The Return to Protectionism*

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Abstract

After decades of supporting free trade, in 2018 the U.S. 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 who 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 Codes:* F1.

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I INTRODUCTION

After more than a half-century of leading efforts to lower international trade barriers, in 2018 the U.S. 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 post-war era due to the sizes of the countries involved, the magnitudes of the tariff increases, and the breadth of tariffs across sectors. What were the short-run impacts 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 U.S. 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 also have distributional consequences across sectors, and therefore across regions with different patterns of specialization.

Very little is known about tariff incidence, despite its central role in policy analysis. In this paper, we first 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 pre-existing 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,

[1] This estimation approach was first applied by Romalis (2007) to study the effects of NAFTA and recently formalized by Zoutman et al. (2018).

we demonstrate that these elasticities are not confounded by pre-existing 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 who 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.

The previous 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 due to relative wage changes across countries or sectors.[2] In other words, the results do not imply that the U.S. 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 effects. The model imposes upward sloping industry supply curves in the U.S. and predicts changes in sector-level prices in the U.S. due to 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 into 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). While we cannot reject the null hypothesis that the aggregate losses are zero, 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)

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

[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 4-digit industry level observed in BEA IO tables and impose unitary elasticities as in Caliendo and Parro (2015). The aggregate impacts 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.

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 impacts. Our counterfactuals imply that all counties experienced reductions in tradeable real wages. Using the model, we find a standard deviation of real 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 because of this pattern of tariff retaliations.

A large literature studies the impacts of changes in trade costs or foreign shocks through empirical and quantitative methods (e.g., Eaton and Kortum (2002), Arkolakis et al. (2012) and Autor et al. (2013)). We focus instead on trade policy, and on tariffs in particular, since 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 impacts on sectors (e.g., Attanasio et al. 2004), regions (e.g., Topalova (2010), Kovak (2013), and Dix-Carneiro and Kovak (2017)), firms (e.g., Amiti and Konings (2007), Goldberg et al. (2010), and Bustos (2011)), or workers (e.g., Autor et al. (2014) and McCaig and Pavcnik (2018)). A complementary approach uses quantitative models to simulate aggregate impacts of tariffs, such as the Nash equilibrium of a global trade war (Ossa, 2014) or regional trade liberalizations (e.g., Caliendo and Parro (2015) and 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 parametrization 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]

Finally, our finding of complete pass-through deserves some discussion.[6] Amiti et al. (2019)

[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; e.g., see Romalis (2007), Spearot (2013) and Spearot (2016). Hillberry and Hummels (2013) 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) and Donaldson (2018)) or GMM identification via heteroskedasticity of supply and demand shocks (e.g., Feenstra (1994) and Broda et al., 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 impact of tariffs on import prices include Irwin (2014) for U.S. sugar duties in late 19th and early 20th centuries, Winkelmann and Winkelmann (1998) for 1980's tariff reductions in New Zealand, and

and Cavallo et al. (2019) also find complete tariff pass-through to border prices in this trade war, and Flaaen et al. (2019) estimate high tariff pass-through to retail prices for washing machines. Yet, a large 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 et al., 2010). Inspecting the precise mechanism underlying the complete tariff pass-through finding deserves further exploration in future research.

The remainder of the paper 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 dataset construction are available in Online Appendix A.

II.A Data

We build a monthly panel dataset of U.S. statutory import tariffs using public schedules from the U.S. International Trade Commission (USITC). Prior to 2018, USITC released annual "baseline" tariff schedules in January and a revised schedule in July. In 2018, by contrast, USITC issued 14 schedule revisions, reflecting a rapid series of tariff increases. These ad-valorem tariff increases were predominantly set at the 8-digit Harmonized System (HS) level, and swiftly implemented within 1-3 weeks following a press release by the Office of the U.S. Trade Representative.[7] As 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 also 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

Feenstra (1989) for U.S. duties on Japanese compact trucks in the 1980s.

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

the announced tariff rate change. We measure export tariffs at the HS-6 level, since 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 affect.

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 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 (value + duties)/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 (one plus) the *ad valorem* retaliatory statutory rate.

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 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 non-farm 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. Panel A of Table I 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 U.S. 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 the U.S.

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

[9]The U.S. authorized the tariffs through Section 201 of the Trade Act of 1974, Section 301 of the Trade Act of 1974, and Section 232 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.

implemented tariffs on approximately $50 billion of Chinese imports, and the scope and value of targeted products on China expanded with subsequent tariffs 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.

Panel B of Table I reports the retaliatory tariffs imposed on U.S. exports by trade partners. Canada, China, Mexico, Russia, Turkey, and the E.U. enacted retaliatory tariffs against the U.S., 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 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, comprise 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, zero).

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 et al. (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 U.S. 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 U.S. nor retaliating countries were

[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 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 to 72% of targeted products in all other sectors.

likely driven by a terms-of-trade rationale, since in that case we would expect tariff changes to vary across sectors. Online Appendix Figure A.2 plots average 2018 sector-level tariff rates against the foreign export supply elasticities estimated by Broda et al. (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 policymakers (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. While 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 impacts 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:

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

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 non-targeted varieties within 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] Non-targeted varieties within the same HS-10 product as a targeted variety are assigned the earliest event date within that product code. For all other non-targeted varieties, we assign the event date to be the earliest month of a targeted variety within the same NAICS-4 sector. If a non-targeted 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 ≥ 6 together and exclude event time ≤ -7. For import outcomes, standard errors are clustered by country and HS-8, since 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

[11]The event date varies by both product and country since some varieties within the same product code are targeted before others. For example, the U.S. 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.

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, both exclusive and inclusive of duties. Upon 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 reveals anticipatory effects occurring before the tariff changes, but they are quantitatively small. Hence, the concern that importers shifted forward their purchases in order 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.

III TRADE FRAMEWORK AND IDENTIFICATION

We now 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 4-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 3-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 U.S. trades with I countries (collected in the set $\mathcal{I}$ and indexed by country i).

[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 U.S. would increase tariffs on $200 billion of already-targeted Chinese varieties from 10% to 25% on January 1, 2019. A plausible reason why we observe large anticipation effects only in this instance is that, unlike in previous U.S. tariff waves, the January 2019 tariff escalation was announced long in advance and was perceived to be credible given the previous tariff waves. The U.S. ultimately implemented this threat in May 2019, which is beyond our sample period.

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 U.S. imposes ad-valorem tariffs τ_{ig} on the CIF price p^*_{ig}, so the domestic price is:

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

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]

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 U.S. 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

[14] This demand system is also used by Broda et al. (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 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 impact 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.

for U.S. varieties is similar to (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 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.

III.C.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 simultaneously. The strategy of identifying two elasticities with one instrument was applied by Romalis (2007) in a trade context and studied by Zoutman et al. (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 sub-section. Then, the import demand elasticity σ is identified by instrumenting the duty-inclusive price Δp_{igt} with the tariff $\Delta \tau_{igt}$ in (8). The export supply ω^* is identified by instrumenting imports with $\Delta \tau_{igt}$ in (9).[15]

III.C.2 Product Elasticity (η)

The elasticity η across products is identified by aggregating variety-specific tariffs to the product level. From (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

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

index, and ε_{Mgt} is a residual that captures the imported product demand shock. 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 (C.8) and (4) we obtain the following exact expression for the change in the product price index:

$$\Delta \ln p_{Mgt} = \frac{1}{1-\sigma} \ln \left(\sum_{i \in \mathcal{C}_{gt}} s_{igt} e^{(1-\sigma)\Delta \ln\left(p^{*}_{igt}(1+\tau_{igt})\right)+\Delta \ln a_{igt}} \right) - \frac{1}{1-\sigma} \ln \left(\frac{S_{g,t+1}\left(\mathcal{C}_{gt}\right)}{S_{g,t}\left(\mathcal{C}_{gt}\right)} \right), \quad (11)$$

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 $S_{g,t}\left(\mathcal{C}\right)$ 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 $\Delta \ln \left(a_{igt}\right)$.

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:

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

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

III.C.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 $P_{Mst}M_{st}$ defined in (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):

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

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:

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

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

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 (10). We instrument for the relative price of imports, $\Delta \ln (P_{Mst}/P_{Dst})$, 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 (12) at the product level and $N_{st}^{\mathcal{C}}$ is the number of continuing products in sector s between t and $t+1$.

III.C.4 Foreign Import and U.S. Export Variety Elasticities (σ^*, ω)

The foreign import demand is estimated using an analogous equation to (8). We consider how U.S. exports respond to retaliatory tariffs. From (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_{igt}^x, we obtain:

$$\Delta \ln x_{igt} = \eta_{gt}^x + \eta_{it}^x + \eta_{is}^x - \sigma^* \Delta \ln \left(\left(1 + \tau_{igt}^*\right) p_{igt}^X \right) + \varepsilon_{igt}^x, \tag{16}$$

where p_{igt}^X is the before-duty price observed in the U.S. If the retaliatory tariffs τ_{igt}^* are uncorrelated with foreign import demand shocks ε_{igt}^x, we can identify σ^* by instrumenting the change in the duty-inclusive price, $p_{igt}^{X*} \equiv p_{igt}^X(1+\tau_{igt}^*)$, with the change in retaliatory tariffs.

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

$$\Delta \ln p_{igt}^X = \eta_{gt}^p + \eta_{it}^p + \eta_{is}^p + \omega \Delta \ln x_{igt} + \varepsilon_{igt}^p, \tag{17}$$

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

III.C.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. While sales taxes may not be salient to consumers because retail prices are quoted in before-tax prices (e.g., Chetty et al. 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 pre-trends that support this key identification assumption.

Third, importers may have anticipated looming tariffs in the months before implementation. If they shifted forward their imports, 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 towards specific sectors between the policymakers elected in 2016 and the previous policymakers. 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 Pre-existing 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 pre-trends 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, since the estimating equations derived in Section III.C.1 exploit tariff variation controlling for these fixed 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 pre-trend 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

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

[18] We examine pre-trends 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 pre-existing 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 towards import or export trends over this longer horizon.

for U.S. export outcomes and show a similar pattern: pre-war 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 of Table IV 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 product-time, country-time and country-sector. 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 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 (8) and (9) in columns 5-6. 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 $\hat{\sigma} = 2.53$ (*se* 0.26). The bootstrapped 90% confidence interval, formed from 1000 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 5-6, the average change in import values of targeted varieties is:

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

[19]The elasticity of the duty-inclusive unit value in column 4 is not one 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. Columns 1 to 4 of Table A.3 report regressions of the variables in columns 2 to 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 one plus the coefficient on the before-duty price (column 4) and the coefficient on import quantities (column 3) is very close to the estimated σ in column 4 of Table IV.

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 column 6 of Table IV. We build the instrument $\Delta \ln Z_{gMt}$ using (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 estimate implies $\hat{\eta} = 1.53$ (*se* 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, re-routing 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 (*se* 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 products, suggesting that re-routing 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 $\Delta \ln p_{Mgt} m_{gt} = -(\hat{\eta} - 1)\, \Delta \ln Z_{gMt}$, where $\hat{\eta} = 1.53$ and $\overline{\Delta \ln Z_{gMt}} = 4.7\%$.

[20] Flaaen et al. (2019) argue that, in response to discriminatory anti-dumping 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.

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

The monthly change in U.S. expenditures in 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-zero 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 $\Delta \ln (P_{Mst}/p_{st})$ instead of $\Delta \ln (P_{Mst}/P_{Dst})$ in (13). The change in the price index, $\Delta \ln P_{Mst}$, is constructed from (14) using the estimated $\hat{\sigma}$ and $\hat{\eta}$ from the previous two steps, and the demand shocks 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 $\hat{\kappa} = 1.19$ (*se* 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 for targeted 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.1. These regressions examine the change in U.S. export outcomes, 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 columns 1-4 of Table VII. 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 (6) on the export side. The first stage is

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

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 $\hat{\sigma}^* = 1.04$ (*se* 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 $\overline{\Delta \ln \left(p^X_{igt} x_{igt}\right)} = -\hat{\sigma}^* \overline{\Delta \ln \left(1 + \tau^*_{igt}\right)}$ where $\overline{\Delta \ln \left(1 + \tau^*_{igt}\right)} = 9.5\%$.

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.

IV.F.1 Trends and Dynamic Specifications

Section IV.A documents that pre-existing 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 pre-existing trends or anticipation effects.

The first robustness check controls for trends through panel fixed effects. We re-estimate the variety-level specifications to include variety fixed effects and report the analog to Table IV in Table A.4 and the analog to Table VII in Table A.6. We assess long-run trends by re-estimating the specifications with variety fixed effects using data from 2013:1 to 2019:4 in Tables A.5 and A.7. The results are essentially unchanged and remain consistent with the prior evidence that pre-existing 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 impacts 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:

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

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

[22] Since 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.

anticipation. Additionally, 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.

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

IV.F.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 also 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 or not 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". While 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: 1) quality ladders from Khandelwal (2010); 2) markups estimated by De Loecker et al. (2018); 3) the coefficient of price variation; 4) elasticities of substitution estimated by Broda and Weinstein (2006); 5) trade elasticities estimated by Caliendo and Parro (2015); 6) contract intensity measured by Nunn (2007); 7) inverse frequency of price adjustments from micro-data tabulated by Nakamura and Steinsson (2008) (a higher value indicates less frequent price adjustments); 8) measures of industry upstreamness by Antràs et al. (2012); 9) inventory to sales ratios constructed from Census data; 10) differentiation developed by Rauch (1999); and, 11) 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. We again find no systematic evidence of heterogeneity with respect to observable characteristics.

IV.F.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 2-month, 3-month, and 4-month level, taking first differences, and re-implementing 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.

IV.F.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 impact of the tariff on before-duty unit values across 8 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 effect in the baseline specification and regress them against monthly exchange rates, and do not find a statistically significant relationship (estimate is 0.11 (*se* 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 (*se* 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 an 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 both 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 $1/2\,(\Delta\mathbf{m})'\,\Delta\tau$, 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 U.S. 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 U.S., 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 U.S. 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 non-traded sector. Traded sectors are freely traded within the U.S. 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 non-traded good, C_{sr} is consumption of tradeable

[23] Baqaee and Farhi (2019) show that, under these assumptions, this back of the envelope 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 $\Delta\ln m_{gi} = -\hat{\sigma}\Delta\ln(1+\tau_{gi})$ with $\sigma = 2.53$. Using the error in the estimation of $\hat{\sigma}$, the 90% bootstrap confidence interval around this aggregate loss is [-$13.1b,-$7.6b].

