across sectors, partly due to an average 2.0% increase in import prices. As a result, real wages in the tradeable sector fall by 1.0% (std. dev. = 0.5%), on average. We do not observe a meaningful change in the Gini coefficient across counties.

Figure VI shows the effects of the trade war across counties. The first map shows the county-level reduction in real wages in tradeable sectors in a hypothetical scenario where U.S. trade partners did not retaliate, and the second map shows real wage losses from the full war. Every county experiences a reduction in the tradeable real wage. Counties with smaller relative losses are concentrated in the Rust Belt region and the Southeast. These patterns map imperfectly with the direct protection received through import tariffs shown in Figure V because of input-output linkages across sectors. The counties hit hardest by the trade war are

31. We compute the NAICS-level import and export tariff shock as the import- and export-weighted averages of the variety-level U.S. and retaliatory tariff changes using average 2013–16 trade shares. We then construct the county-level import and export tariff shocks as the labor-compensation weighted average of the NAICS-level tariff shocks. In the notation of the model, the import tariff shock (due to U.S. tariffs) is $\Delta\tau_r^j = \sum_{s\in\mathcal{S}} \left(\frac{w_{sr} L_{sr}}{w_r^T L_r^T}\right) \frac{\sum_{g\in\mathcal{G}_s} \sum_{i\in\mathcal{I}} p_{ig}^* m_{ig} \Delta\tau_{ig}}{\sum_{g'\in\mathcal{G}_s} \sum_{i'\in\mathcal{I}} p_{i'g'}^* m_{i'g'}}$ and the export tariff shock (due to retaliatory tariffs) is $\Delta\tau_s^* = \sum_{s\in\mathcal{S}} \left(\frac{w_{sr} L_{sr}}{w_r^T L_r^T}\right) \frac{\sum_{g\in G_s} \sum_{i\in\mathcal{I}} p_{ig}^X x_{ig} \Delta\tau_{ig}^*}{\sum_{g\in G_s} \sum_{i\in\mathcal{I}} p_{ig}^X x_{ig}}$, where $w_r^T L_r^T$ are total tradeable sector wages in county r.

32. The real tradeable wage change in region r is defined as $\hat{w_{T,r}} - \hat{P}_r$, where $\hat{w_{T,r}}$ is the nominal wage increase in the tradeable sector, and where $\hat{P}_r = \beta_{NT} \hat{P}_{NT,r} + \sum_{s\in\mathcal{S}} \beta_s \hat{P}_s$ is the change in the local price index. Equation (D.4) gives the solution for the wage change as a function of price changes. Equations (D.9) to (D.12) characterize the block of the model with the solution to the price changes as a function of tariffs and expenditure shifters.

(A) Model Simulation: Tradeable Real Wage Loss from Full War



(B) Model Simulation: Tradeable Real Wage Loss from U.S. Tariffs (without retaliations)

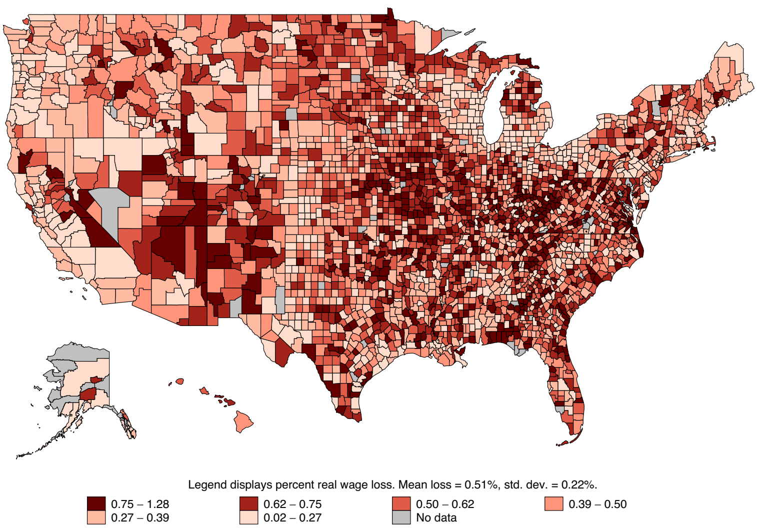


FIGURE VI

Model Simulation of Real Wage Impacts from U.S. and Retaliatory Tariffs

Figure shows county-level mean tradeable wage losses as simulated from the model. Panel A shows losses accounting for both import and retaliatory tariffs. Panel B shows losses in the counterfactual scenario that U.S. trade partners did not retaliate. Darker shades indicate greater losses. Values indicate percent wage declines.

those concentrated in the Midwestern Plains, largely due to the structure of the retaliatory tariffs.