[24] The assumption of free internal trade sidesteps the need to pin down the location of production of HS-10 products within the U.S., 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.

sector s, and the β's add up to 1. The price of the non-traded 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). Since 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:

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

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, $Q_s = \sum_{r \in \mathcal{R}} Q_{sr}$. Non-traded output in region r uses labor: $Q_{NT,r} = Z_{NT,r} L_{NT,r}$, where $L_{NT,r}$ is the employment in the non-traded sector in region r.

Production by sector and region, defined above in (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:

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

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 $p_{ig}^X = \delta_{ig} p_{Dg}$.

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

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

Hence, market clearing in the U.S. variety of product g implies

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

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 (C.2), and P_{Ds} is the price index of domestically produced goods defined in (C.6). x_{ig} is the foreign import demand defined in (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]

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

A general equilibrium given tariffs consists of import prices p_{ig}^{*}, U.S. prices p_{Dg}, traded wages w_{sr}, non-traded wages $w_{NT,r}$, and price indexes (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 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 (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 pre-war equilibrium. Since the U.S. 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 non-estimated 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]

[27] We now have an explicit expression for the aggregate demand shifters E_s entering previously in the import demand defined in (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.

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

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. Since 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 (23) and its world demand (from both the U.S. and foreign countries) resulting from adding up the right-hand side of (25) over all varieties within a sector.

The U.S. 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 U.S. 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 these price changes due to tariffs depends on the elasticities of both 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 indexes 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 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 pre-war import basket, EV^X is the increase in the value of the pre-war export basket, and ΔR is the change in tariff revenue. The pre-tariff war levels of imports and exports in (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 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). Since our estimation finds a foreign supply elasticity ω^* very close to zero, this number remains very close (but not identical since ω^* is not exactly zero) 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 zero.

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. Since 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 U.S. 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

[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 $\mathbf{x}'\Delta\mathbf{p}^X \equiv \sum_{s\in\mathcal{S}}\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}} x_{ig}\Delta p^X_{ig}$.

producers. However, the effects approximately balance out, leading to a small aggregate loss for the U.S. 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. While we cannot reject the null that the aggregate losses are zero, 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 U.S. 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 gains without retaliation.

V.E Regional Impacts

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 why 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 U.S. 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 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

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

[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 2013-2016 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.

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 impacts 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% (*sd* 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% (*sd* 0.5%), on average. We do not observe a meaningful change in the gini coefficient across counties.

Figure VI shows the impacts 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 as well as 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 war are 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 policymakers suggested by the relationship between tariffs and voting with the *ex post* distributional consequences of their policies.

Figure VII presents a non-parametric 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%

[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 function of price changes. Equations (D.9) to (D.12) characterize the block of the model with the solution to the price changes as function tariffs and expenditure shifters.

[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.

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.

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 impacts of the 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 war. The peak shifts leftward and is more pronounced. The 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 is illustrated by the mass of red counties that fall far below the 45-degree line. In contrast, the model implies that Democratic-leaning counties were not as harshly affected by retaliations.

VI CONCLUSION

This paper 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 U.S. 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 U.S. 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

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

[35] Auer et al. (2018) suggest heavy Republican districts would loose more from revoking NAFTA. Ma and McLaren (2018) provide evidence that tariff changes in the years leading up to NAFTA were biased towards industries located in swing states.

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 impacts 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 impact 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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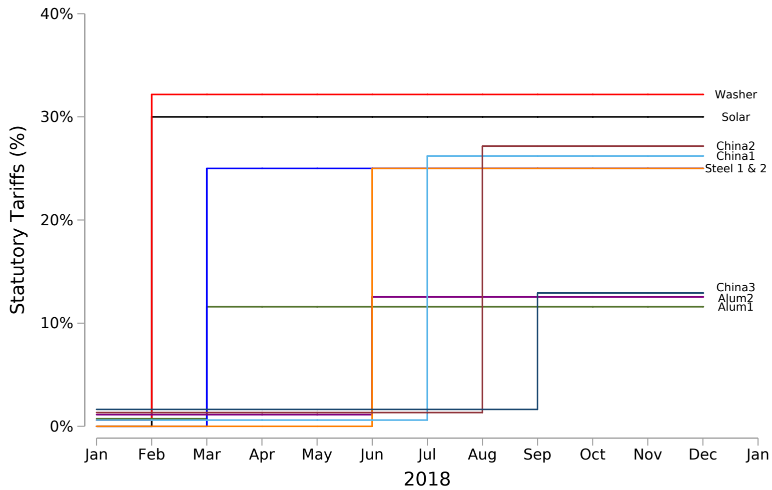
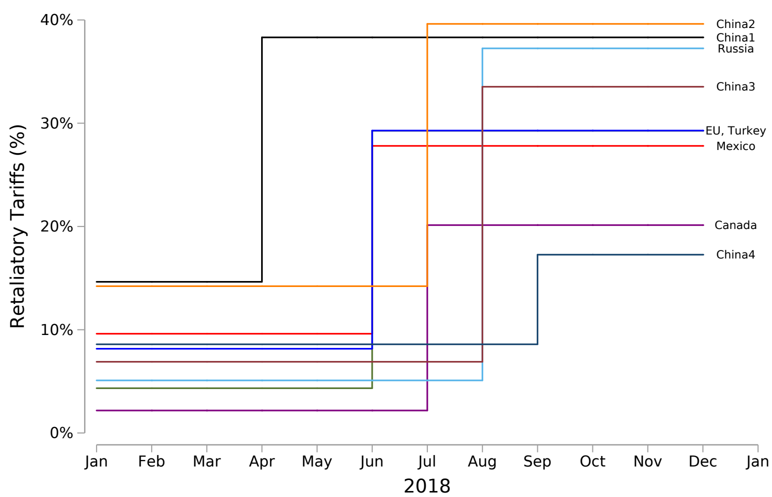
Figures and Tables

Figure I: Trade War Timeline

Panel A: Tariffs on U.S. Imports

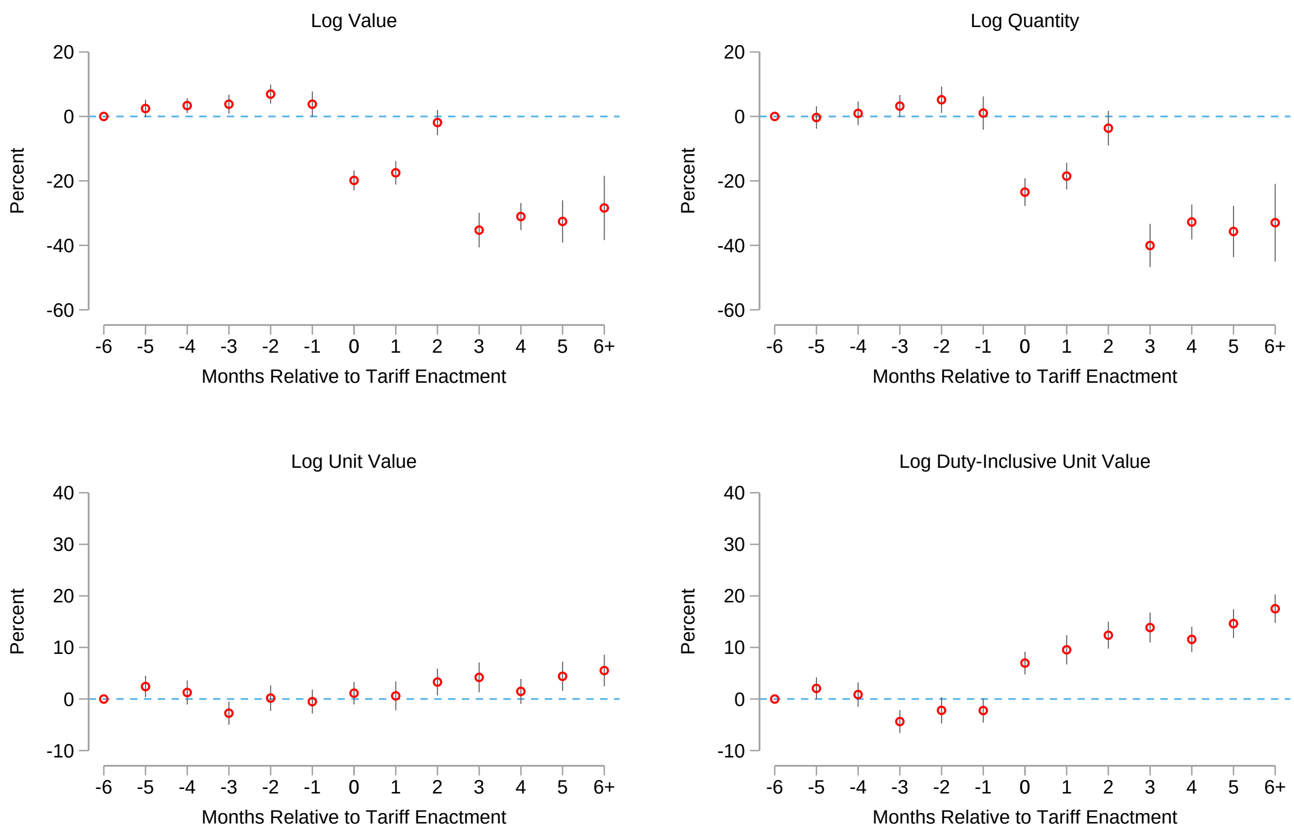


Panel B: Retaliatory Tariffs on U.S. Exports



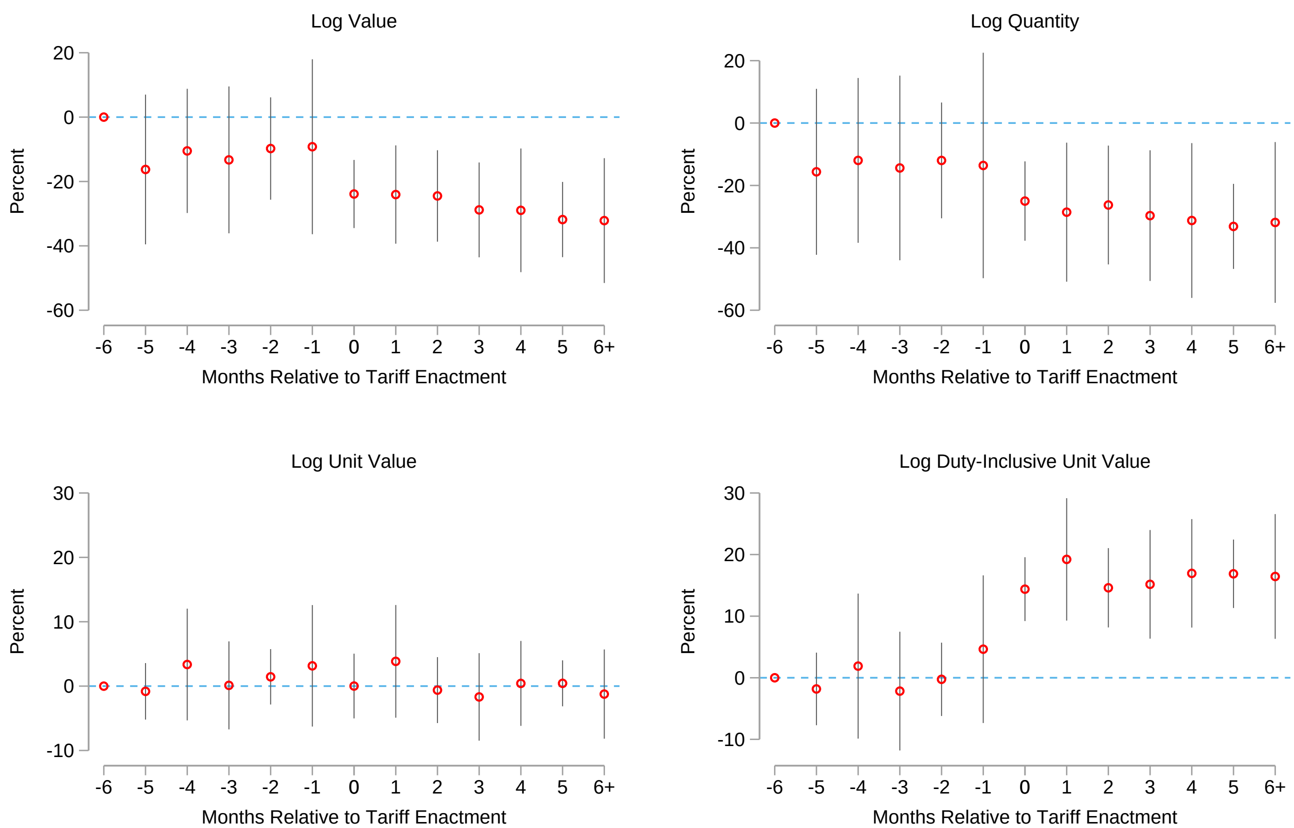
Notes: Figure shows the unweighted average tariff rate of targeted import and export varieties for each tariff wave before and after they are targeted. Import tariffs constructed from U.S. International Trade Commission (USITC) documents, and retaliatory tariffs constructed using official documents from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

Figure II: Variety Event Study: Imports



Notes: 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 clustered by country and HS-8. Event periods before -6 are dropped, and event periods >=6 are binned. Error bars show 95% confidence intervals. In 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 from U.S. Census. Sample period is 2017:1 to 2019:4.

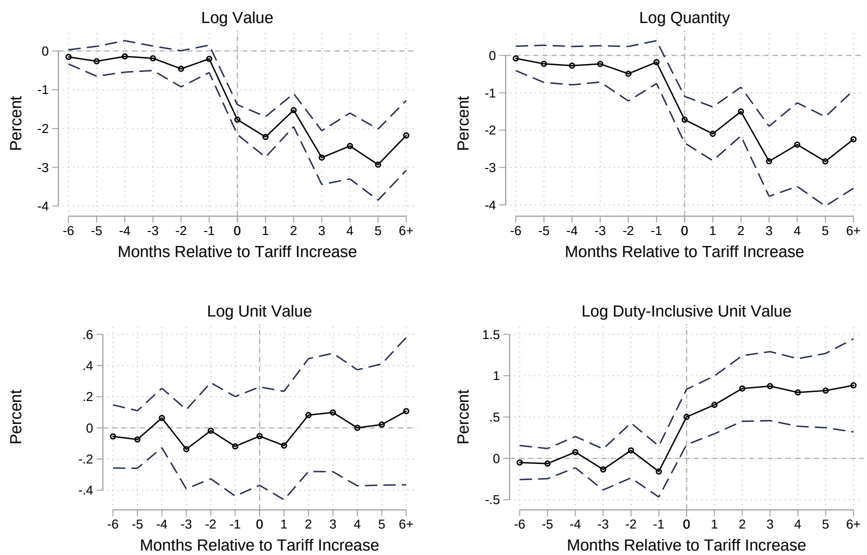
Figure III: Variety Event Study: Exports



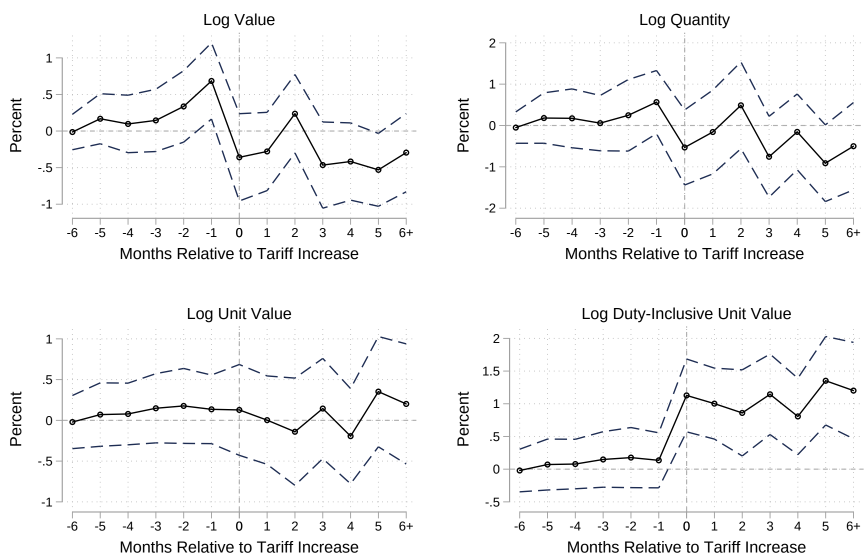
Notes: Figure plots event time dummies for targeted varieties relative to untargeted varieties. Regressions include country-product, product-time, and country-time fixed effects. Standard errors clustered by country and HS-6. Event periods before -6 are dropped, and event periods >=6 are binned. Error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

Figure IV: Dynamic Specification

Panel A: Tariffs on U.S. Imports



Panel B: Retaliatory Tariffs on U.S. Exports

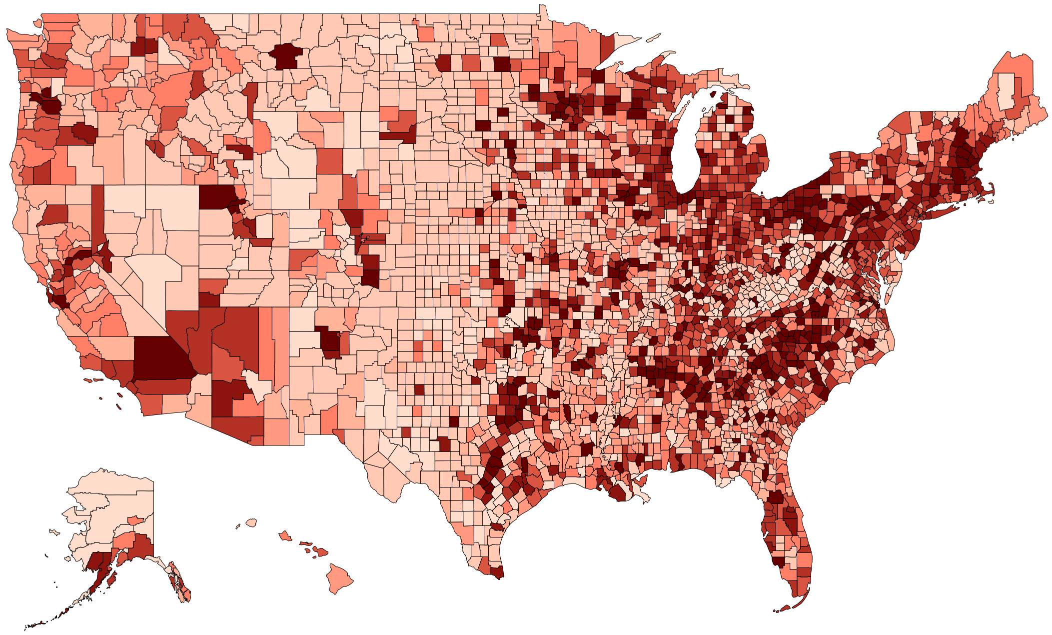


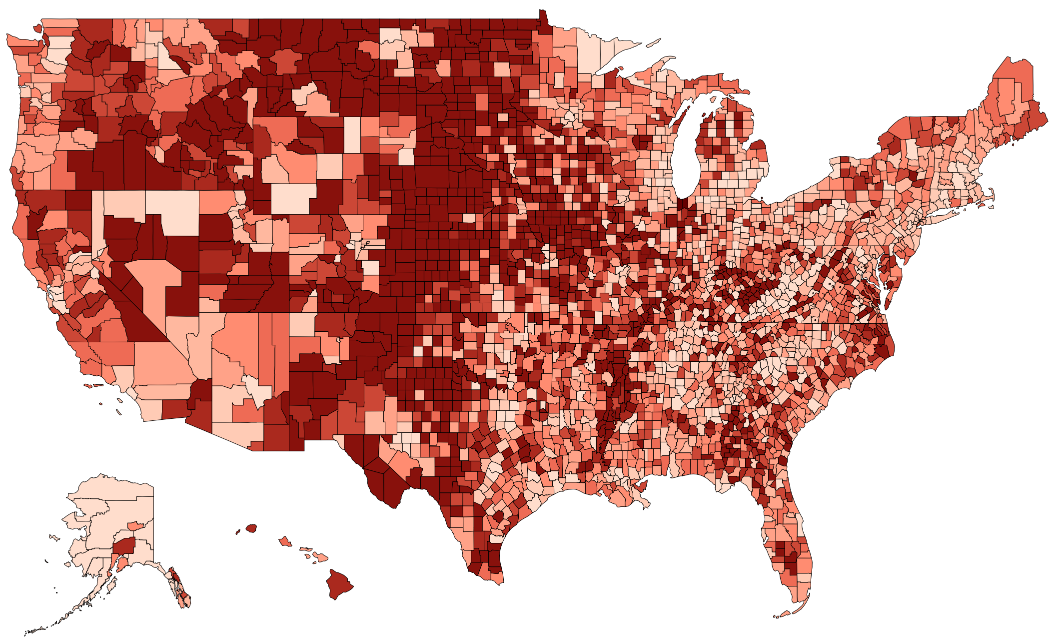
Notes: Figures plot cumulative sum of β coefficients from the regression:

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

where i denotes countries, g denotes products, and t denotes time. Standard errors clustered by county 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 from U.S. Census. Sample period is 2017:1 to 2019:4.

Figure V: Regional Variation in U.S. and Retaliatory Tariffs

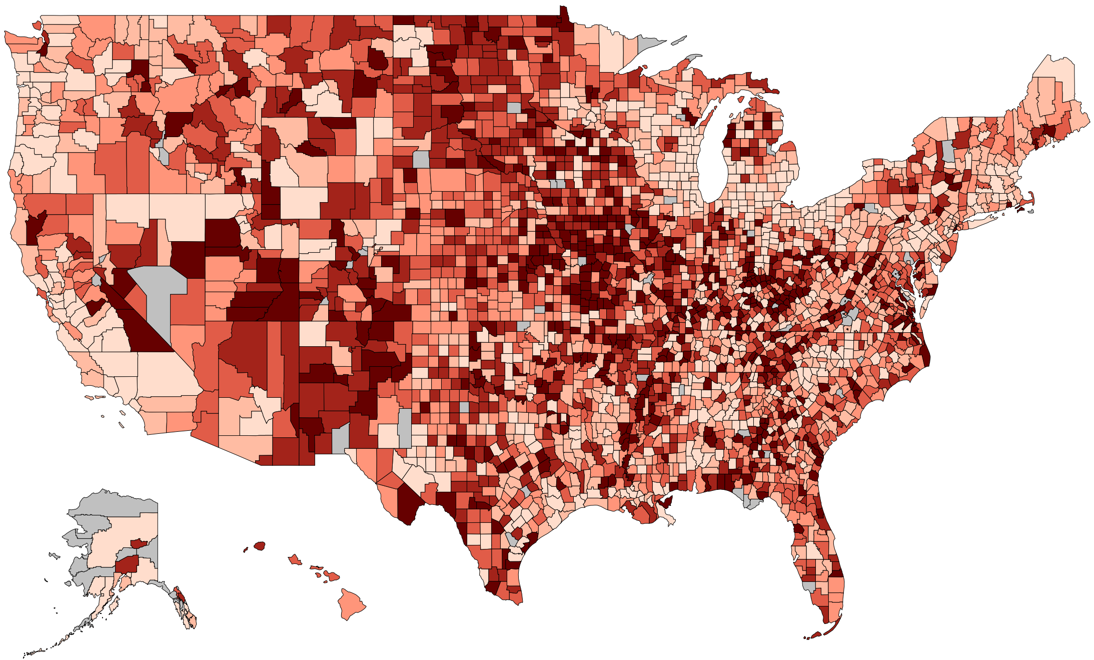




Notes: Figure shows county-level exposure to U.S. import tariff changes (Panel A) and retaliatory tariff changes (Panel B) due to the trade war, weighted by variety-level 2013-2017 U.S. trade shares (constructed from Census data) and by 2016 county-level tradeable sector employee wage bill (constructed from County Business Patterns). Darker shades indicate higher tariff exposure. Values indicate percentage point tariff increases.

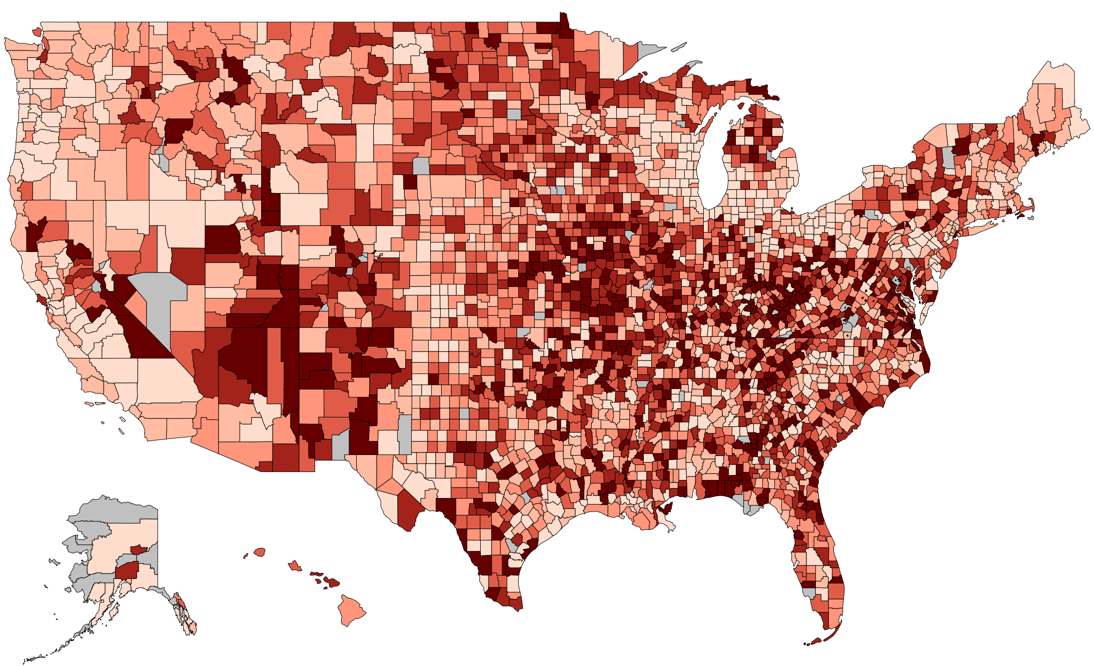
Figure VI: Model Simulation of Real Wage Impacts from U.S. and Retaliatory Tariffs

Panel A: Model Simulation: Tradeable Real Wage Loss from Full War



Legend displays percent real wage loss. Mean loss = 1.03%, std = 0.54%.