V.F. Tariff Protection, Wages, and Voting Patterns

As discussed in Section II.C, the pattern of tariff changes across sectors does not a priori support the view that protection was driven by incentives to maximize national income or by contributions of special interests. We probe a third hypothesis from the political economy of trade protection literature, namely, that policy makers pursued an electoral strategy when setting tariffs by targeting regions according to their voting patterns. We examine the relationship between the county-level tariff exposure shown in Figure V and voting patterns in the 2016 presidential election. The logic of majority voting suggests that tariffs set by an electorally motivated incumbent government should be higher in sectors that are disproportionally located in regions where voters are likely to be pivotal in elections.[33] We then contrast the ex ante incentives of policy makers suggested by the relationship between tariffs and voting with the ex post distributional consequences of their policies.

Figure VII presents a nonparametric plot of county-level import and retaliatory tariff changes against the Republican (GOP) vote share, weighted by county population. The county-level tariffs are constructed within tradeables and therefore do not reflect differences in shares of tradeable activity across counties. The figure reveals two different patterns of protection for U.S. and retaliatory tariffs. For U.S. tariffs, we observe an inverted-U shape, implying that counties with a 40–60% Republican vote share received more protection than heavily Republican or Democratic counties. Hence, U.S. tariffs appear targeted toward sectors concentrated in politically competitive counties. By contrast, trading partners retaliated by targeting exports in sectors concentrated in heavily Republican counties.[34] We explore how these targeting patterns vary with other demographic and economic variables in Online Appendix E.

33. Helpman (1995) characterizes optimal tariffs under majority voting in a specific factors model, showing that tariffs are higher in sectors where the median voter has larger factor ownership. Grossman and Helpman (2018) emphasize that psychological benefits to voters from tariff protection (e.g., increased self-esteem from mutually recognized group membership) may underlie a shift to protectionism.

34. This finding is also shown by Fetzer and Schwarz (2019).

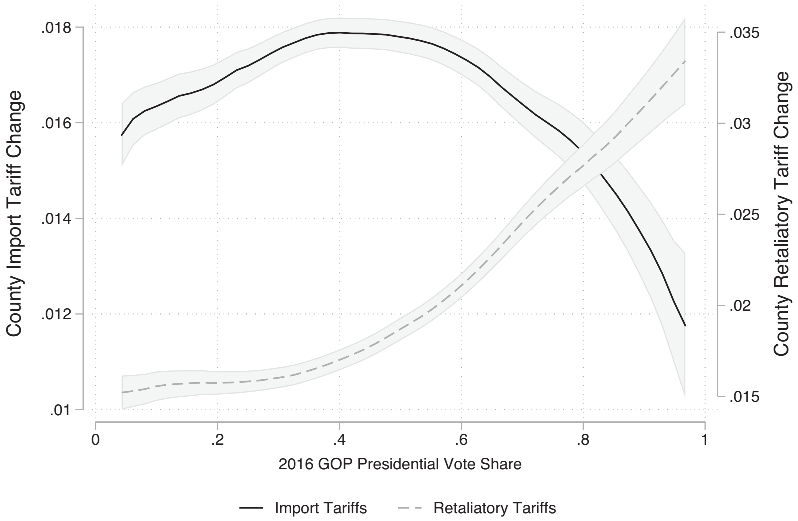


FIGURE VII

Tariff Changes versus 2016 Republican Vote Share

Figure plots county-level import and retaliatory tariff changes against the 2016 Republican presidential two-party vote share, using a nonparametric fit weighted by county population. County-level tariff changes weighted by variety-level 2013–17 U.S. trade shares and by 2016 county-level tradeable sector employee wage bill. Vote shares constructed from Federal Election Commission data. The unit of analysis is 3,111 U.S. counties.

We use the general equilibrium model to assess if the tradeable real wages of electorally competitive counties indeed experience the largest (relative) gains. Figure VIII plots tradeable real wages against the county Republican vote share for two different scenarios. The black solid curve shows the actual effects of the trade war. The dashed curve reflects the impact under a hypothetical scenario where U.S. trade partners did not retaliate. The figure reveals that in the (hypothetical) scenario where trade partners did not retaliate, the impacts would have been fairly even across electorally competitive counties. There is no sharp peak, and the relationship plateaus between a 35% and 50% vote share. Relative to a heavily Democratic county (a 5–15% vote share), the losses in a heavily Republican county (85–95% vote share) are 6% larger.