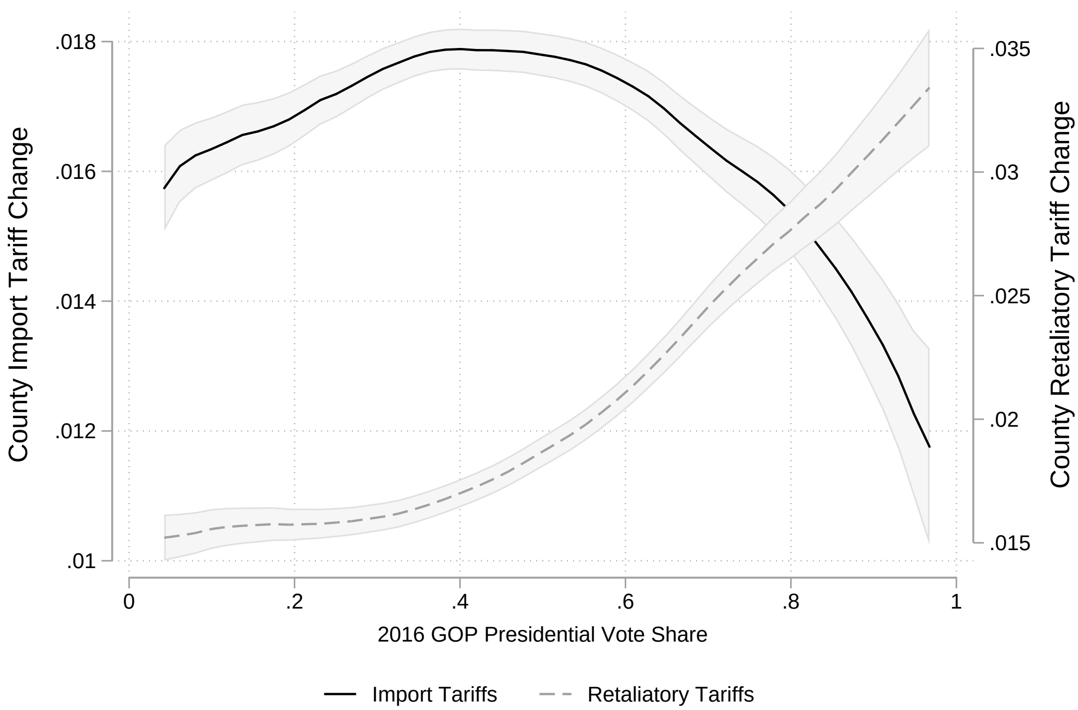
Panel B: Model Simulation: Tradeable Real Wage Loss from U.S. Tariffs (without retaliations)



Legend displays percent real wage loss. Mean loss = 0.51%, std = 0.22%.

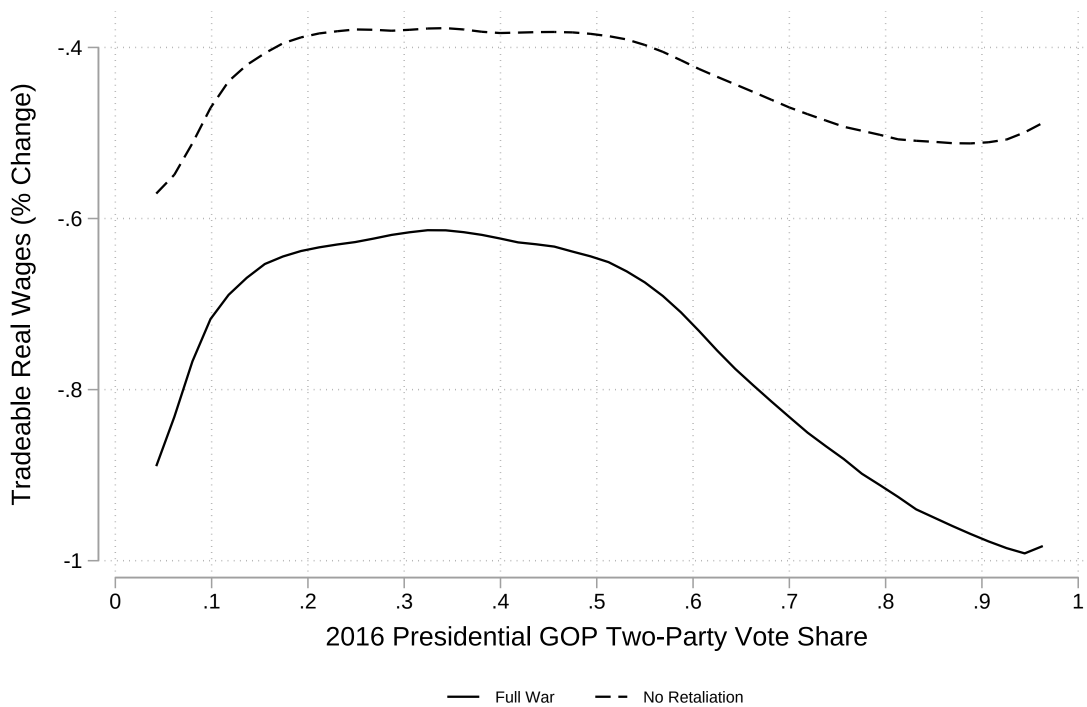
Notes: Figure shows county-level mean tradeable wage losses as simulated from the model. Panel A shows losses accounting for both import and retaliatory tariffs. Panel B shows losses in the counterfactual scenario that U.S. trade partners did not retaliate. Darker shades indicate greater losses. Values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

Figure VII: Tariff Changes vs. 2016 Republican Vote Share



Notes: Figure plots county-level import and retaliatory tariff changes against the 2016 Republican presidential two-party vote share, using a non-parametric fit weighted by county population. County-level tariff changes weighted by variety-level 2013-2017 U.S. trade shares and by 2016 county-level tradeable sector employee wage bill. Vote shares constructed from Federal Election Commission data. Unit of analysis is 3,111 U.S. counties.

Figure VIII: Model-Simulated Tradeable Real Wage Impact vs. 2016 Republican Vote Share



Notes: 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 non-parametric fit weighted by county population. Vote shares constructed from Federal Election Commission data. Unit of analysis is 3,049 U.S. counties.

Table I: The 2018 Trade War

Panel A: Tariffs on U.S. Imports Enacted by U.S. in 2018

Tariff Wave	Date Enacted	Products	2017 Imports		Tariff (%)	
		(# HS-10)	(mil USD)	(%)*	2017	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

Retaliating Country	Date Enacted	Products	2017 Exports		Tariff (%)	
		(# HS-10)	(mil USD)	(%)*	2017	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: "*" Values indicate percentage point tariff increases. Panels display unweighted monthly HS10-country average statutory tariff rates. 2017 tariff rates computed as the annual average; 2018 tariff rates 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 USD value of all U.S. imports (exports). The U.S. government announced import tariffs on aluminum and steel products on March 23 but granted excemptions 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 text for data sources.

Table II: Sector Variation in Tariff Rate Changes

Tariff Changes for Targeted Import Varieties and Export Products, by NAICS3 Code									
		Imports (U.S. Tariffs)				Exports (Retaliatory Tariffs)			
				Δ Tariffs				Δ Tariffs	
Sector	NAICS-3	# Varieties	# Products	Mean	Std.	# Products	# Varieties	Mean	Std.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(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 Product	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 Product	316	237	237	0.10	0.00	196	357	0.16	0.08
Wood Product	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
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 Product	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 Product	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 Product	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 Product	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 computed as the simple average of table row values. Import tariffs constructed from U.S. International Trade Commission (USITC) documents, and retaliatory tariffs constructed using official documents from foreign finance and trade ministries.

Table III: Tests for Pre-Existing Trends

Panel A: U.S. Import Trends

	(1)	(2)	(3)	(4)
	$\Delta \ln p^*_{ig} m_{ig}$	$\Delta \ln m_{ig}$	$\Delta \ln p^*_{ig}$	$\Delta \ln p_{ig}$
$\Delta_{17-18} \ln(1+\tau_{ig})$	0.12	-0.04	0.18	0.18
	(0.11)	(0.19)	(0.15)	(0.15)
Country $\times$ Sector FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
R2	0.14	0.14	0.14	0.14
N	180,744	149,173	149,173	149,173

Panel B: U.S. Export Trends

	(1)	(2)	(3)	(4)
	$\Delta \ln p^X_{ig} x_{ig}$	$\Delta \ln x_{ig}$	$\Delta \ln p^X_{ig}$	$\Delta \ln p^X_{ig}(1+\tau^*_{ig})$
$\Delta_{17-18} \ln(1+\tau^*_{ig})$	0.07	0.11	-0.03	-0.03
	(0.06)	(0.09)	(0.07)	(0.07)
Country $\times$ Sector FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
R2	0.11	0.12	0.12	0.12
N	207,840	163,181	163,181	163,181

Notes: Table reports pre-trend 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 clustered by country and HS-8 (imports) or HS-6 (exports). Significance: *** .01; ** 0.05; * 0.10.

Table IV: Variety Import Demand (σ) and Foreign Export Supply (ω^*)

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \ln p^*_{igt} m_{igt}$	$\Delta \ln m_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln m_{igt}$
$\Delta \ln(1+\tau_{igt})$	-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]
R2	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 clustered by country and HS-8. 90% Bootstrap confidence intervals constructed from 1000 samples. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level import data from 2017:1 to 2019:4.

Table V: Product Elasticity η

	(1)	(2)	(3)
	$\Delta \ln s_{Mgt}$	$\Delta \ln p_{Mgt}$	$\Delta \ln s_{Mgt}$
$\Delta \ln Z_{Mgt}$	-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]
R2	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 (11), and the instrument is constructed using the statutory tariffs using equation 12. All regressions include sector-time fixed effects. 90% Bootstrap confidence intervals constructed from 1000 samples. Regressions clustered by HS-8. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly product-level import data from 2017:1 to 2019:4.

Table VI: Sector Elasticity κ

	(1)	(2)	(3)
	$\Delta \ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$	$\Delta \ln\left(\frac{P_{Mst}}{p_{st}}\right)$	$\Delta \ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$
$\Delta \ln Z_{Mst}$	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]
R2	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 column 6 of Table IV and $\hat{\eta}$ from column 3 of Table V according to (14), and the instrument is constructed using the statutory tariffs using (15). All regressions include sector fixed effects. Regressions clustered by sector. 90% Bootstrap confidence intervals constructed from 1000 samples. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly sector-level import data from from 2017:1 to 2019:4.

Table VII: Foreign Import Demand σ^*

	(1) $\Delta \ln p^X_{igt} x_{igt}$	(2) $\Delta \ln x_{igt}$	(3) $\Delta \ln p^X_{igt}$	(4) $\Delta \ln p^X_{igt}(1+\tau^*_{igt})$	(5) $\Delta \ln p^X_{igt}$	(6) $\Delta \ln x_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	-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]
R2	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 clustered by country and HS-6. 90% Bootstrap confidence intervals constructed from 1000 samples. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level export data from 2017:1 to 2019:4.

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 impacts 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 USD. 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 1000 simulations of the estimated parameters reported in brackets.

The Return to Protectionism

Appendices for Online Publication

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A Data Appendix

A.1 Definitions

Recall from the main text that we use the following definitions throughout our analysis:

- *Products* are HS-10 codes. For example, the HS-10 code 7206100000 covers the product "iron and non-alloy steel ingots."
- *Varieties* are product-country pairs. For example, imports (exports) of "iron and non-alloy steel ingots" from (to) Canada are a distinct variety.
- *Sectors* are NAICS-4 codes. For example, the NAICS-4 code 3312 covers "Steel Product Manufacturing from Purchased Steel."

A.2 Trade Data

A.2.1 Census Trade Data

Our sample is a monthly panel of variety-level traded goods from January 2017 to April 2019. This sample covers the universe of countries and HS-10 codes available in the Census data, including both manufacturing and agricultural products. The Census data does not cover imports or exports of services, such as education or tourism.

In these data we observe the following variables:

- USD value of all imports and exports.
- Quantities of imports and exports. Quantities are missing for approximately 16% of observations in the variety-level import sample and 20% of observations in the variety-level export sample. Within HS-10 codes, units of quantity are homogeneous.
- For imports, we observe the USD value of duties collected by U.S. customs.

A.2.2 Import Tariffs

Our import tariff database is a monthly variety-level panel of tariffs on U.S. imports from 2017:1 to 2019:4. To construct this database, we scrape the U.S. tariff schedule from publicly available official U.S. International Trade Commission (USITC) documents. USITC publishes a "baseline" tariff schedule in January of each year, and publishes revisions to the baseline schedule to reflect changes in tariff policy. These revision files (14 revisions in total for 2018) document the ad-valorem tariff increases that we use as identifying variation in our empirical analysis. We find 99.8% overlap in the value of targeted import products when comparing our dataset to the compilation of targeted products by Bown and Zhang (2019).

The U.S. typically implemented tariff increases at the level of HS-8 codes, and this is why we cluster standard errors at the HS-8 level in our analyses of U.S. import tariffs. However, in rare cases the U.S. exempted specific HS-10 codes within HS-8 categories. A total of 18 Chinese varieties received tariff exemptions at the 10-digit level. These varieties have a 2017 annual value of $1 million. By using HS-10 codes as our definition of products, we are able to exploit this variation in our empirical analysis.

The U.S. and trade partners frequently enacted tariff increases in the middle of the month. In our event study analyses, we assign event time = 0 to the subsequent month if tariffs increases were implemented after the 15th of the month. When estimating the elasticities, we scale tariff increases by the number of days of the month they were in effect. For example, a 15 p.p. tariff increase enacted on the 20th day of a 30-day month is assigned a 10 p.p. tariff increase (15 * 20/30 = 10) in the initial month, and an additional 5 p.p. increase in the subsequent month.[1]

Here we provide additional details about which countries are targeted or exempt for each U.S. tariff wave; this information is intended to complement Table I in the main text.

1. **Washer Tariffs:** Apply to all countries except Canada and GSP Least Developed Nations.[2]
2. **Solar Panel Tariffs:** Apply to all countries except GSP Least Developed Nations.
3. **Steel Tariffs:** Apply to all countries except Argentina, Australia, Brazil, and South Korea. Canada, Mexico, and the EU were exempt until June 1, 2018, after which exemptions were lifted.
4. **Aluminum Tariffs:** Apply to all countries except Argentina (subject to quotas) and Australia (fully exempt with no quota restrictions). Canada, Mexico, and the EU were exempt until June 1, 2018, after which exemptions were lifted.
5. **China Tariffs:** Apply only to imports of Chinese varieties.

[1]Our database does not account for antidumping or countervailing tariffs. It also does not account for a very small fraction of varieties for which tariff increases apply only after surpassing a quota threshold; we estimate that such quota thresholds affect only $16 million (out of ~$300 billion) of annual targeted imports. We also ignore all 2018 tariff changes not associated with the trade war, such as tariff reductions resulting from long-standing treaty commitments. Our empirical specifications are thus identified solely from plausibly exogenous changes in tariffs implemented during the trade war.

[2]GSP Least Developed Nations include: Afghanistan, Angola, Benin, Bhutan, Burkina Faso, Burma, Burundi, Cambodia, Central African Republic, Chad, Comoros, Djibouti, Ethiopia, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Nepal, Niger, Rwanda, Samoa, Sao Tome and Principe, Senegal, Sierra Leone, Solomon Islands, Somalia, Tanzania, Togo, Tuvalu, Uganda, Vanuatu, Yemen, and Zambia.

A.2.3 Retaliatory Tariffs

Our export (retaliatory) tariff database is a monthly variety-level panel of tariffs on U.S. exports from January 2017 to April 2019. We collect "baseline" tariff rates on U.S. exports using *ad valorem* equivalent MFN rates from the most recently available vintage of the WTO World Tariff Database. We then collect official documentation from foreign finance ministries describing retaliatory tariff actions due to the trade war. We construct the retaliatory tariff rate as the MFN rate plus the *ad valorem* retaliatory tariff increase, and follow the same event date assignment and tariff scaling rules as we use for the import tariffs.

Since we do not have access to foreign customs data, we do not observe tariff revenue collected by U.S. trade partners on U.S. exports. We thus construct the duty-inclusive price as (one plus) the value of U.S. exports multiplied by the retaliatory tariff rate.

In rare cases, retaliatory tariffs increased over multiple months: for example, Mexico announced retaliatory tariffs in June 2018 that were increased in July 2018. In other rare cases, retaliatory tariffs decreased over time: for example, in January 2019 China reinstated the MFN tariff rate on U.S. autos and auto parts as a result of tariff negotiations.[3]

Finally, we note that HS codes are only harmonized across countries up to the level of HS-6 codes. Finer codes, such as HS-8 and HS-10 codes, are developed independently by each country for internal classifications. Thus when U.S. trade partners enact tariffs using their own versions of HS-8 codes, we nevertheless assign tariffs at the HS-6 level. In principle, this could imply that our analysis overestimates the value of U.S. exports subject to tariffs and underestimates the foreign import demand elasticity. However, when we estimate the foreign demand elasticity using a merge between Chinese HS-10 to U.S. HS-10 codes, we estimate $\hat{\sigma^*}$ =1.08(*se* 0.36) which is not statistically different from our baseline estimate of $\hat{\sigma}^*$=1.04 (*se* 0.32). This merge does not use an official concordance between the two countries' HS classifications, and therefore we perform all the analyses by assigning retaliatory tariffs at the HS-6 level.

A.3 Sector-Level Data

1. **BLS Price Indexes**: The BLS Producer Price Index (PPI) is a monthly sector-level panel indexing the prices received by producers for their output, covering virtually all tradeable non-farm domestic output. The BLS Import Price Index (MPI) and Export Price Index (XPI) are monthly sector-level panels that measure FOB price inflation in imported and exported goods. All three price indexes are Laspeyres indexes, and thus hold the quality and availability of goods constant over time. The MPI and XPI exclude price inflation due to tariffs and use two-year lagged annual trade value weights.
2. **Federal Reserve G17 Industrial Production Index (G17)**: The Fed G17 is a monthly sector-level panel indexing real output in non-farm sectors. Index values are computed as a

[3]As with the import tariffs, our retaliatory tariff database does not capture antidumping or countervailing duties. It also does not capture potential non-tariff retaliatory actions, such as changes in purchasing behavior by state-owned enterprises.

Fisher index, with weights constructed from annual estimates of value added.

3. **BEA 2016 Input-Output (IO) Accounts**, "Use" Tables: These tables quantify annual 2016 inputs and outputs of commodities by intermediate and final users.
4. **Pierce and Schott (2012)** provide a cross-walk between HS-10 and NAICS codes. For the quantitative model, we classify NAICS-4 sectors as tradeable if they match to an HS code.

A.4 County-Level Data

- **Census County Business Patterns (CBP)**: These data provide annual 2016 industry employment and wage data at the county-level for non-farm sectors.

- **BEA Local Area Personal Income and Employment**: These data provide annual 2016 farm-sector employment and wage data at the country-level.

- **American Community Survey, 5-Year**: We collect the following country-level variables: share unemployed, share white, share with a college degree, and mean income. These data are used in Online Appendix Table A.15.

- **U.S. Federal Election Commission**: Country-level voting patterns for each political party in the 2016 federal elections.

B Appendix to Section II.D (Event Study)

In Figure II, we document a sharp temporary increase in U.S. imports of targeted varieties at event period = 2, followed by a sharp decline in event time = 3. The pattern driven by targeted Chinese varieties in December 2018, and is apparent across a broad range of sectors, implying that it is not a result of seasonality, which in any case would be controlled for by α_{gt} fixed effects. Here, we provide evidence that this effect reflects an anticipatory response to an announcement made by the U.S. at the end of September 2018 that the U.S. would increase tariffs on approximately \$200 billion of already-targeted Chinese varieties from 10% to 25% on January 1, 2019.

To isolate this anticipation effect, we first split targeted import varieties into two subsamples: (1) Chinese varieties worth approximately \$200 billion that were initially targeted with a 10% tariff increase in late September 2018, and then threatened with an additional 15% tariff increase in January 2019; and (2) all other targeted varieties, worth approximately \$100 billion. We then re-estimate the event study specification from Equation 1, but allow the event-time coefficients to vary for threatened and non-threatened varieties. If the anticipation explanation is correct, we should not observe a surge in imports at event period = 2 for non-threatened varieties.[4]

Figure A.4 plots the event-time coefficients for both groups relative to untargeted varieties. At event period = 2, we observe a sharp increase in imports for the threatened varieties, corresponding

[4]Recall that for tariffs implemented after the 15th of the month, we assign event time = 0 to the following month. In this case, that means the September 24th tariff wave is assigned event time = 0 in October, and event time = 2 corresponds to December.

to a surge in anticipatory imports in December 2018 prior to expected tariff increases in January 2019. As expected, we do not observe a similar import surge for non-threatened varieties and the pronounced jump at event time 2 is concentrated entirely in threatened Chinese varieties.

C Appendix to Section III (Trade Framework and Identification)

C.1 Utility and Price Indexes

The demands of consumers and final producers are aggregated at the sector level. Each tradeable sector $s = 1, .., S$ is used for consumption C_s and as intermediate I_s. Sector-level aggregate demands are:

$$C_s + I_s = \left(A_{Ds}^{\frac{1}{\kappa}} D_s^{\frac{\kappa-1}{\kappa}} + A_{Ms}^{\frac{1}{\kappa}} M_s^{\frac{\kappa-1}{\kappa}} \right)^{\frac{\kappa}{\kappa-1}}, \tag{C.1}$$

where D_s and M_s are composite domestic and imported products,

$$D_s = \left(\sum_{g \in \mathcal{G}_s} a_{Dg}^{\frac{1}{\eta}} d_g^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}, \tag{C.2}$$

$$M_s = \left(\sum_{g \in \mathcal{G}_s} a_{Mg}^{\frac{1}{\eta}} m_g^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}}, \tag{C.3}$$

where d_g and m_g is U.S. consumption of the domestic variety and an aggregate of imported varieties of product g, respectively, and where $\mathcal{G}_s$ is the set of products in sector s. The imported products are further differentiated by origin. For each $g \in \mathcal{G}_s$, the quantity imported is

$$m_g = \left(\sum_{i} a_{ig}^{\frac{1}{\sigma}} m_{ig}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{C.4}$$

where m_{ig} is the quantity of product g imported from country i. The terms A_{Ds}, A_{Ms}, a_{Dg}, and a_{ig} denote demand shocks at the different tiers.

The sector level price index associated with (C.1) is

$$P_s = \left(A_{Ds} P_{Ds}^{1-\kappa} + A_{Ms} P_{Ms}^{1-\kappa} \right)^{\frac{1}{1-\kappa}}, \tag{C.5}$$

where P_{Ds} and P_{Ms} are the price indexes of domestic and imported goods in sector s associated with (C.2) and (C.3),

$$P_{Ds} = \left(\sum_{g \in \mathcal{G}_s} a_{Dg} p_{Dg} \right)^{\frac{1}{1-\eta}}, \tag{C.6}$$

$$P_{Ms} = \left(\sum_{g \in \mathcal{G}_s} a_{Mg} p_{Mg} \right)^{\frac{1}{1-\eta}}, \tag{C.7}$$

where p_{Dg} is the price of the domestic variety of good g, and p_{Mg} is the price index of imported varieties associated with (C.4),

$$p_{Mg} = \left(\sum_i a_{ig} p_{ig}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}, \tag{C.8}$$

where p_{ig} is the domestic price defined in (5).

D Appendix to Section V (Aggregate and Distributional Effects)

D.1 Wages

The inverse labor demand resulting from profit maximization (23) is

$$w_{sr} = \left(\frac{Z_{sr} p_s}{\left(L_{sr}/\alpha_{L,s}\right)^{\alpha_{K,s}} \phi_s^{\alpha_{I,s}}} \right)^{\frac{1}{1-\alpha_{I,s}}}, \tag{D.1}$$

for $s = 1, .., S$, where L_{sr} is the number of workers by sector and region. We define the tradeable sector wage as

$$w_{T,r} = \frac{\sum_{s \in \mathcal{S}} w_{sr} L_{sr}}{\sum_{s \in \mathcal{S}} L_{sr}}.$$

Using the non-traded wage $w_{NT,r} = P_{NT,r} Z_{NT,r}$, market clearing in the non-traded sector gives:

$$w_{NT,r} = \beta_{NT} \frac{X_r}{L_{NT,r}}. \tag{D.2}$$

The wage per person in the non-traded sector is $w_{NT,r} = P_{NT,r} Z_{NT,r}$.

D.2 General-Equilibrium System in Changes

We derive the model solution as a system of first-order approximations around an initial equilibrium corresponding to the period before the tariff war. We use this system for the numerical experiments in Section V. Every market clearing condition is expressed in log-changes. The outcome depends on endogenous variables, observed initial shares, elasticities and tariff shocks.

Letting $\hat{x} \equiv d \ln x$, the system gives the change in each endogenous variable given shocks to U.S. and foreign tariffs, $\left\{ d\tau_{ig}, d\tau_{ig}^* \right\}$. Using market clearing conditions, the solution of the model can be expressed as a system for the changes in wages per efficiency unit $\{\hat{w}_{sr}\}$, average wages in the traded sectors $\left\{ \hat{w}_r^T \right\}$, wages in the non-traded sector $\left\{ \hat{w}_r^{NT} \right\}$, producer prices $\{\hat{p}_s\}$, intermediate input prices $\left\{ \hat{\phi}_s \right\}$, employment in the tradeable sector $\left\{ \hat{L}_r^T \right\}$, sector price indexes $\left\{ \hat{P}_s \right\}$, import price indexes $\left\{ \hat{P}_{Ms} \right\}$, product level price indexes $\{\hat{p}_{Mg}\}$, duty-inclusive prices of imported varieties $\{\hat{p_{ig}}\}$, tariff revenue $\hat{R}$, sector level expenditures $\left\{ \hat{E}_s \right\}$, national final consumer expenditures $\hat{X}$, national value added $\hat{Y}$, national intermediate expenditures by sector $\left\{ \widehat{P_s I_s} \right\}$, national sales by sector $\left\{ \widehat{p_s Q_s} \right\}$, and final consumer expenditures by region $\left\{ \hat{X}_r \right\}$.

We now describe the full system that characterizes the solution to these outcomes. To organize the presentation, it is convenient to split it in 4 blocks.

Wages, Producer Prices, Input Prices, and Tradable Employment

The first block characterizes $\left\{\hat{w_{sr}}, \hat{w_{T,r}}, \hat{w_{NT,r}}, \hat{p_s}, \hat{\phi}_s, \hat{L_r^T}\right\}$ given $\left\{\hat{X}_r, \hat{E}_s, \hat{P}_s, \hat{\tau_{ig}^*}\right\}$. We let χ^I be an indicator variable for whether labor is immobile across sectors, as in our benchmark (otherwise, it is perfectly mobile). From (D.1) to (D.2):

$$\hat{w_{sr}} = \frac{\chi^I}{1-\alpha_{I,s}}\left(\hat{p_s} - \alpha_{I,s}\hat{\phi}_s\right) + \left(1-\chi^I\right)\hat{w_{T,r}}, \tag{D.3}$$

$$\hat{w_{T,r}} = \left(1-\chi^I\right)\frac{\sum_{s\in\mathcal{S}}\left(\frac{w_{sr}L_{sr}}{w_{T,r}L_r^T}\right)\frac{\hat{p_s}-\alpha_{I,s}\hat{\phi}_s}{\alpha_{K,s}} - \hat{L_r^T}}{\sum_{s\in\mathcal{S}}\left(\frac{w_{sr}L_{sr}}{w_{T,r}L_r^T}\right)\frac{1-\alpha_{I,s}}{\alpha_{K,s}}} + \chi^I\sum_{s\in\mathcal{S}}\left(\frac{w_{sr}L_{sr}}{w_{T,r}L_r^T}\right)\frac{\hat{p_s}-\alpha_{I,s}\hat{\phi}_s}{1-\alpha_{I,s}}, \tag{D.4}$$

$$\hat{w_{NT,r}} = \chi^I\hat{X}_r + \left(1-\chi^I\right)\hat{w_{T,r}}. \tag{D.5}$$

From the equilibrium in the non-traded sector, the change in traded sector employment is

$$\hat{L_r^T} = \left(1-\chi^{\mathrm{I}}\right)\left(\hat{w_{T,r}} - \hat{X}_r\right)\frac{L_r^{NT}}{L_r^T}. \tag{D.6}$$

Adding up (25) across all varieties within a sector and using the sector supply Q_s implied by (23), the producer price in sector s changes according to:

$$\hat{p_s} = \frac{\frac{P_{Ds}D_s}{p_sQ_s}\left(\hat{E}_s + (\kappa-1)\hat{P}_s\right) + \frac{\alpha_{I,s}}{\alpha_{K,s}}\hat{\phi}_s + \sum_{r\in\mathcal{R}}\frac{p_sQ_{sr}}{p_sQ_s}\frac{\alpha_{L,s}}{\alpha_{K,s}}\hat{w_{sr}} - \sigma^*\sum_{g\in G_s}\sum_{i\in\mathcal{I}}\frac{p_{Dg}x_{ig}}{p_sQ_s}\frac{d\tau_{ig}^*}{1+\tau_{ig}^*}}{\frac{1-\alpha_{K,s}}{\alpha_{K,s}} + \frac{P_{Ds}D_s}{p_sQ_s}\kappa + \left(1-\frac{P_{Ds}D_s}{p_sQ_s}\right)\sigma^*}. \tag{D.7}$$