The black curve reveals the impacts from the full trade war. The peak shifts leftward and is more pronounced. The trade

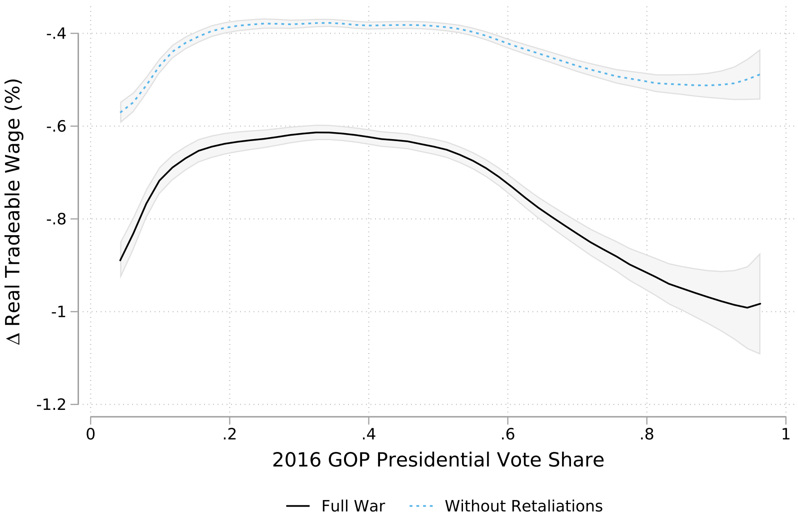


FIGURE VIII

Model-Simulated Tradeable Real Wage Impact versus 2016 Republican Vote Share

Figure plots model-simulated county-level tradeable real wage changes due to the trade war against the 2016 Republican presidential two-party vote share, using a nonparametric fit weighted by county population. Vote shares are constructed from Federal Election Commission data. The unit of analysis is 3,049 U.S. counties.

war relatively favored tradeable workers in Democratic-leaning counties with a 2016 presidential vote share of roughly 35%. Moreover, workers in Republican counties (85–95% vote share) bore the largest cost of the full war.[35] The losses in these counties are 32% larger than in a heavily Democratic county (a 5–15% vote share). This asymmetry between Republican and Democratic counties is further illustrated in Online Appendix Figure A.6, which plots across counties the simulated tradable wage change from the full trade war against the hypothetical scenario where U.S. trade partners did not retaliate. Retaliatory tariffs had a disproportionately negative impact on Republican counties, as illustrated by the mass of red counties that fall far below the 45-degree line. In contrast, the model

35. Auer, Bonadio, and Levchenko (2018) suggest heavy Republican districts would lose more from revoking NAFTA. Ma and McLaren (2018) provide evidence that tariff changes in the years leading up to NAFTA were biased toward industries in swing states.

implies that Democratic-leaning counties were not as harshly affected by retaliations.

VI. Conclusion

This article analyzes the impacts of the 2018 trade war on the U.S. economy. We estimate key elasticities of trade outcomes using import and retaliatory tariff variation. We find large impacts of the war on imports and exports. Before-duties import prices faced by the United States did not fall in response to tariffs over the time horizon that we consider, implying complete pass-through of tariffs to duty-inclusive import prices.

These estimates imply an annual loss for the United States of \$51 billion due to higher import prices. However, a general equilibrium model imposing neoclassical assumptions implies a small aggregate real income loss of \$7.2 billion. Hence, we find substantial redistribution from buyers of foreign goods to U.S. producers and the government, but a small net effect for the U.S. economy as a whole. We also document that U.S. tariffs protected sectors concentrated in electorally competitive counties, while foreign retaliations affected sectors concentrated in Republican counties. These spatial patterns generate heterogeneous effects of the trade war, and through model simulations we find that tradeable sectors in heavily GOP counties experienced the largest losses. Therefore, even though the aggregate impacts are small, the distributional effects are substantial.

We close with four important caveats. First, our analysis does not include an analysis of U.S. retail prices paid by final consumers. Second, we do not consider the impacts of trade policy uncertainty on the business climate. Third, our framework does not allow for country-level wage effects in foreign countries that would further affect the terms of trade. Finally, our analysis does not examine long-run impacts of the trade war. We believe these are important topics for future research.

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Supplementary Material

An Online Appendix for this article can be found at *The Quarterly Journal of Economics* online. Data and code replicating tables and figures in this article can be found in Fajbelbaum et al. (2019), in the Harvard Dataverse, doi:10.7910/DVN/KSOVSE.

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