Finally using (22) the price index of intermediates is

$$\hat{\phi}_s = \sum_{s'\in\mathcal{S}}\frac{\alpha_s^{s'}}{\alpha_{I,s}}\hat{P}_{s'}. \tag{D.8}$$

Consumer Prices, Import Prices, and Tariff Revenue

The second block characterizes $\left\{\hat{P}_s, \hat{P_{Ms}}, \hat{p}_{gM}, \hat{p_{gi}}, \hat{R}\right\}$ given $\left\{\hat{E}_s, d\tau_{ig}\right\}$. From (C.5), the sector price index changes according to a weighted average of producer prices and the import price index,

$$\hat{P}_s = \frac{P_{Ds}D_s}{E_s}\hat{p_s} + \left(1-\frac{P_{Ds}D_s}{E_s}\right)\hat{P}_{Ms}. \tag{D.9}$$

From (2), (4), (6), (C.7), and (C.8), the import price index $\hat{P}_{Ms}$ in sector s changes according to

$$\hat{P_{Ms}} = \sum_{g\in\mathcal{G}_s}\left(\frac{p_{Mg}m_g}{P_{Ms}M_s}\right)\hat{p_{Mg}}, \tag{D.10}$$

where the product-level import price index changes according to

$$\hat{p}_{Mg} = \sum_{i\in\mathcal{I}}\left(\frac{p_{ig}m_{ig}}{p_{Mg}m_g}\right)\hat{p}_{ig}, \tag{D.11}$$

and where the CIF price changes according to

$$\hat{p_{ig}} = \frac{\omega^*}{1+\omega^*\sigma}\left(\hat{E}_s + (\kappa-1)\hat{P}_s + (\eta-\kappa)\hat{P}_{Ms} + (\sigma-\eta)\hat{p}_{Mg}\right) + \frac{1}{1+\omega^*\sigma}\frac{d\tau_{ig}}{1+\tau_{ig}}. \tag{D.12}$$

A second order approximation to the change in tariff revenue, defined as $R = \sum_{s\in\mathcal{S}}\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}}\tau_{ig}p^*_{ig}m_{ig}$, gives:

$$\hat{R} = \sum_s\sum_{g\in G_s}\sum_i \frac{p^*_{gi}m_{gi}}{R}d\tau_{gi} + \sum_s\sum_{g\in G_s}\sum_i \frac{p^*_{gi}m_{gi}}{R}\left(\tau_{gi}+d\tau_{gi}\right)\left(\hat{p^*_{gi}}+\hat{m_{gi}}\right) + \frac{1}{2}\sum_s\sum_{g\in G_s}\sum_i \tau_{gi}d^2\left(p^*_{gi}m_{gi}\right),$$

where $d^2\left(p^*_{gi}m_{gi}\right) = d\tau' \frac{\partial\left(p^*_{gi}m_{gi}\right)}{\partial\tau'\partial\tau}d\tau$.[5] From the equilibrium in the market for each variety that results from combining (4) and (6), using the solution for $\hat{p_{ig}}+\hat{m_{ig}}$ we obtain an equation relating tariff revenue to observable shares, changes in tariffs, and changes in price indexes and expenditure shifters computed in the previous blocks of equations:

$$\begin{aligned}
\hat{R} =& \sum_s\sum_{g\in G_s}\sum_i \left(\tau_{gi}+d\tau_{gi}\right)\frac{p^*_{gi}m_{gi}}{R}\frac{1+\omega^*}{1+\omega^*\sigma}\left(\hat{E}_s + (\kappa-1)\hat{P}_s + (\eta-\kappa)\hat{P}_{Ms} + (\sigma-\eta)\hat{p}_{gM}\right)\\
&+\sum_s\sum_{g\in G_s}\sum_i \left(1-\tau_{ig}\frac{\sigma-1}{1+\omega^*\sigma}\right)\frac{p^*_{ig}m_{ig}}{R}\frac{d\tau_{ig}}{1+\tau_{ig}}\\
&-\sum_s\sum_{g\in G_s}\sum_i \frac{p^*_{ig}m_{ig}}{R}\sigma\frac{1+\omega^*}{1+\omega^*\sigma}\left(\frac{d\tau_{ig}}{1+\tau_{ig}}\right)^2.
\end{aligned} \tag{D.13}$$

Sector and Region Demand Shifters

The third block characterizes the sector and region level expenditure shifters $\left\{\hat{E}_s, \hat{X}_r\right\}$ given $\left\{\hat{R}, \hat{p_s}, \hat{\phi_s}, \hat{w_{NT,r}}, \hat{w_{sr}}\right\}$. Sector-level expenditures are defined as $E_s = P_sC_s + P_sI_s$. Hence, they change according to:

$$\hat{E}_s \equiv \frac{P_sC_s}{E_s}\hat{X} + \left(1-\frac{P_sC_s}{E_s}\right)\hat{P_sI_s}, \tag{D.14}$$

where national consumer consumer expenditures change as function of the change in net income $\hat{Y}$ and tariff revenue,

$$\hat{X} = \frac{Y}{X}\hat{Y} + \frac{R}{X}\hat{R}, \tag{D.15}$$

and where net national income changes according to

$$\hat{Y} = \sum_{r\in\mathcal{R}}\left(\frac{P_{NT,r}Q_{NT,r}}{Y}\right)\hat{X}_r + \sum_{s\in\mathcal{S}}\left(1-\alpha_{I,s}\right)\left(\frac{p_sQ_s}{Y}\right)\sum_{r\in\mathcal{R}}\left(\frac{p_sQ_{sr}}{p_sQ_s}\right)\left(\hat{p_s}+\hat{Q_{sr}}\right). \tag{D.16}$$

Aggregate expenditures $\hat{P_sI_s}$ in intermediates from sector s are given by

$$\hat{P_sI_s} = \sum_{s'\in\mathcal{S}}\alpha^s_{s'}\sum_{r\in\mathcal{R}}\frac{p_{s'}Q_{s'r}}{P_sI_s}\left(\hat{p_{s'}}+\hat{Q_{s'r}}\right). \tag{D.17}$$

Using local labor market clearing we obtain the change in sales of sector s in region r entering in the last three expressions:

$$\hat{p_s}+\hat{Q_{sr}} = \frac{1}{\alpha_{K,s}}\hat{p_s} - \frac{\alpha_{I,s}}{\alpha_{K,s}}\hat{\phi}_s - \frac{\alpha_{L,s}}{\alpha_{K,s}}\hat{w_{sr}}. \tag{D.18}$$

[5]Since initial tariffs are small, we set the product of initial tariffs and the second order term $\frac{1}{2}\tau d^2\left(p^*m\right)$ to zero. The product of tariffs and the first-order term in the change of imports, tdm, is 0.003% of GDP.

Finally using (26) final expenditures in region r change according to

$$\hat{X}_r = \frac{\sum_{s\in\mathcal{S}} \frac{p_{sr}Q_{sr}}{X_r}\left(1-\alpha_{I,s}\right)\left(\hat{p_s}+\hat{Q_{sr}}\right)+\frac{b_r R}{X_r}\hat{R}}{1-\frac{P_{NT,r}Q_{NT,r}}{X_r}}. \tag{D.19}$$

D.3 Numerical Implementation and Parametrization

To implement the system (D.3)-(D.13) we write it in the reduced form $A\hat{x} = y$, where $\hat{x}$ is a column vector stacking all the endogenous variables, y is a column vector with the retaliatory tariff shocks, and A collects elasticities and observed shares. The reduced-form of the system, giving the solution for endogenous variables as function of shocks, takes the form $\hat{x} = A^{-1}y$. We check numerically that the matrix A has full rank and that, therefore, the equilibrium in changes is uniquely defined. The vector $\hat{x}$ includes $1,020,045$ endogenous variables, hence the matrix A has 10^{12} elements. However the matrix A is very sparse, making this inversion computationally feasible and quick. The reason the matrix is very sparse is that, as noted above, the various blocks of the system interact only through a few variables. Specifically, of the approximately 1 million endogenous variables, about $700,000$ correspond to the variety prices $\hat{p_{ig}}$, which only enter in the rows of A corresponding to import prices and tariff revenue.

To parametrize the system (D.3)-(D.13), from the IO tables we use sales from tradeable sector s' to sector s ($P_{s'}I_s^{s'}$), consumption expenditures by sector (P_sC_s), exports by sector, import expenditures by sector ($P_{Ms}M_s$), total labor compensation (w_sL_s), and gross operating surplus ($\sum_r \Pi_{sr}$). Tradeable sectors are defined as those for which we find a concordance with the HS codes using the concordance of Pierce and Schott (2012).[6] Since non-traded sectors only use labor in the model, sector payments to non-traded sectors are accounted as payments to labor, and non-traded sector purchases from other sectors are accounted as final absorption. We construct total sales (p_sQ_s in the model) as the sum of sales to other sectors, final absorption and net exports.

The elasticities $\{\sigma, \sigma^*, \omega, \eta, \kappa\}$ are point estimates from the estimation in Section IV, and bootstrapped confidence intervals are computed using the 1,000 bootstrapped estimates. The technology parameters $\alpha_s^{s'}$, $\alpha_{K,s}$ and $\alpha_{L,s}$ are defined as intermediate input, gross operating surplus are labor shares of sales. The tradeable consumption shares β_s are defined as the sectoral shares in the domestic absorption columns of the IO tables. We set a non-traded share of expenditures of $\beta_{NT} = 0.7$ such that the model matches the observed 15% share of imports in GDP.

Implementing the system (D.3)-(D.13) also requires information on labor income and employment shares by counties. We allocate the total labor compensation from IO tables across U.S. counties using the regional labor compensation shares from the 2016 County Business Patterns database. We keep counties with positive employment in both tradeable and non-tradeable sectors (this drops 41 counties). Consistent with our assumption that the Cobb-Douglas function is constant across regions within a sector, county-level sales by sector are constructed by applying the (inverse) national labor share to the regional wage bill by sector.

[6] The NAICS codes that do not match to any HS code using the concordance of Pierce and Schott (2012) are included in the non-traded sector: 23, 42, 55, 115, 44, 45, 48, 49, 52, 53, 56, 62, 71, 72, 2131, 22, 3328, 51, 54, 61, 81.

Finally, implementing the system requires information on import and export flows by variety. We apply the import and export shares within each 4-digit NAICS sector from customs data for 2016 to the sector-level import and export flows of the IO table. To limit the scale of the counterfactuals we restrict the trade dataset to the largest trade partners accounting for 99% of U.S. trade and to the largest varieties accounting for 99% of trade within each sector and at least $10,000.

As a result, we match the model to 2016 data on economic activity for 3,067 U.S. counties, 88 traded sectors (4-digit NAICS), 71 trade partners, 10,228 imported HS-10 products, 213,578 imported varieties (unique product-country origin), 3,684 exported products, and 53,508 unique product-destination countries.

D.4 Producer Price Increases

When foreign export supply is perfectly elastic ($\omega = 0$), we can combine our previous solution for the increase in the producer price index from (D.7) with the price indexes (D.9) to (D.12) to obtain the following decomposition of the change in producer prices in response to a tariff shock:

$$\hat{p_s} = \frac{1}{\Phi_s} \left(DomExpenditure_s + TariffShock_s + CostShock_s \right) \tag{D.20}$$

where

$$\begin{aligned}
DomExpenditure_s &\equiv \frac{P_{Ds} D_s}{p_s Q_s} \hat{E}_s, \\
TariffShock_s &\equiv (\kappa - 1) \sum_{g \in \mathcal{G}_s} \sum_{i \in \mathcal{I}} \frac{P_{Ds} D_s}{p_s Q_s} \frac{p_{ig} m_{ig}}{E_s} \frac{d\tau_{ig}}{1 + \tau_{ig}} - \sigma^* \sum_{g \in \mathcal{G}_s} \sum_{i \in \mathcal{I}} \frac{p_{Dg} x_{ig}}{p_s Q_s} \frac{d\tau^*_{ig}}{1 + \tau^*_{ig}}, \\
CostShock_s &\equiv \frac{\alpha_{I,s}}{\alpha_{K,s}} \hat{\phi}_s + \sum_{r \in \mathcal{R}} \frac{p_s Q_{sr}}{p_s Q_s} \frac{\alpha_{L,s}}{\alpha_{K,s}} \hat{w_{sr}}, \\
\Phi_s &\equiv \frac{1 - \alpha_{K,s}}{\alpha_{K,s}} + \frac{P_{Ds} D_s}{p_s Q_s} \frac{P_{Ds} D_s}{E_s} + \frac{P_{Ds} D_s}{p_s Q_s} \frac{P_{Ms} M_s}{E_s} \kappa + \left(1 - \frac{P_{Ds} D_s}{p_s Q_s} \right) \sigma^*.
\end{aligned}$$

This decomposition highlights the general-equilibrium effects on the producer prices in the U.S. when U.S. or foreign tariffs change. The first two components, domestic expenditures and tariffs, drive price changes through reallocation of domestic and foreign demand. The first component includes demand shifters ($\hat{E}_s$) entering through the shares of sectors and final consumers in aggregate demand. The second component (tariffs) implies that higher domestic tariffs ($d\tau_{ig} > 0$) and higher foreign tariffs ($d\tau^*_{ig} > 0$) reallocate expenditures into or away of domestic products, respectively leading to higher or lower prices. The third component shows that domestic prices change with costs, either through input linkages or wages in those regions where the sector is more concentrated. The intensity of these effects is mediated by the estimated elasticities σ^* and κ, entering through the tariff component and through the constant Φ_s.

E Appendix to Section V.F (Tariff Protection, Wages, and Voting Patterns)

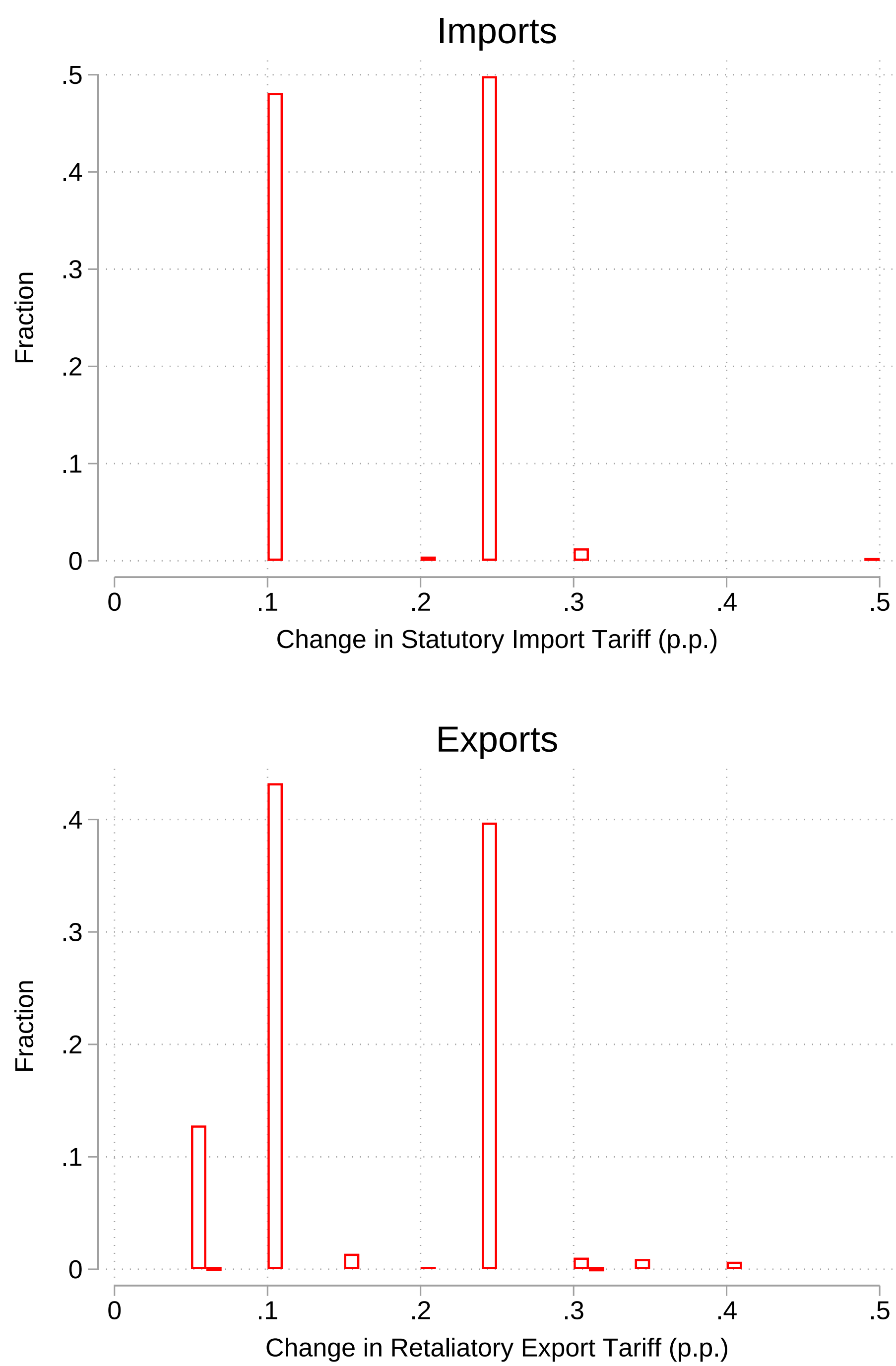
In Section V.F we document that import tariffs were targeted toward politically competitive counties (as measured by their 2016 presidential vote share), whereas retaliatory tariffs were targeted at heavily Republican counties. Here, we further explore how these patterns vary with other political, economic, and demographic characteristics of counties.

First, we examine whether the inverted U-shape pattern in import tariffs holds when we restrict to counties that are located in politically competitive states in the U.S. Electoral College. Figure A.5 plots county-level tariffs for states that had GOP vote shares of 45-55% in the 2016 presidential election and match the list of the most competitive states in the electoral college by fivethirtyeight.com: AZ, CO, FL, GA, MI, MN, NC, NH, NM, NV, OH, PA, VA, and WI. The inverted U-shape pattern in import tariffs is even more pronounced in these states.

Table A.15 further explores how these patterns vary with counties' economic and demographic characteristics. For U.S. tariffs, Panel A shows that the inverted-U pattern over county-level Republican vote share remains even after controlling for agriculture employment shares, several measures of county demographic characteristics, and pre-existing trends in county employment and income growth. For retaliatory tariffs, Panel B shows that the positive relationship with county Republican vote share disappears once we control for agriculture employment share.

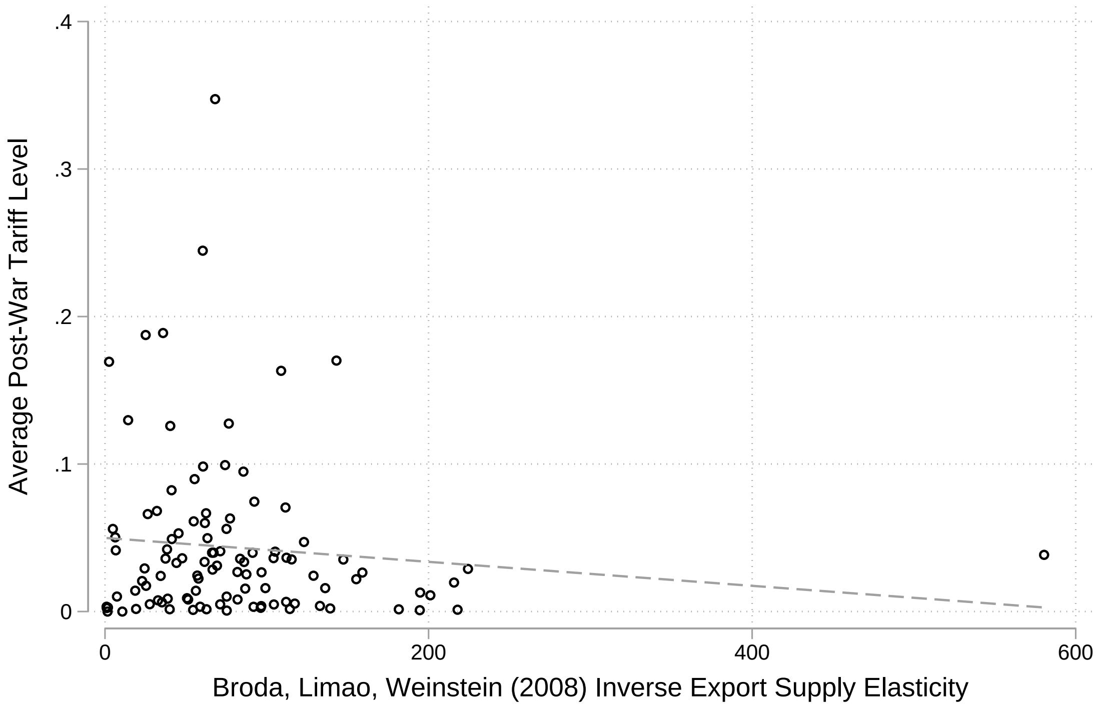
Online Appendix Figures and Tables

Figure A.1: Statutory Tariff Changes



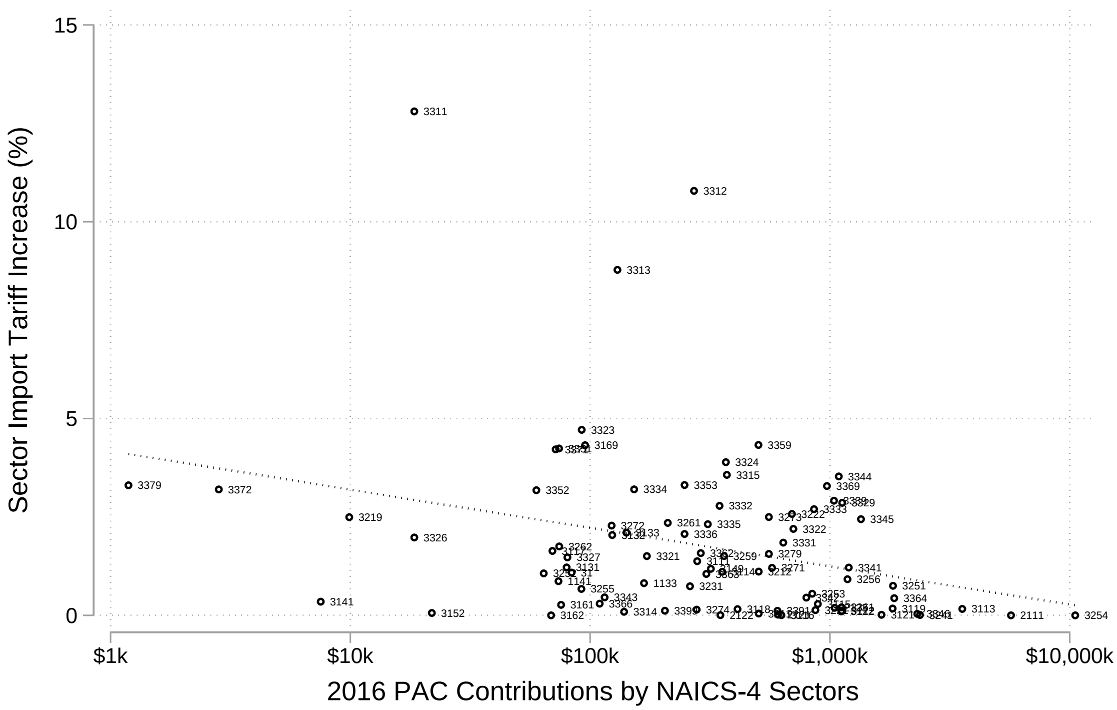
Notes: Figures show the distribution of tariff increases due to the trade war. Import tariff changes constructed from U.S. International Trade Commission (USITC) documents, and retaliatory tariff changes constructed using official documents from foreign finance and trade ministries.

Figure A.2: Import Tariffs and Export Supply Elasticities from Broda et al. (2008)



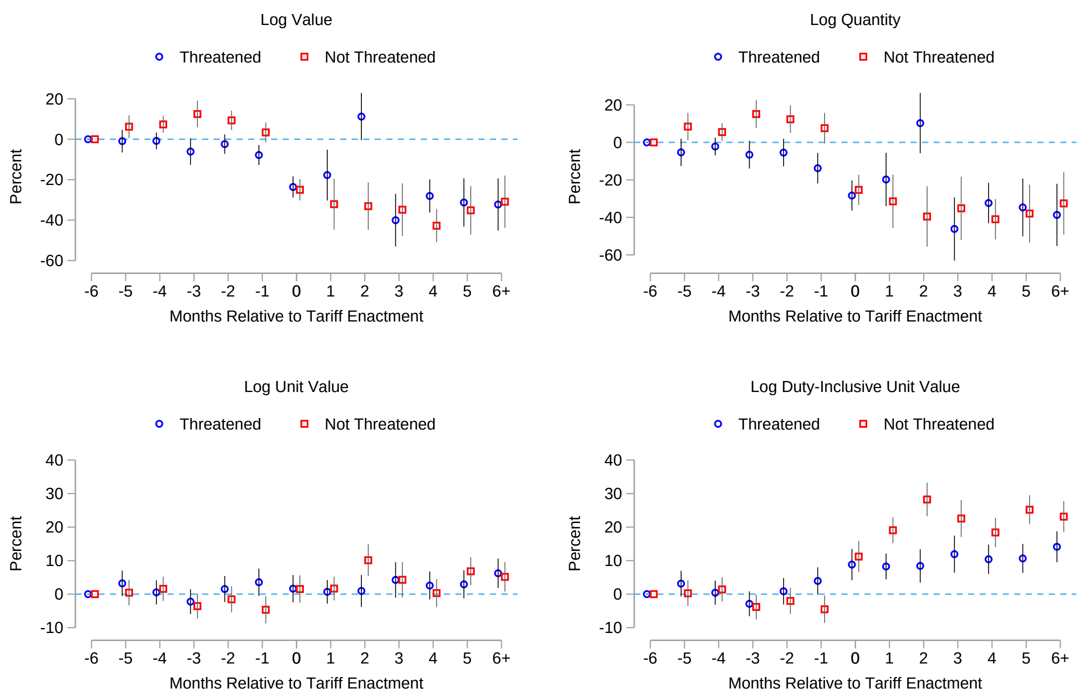
Notes: Figure plots post-war tariff levels against export supply elasticities estimated by Broda et al. (2008). Unit of analysis is NAICS-4 sectors.

Figure A.3: Political Contributions and Statutory Tariff Changes



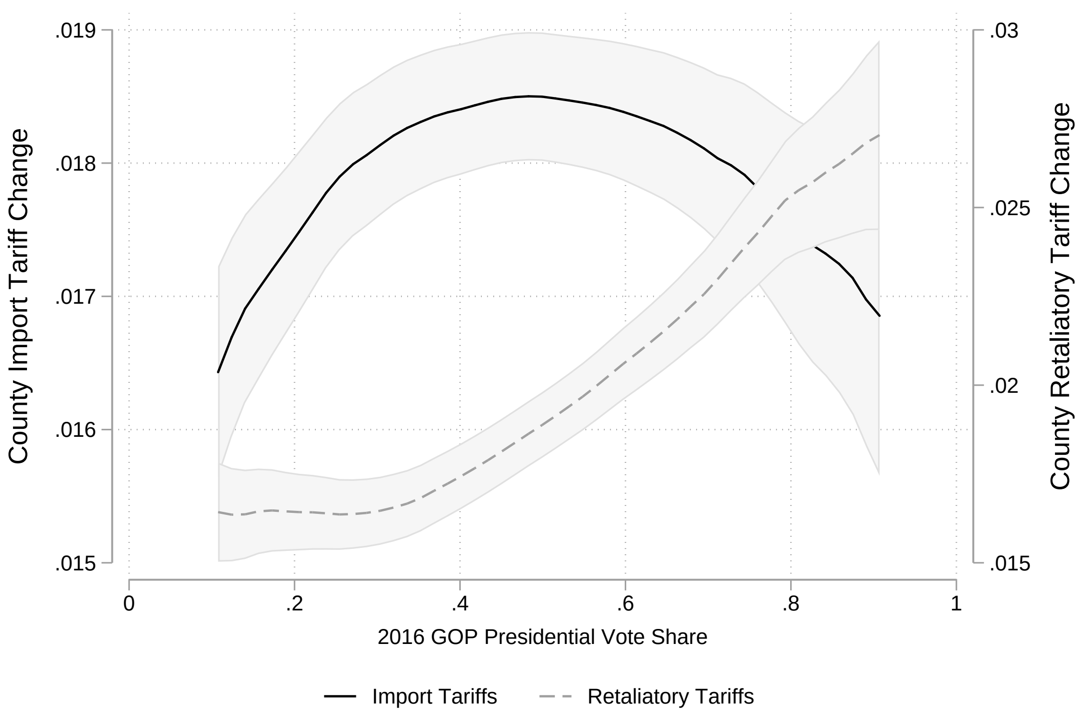
Notes: Figure plots 2016 financial campaign contributions against tariff changes at the sector level. Campaign contributions are measured using legal disclosure data compiled by the Center for Responsive Politics and cover contributions to candidates for the U.S. House of Representatives during the 2016 election cycle. Import tariffs are trade-weighted averages within NAICS-4 sectors.

Figure A.4: Import Event Study for 2019 Threatened Varieties



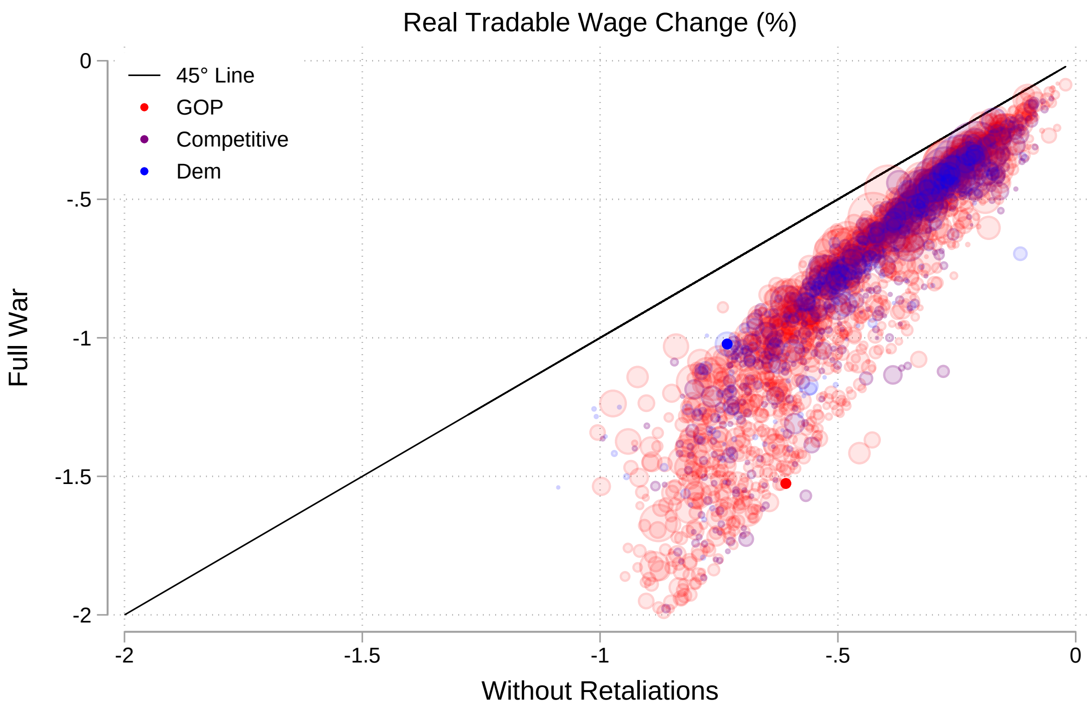
Notes: Figure reports the event study specification from equation (1) but allows the event-time coefficients to vary over two subsamples of targeted varieties: (a) Chinese varieties that were initially targeted in late September 2018 and threatened with additional tariff increases in January 2019 (shown in blue), and (b) targeted import varieties that were not threatened by additional tariff increases in January 2019 (shown in red). The graph plots the event-time coefficients for both targeted subsamples relative to untargeted varieties. Standard errors clustered by country and HS-8. Error bars show 95% confidence intervals. Significance: * 0.10, ** 0.05, *** 0.01. Monthly variety-level import data from U.S. Census. Sample period is 2017:1 to 2019:4.

Figure A.5: Tariff Changes vs. 2016 Republican Vote Share in Politically Competitive States



Notes: Figure shows a population-weighted non-parametric fit of county-level 2017-2018 tariff changes due to the trade war against the 2016 GOP presidential vote share within the following states: AZ, CO, FL, GA, MI, MN, NC, NH, NM, NV, OH, PA, VA, and WI.

Figure A.6: Simulated Real Tradeable Wage Impacts by Political Orientation



Notes: Unit of analysis is U.S. counties. The y-axis indicates the real tradeable wage change due to both U.S. and retaliatory tariffs, as simulated from the model. The x-axis indicates the simulated real tradeable wage change in a counterfactual scenario in which U.S. trade partners did not retaliate. Blue (red) markers indicate counties where Democrats (Republicans) received >60% of the two-party 2016 presidential vote. Purple markers indicate politically competitive counties where both the Democratic and Republican party received between 40-60% of the two-party vote. Marker sizes are proportional to each county's 2016 population. Counties with a less than 2% decline in the full-war real tradeable wage or with only agriculture employment are dropped to improve the data visualization; the dropped counties are overwhelmingly Republican and fall far below the 45-degree line.

Table A.1: Targeted Products, Intermediate vs. Final Goods

Targeted US Imports			
Product Type	# HS-10	mil USD	Δ Tariff
Intermediate/Capital Good	10,115	257,032	14.3
Final/Consumer Good	1,928	45,938	10.2
Total	**12,043**	**302,970**	**14.0**

Targeted US Exports			
Product Type	# HS-10	mil USD	Δ Tariff
Intermediate/Capital Good	6,212	104,402	11.0
Final/Consumer Good	1,861	22,746	14.5
Total	**8,073**	**127,148**	**13.1**

Notes: Intermediate and final consumer goods are classified using BEC codes. Table reports the number and 2017 annual value of targeted products, as well as the unweighted average tariff increase.

Table A.2: Tests of Pre-Existing Trends, 2013-17

Panel A: U.S. Import Trends

	(1)	(2)	(3)	(4)
	$\Delta \ln p^*_{ig} m_{ig}$	$\Delta \ln m_{ig}$	$\Delta \ln p^*_{ig}$	$\Delta \ln p_{ig}$
$\Delta_{17-18} \ln(1+\tau_{ig})$	-0.01	-0.07	0.08	0.08
	(0.05)	(0.08)	(0.06)	(0.06)
Country × Sector FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
R2	0.11	0.12	0.11	0.11
N	273,550	228,753	228,753	228,753

Panel B: U.S. Export Trends

	(1)	(2)	(3)	(4)
	$\Delta \ln p^X_{ig} x_{ig}$	$\Delta \ln x_{ig}$	$\Delta \ln p^X_{ig}$	$\Delta \ln p^X_{ig}(1+\tau^*_{ig})$
$\Delta_{17-18} \ln(1+\tau^*_{ig})$	-0.04	0.02	-0.02	-0.02
	(0.06)	(0.08)	(0.06)	(0.06)
Country × Sector FE	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes
R2	0.08	0.09	0.09	0.09
N	328,666	263,919	263,919	263,919

Notes: Table reports pre-trend tests for import (Panel A) and export (Panel B) variety-level trade outcomes. Table reports regressions of the 2013:1-2017:12 average monthly changes in values, quantities, unit values, and tariff-inclusive unit values against the 2018 tariff changes. Standard errors clustered by country and HS-8 (imports) or HS-6 (exports). Significance: *** .01; ** 0.05; * 0.10.

Table A.3: Reduced Form Variety Import Outcomes, Applied Tariffs

	(1)	(2)	(3)	(4)	(5)
	$\Delta \ln(1+\tau_{igt}^{app})$	$\Delta \ln p_{igt}^{*} m_{igt}$	$\Delta \ln m_{igt}$	$\Delta \ln p_{igt}^{*}$	$\Delta \ln p_{igt}$
$\Delta \ln(1+\tau_{igt})$	0.61***				
	(0.07)				
$\Delta \ln(1+\tau_{igt}^{app})$		-2.50***	-2.55***	0.01	1.01***
		(0.15)	(0.24)	(0.14)	(0.14)
Product × Time FE	Yes	Yes	Yes	Yes	Yes
Country × Time FE	Yes	Yes	Yes	Yes	Yes
Country × Sector FE	Yes	Yes	Yes	Yes	Yes
1st-Stage F		80.5	76.9	76.9	76.9
R2	0.14	0.01	0.01	0.00	0.00
N	2,993,288	2,993,288	2,454,023	2,454,023	2,454,023

Notes: Table reports the variety-level import responses to applied import tariffs. Columns 1-4 report the reduced-form outcomes of import values, quantities, before-duty unit values, and duty-inclusive unit values regressed on $\Delta \ln(1+\tau_{igt}^{app})$, where $\Delta \ln(1+\tau_{igt}^{app})$ is instrumented by the statutory rate $\Delta \ln(1+\tau_{igt})$. All regressions include product-time, country-time and country-sector fixed effects. Sample: Monthly variety-level import data from 2017:1 to 2019:4. Standard errors clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.4: Variety Import Outcomes with Trends

	(1) $\Delta \ln p^*_{igt} m_{igt}$	(2) $\Delta \ln m_{igt}$	(3) $\Delta \ln p^*_{igt}$	(4) $\Delta \ln p^*_{igt}(1+\tau_{igt})$	(5) $\Delta \ln p^*_{igt}$	(6) $\Delta \ln m_{igt}$
$\Delta \ln(1+\tau_{igt})$	-1.49***	-1.45***	0.01	0.60***		
	(0.19)	(0.26)	(0.08)	(0.13)		
$\Delta \ln m_{igt}$					-0.01	
					(0.06)	
$\Delta \ln p_{igt}$						-2.44***
						(0.25)
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
Variety FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-Stage F					32.2	20.5
R2	0.16	0.16	0.15	0.15	0.02	.
N	2,956,057	2,419,851	2,419,851	2,419,851	2,419,851	2,419,851

Notes: Table reports the variety-level import responses to import tariffs, controlling for variety-specific time trends. Columns 1-4 report the reduced-form outcomes of import values, quantities, before-duty unit values, and duty-inclusive unit values regressed on $\Delta \ln(1+\tau_{igt})$. 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 variety, product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-8. Sample: Monthly variety-level import data from 2017:1 to 2019:4. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.5: Variety Import Outcomes with Long-Run Trends

	(1) $\Delta \ln p^*_{igt} m_{igt}$	(2) $\Delta \ln m_{igt}$	(3) $\Delta \ln p^*_{igt}$	(4) $\Delta \ln p^*_{igt}(1+\tau_{igt})$	(5) $\Delta \ln p^*_{igt}$	(6) $\Delta \ln m_{igt}$
$\Delta \ln(1+\tau_{igt})$	-0.79**	-0.78**	0.04	0.38**		
	(0.33)	(0.34)	(0.07)	(0.15)		
$\Delta \ln m_{igt}$					-0.05	
					(0.08)	
$\Delta \ln p_{igt}$						-2.07***
						(0.31)
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
Variety FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-Stage F					5.2	6.3
R2	0.15	0.15	0.13	0.13	0.10	.
N	7,872,049	6,403,668	6,403,668	6,403,668	6,403,668	6,403,668

Notes: Table reports the variety-level import responses to import tariffs, controlling for long-run variety-specific time trends. Columns 1-4 report the reduced-form outcomes of import values, quantities, before-duty unit values, and duty-inclusive unit values regressed on $\Delta \ln(1+\tau_{igt})$. 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 variety, product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-8. Sample: Monthly variety-level import data from 2013:1 to 2019:4. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.6: Variety Export Outcomes with Trends

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \ln p^X_{igt} x_{igt}$	$\Delta \ln x_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}(1+\tau^*_{igt})$	$\Delta \ln p^X_{igt}$	$\Delta \ln x_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	-1.03***	-1.02***	-0.07	0.93***		
	(0.30)	(0.38)	(0.16)	(0.16)		
$\Delta \ln x_{igt}$					0.07	
					(0.17)	
$\Delta \ln p^X_{igt}(1+\tau^*_{igt})$						-1.10***
						(0.35)
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
Variety FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-Stage F					7.0	33.6
R2	0.10	0.11	0.10	0.10	.	0.50
N	3,252,348	2,515,825	2,515,825	2,515,825	2,515,825	2,515,825

Notes: Table reports the variety-level export responses to retaliatory tariffs, controlling for variety-specific time trends. 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 variety, product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-6. Sample: Monthly variety-level export data from 2017:1 to 2019:4. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.7: Variety Export Outcomes with Long-Run Trends

	(1) $\Delta \ln p^X_{igt} x_{igt}$	(2) $\Delta \ln x_{igt}$	(3) $\Delta \ln p^X_{igt}$	(4) $\Delta \ln p^X_{igt}(1+\tau^*_{igt})$	(5) $\Delta \ln p^X_{igt}$	(6) $\Delta \ln x_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	-0.41*	-0.38	-0.06	0.94***		
	(0.22)	(0.25)	(0.09)	(0.09)		
$\Delta \ln x_{igt}$					0.16	
					(0.28)	
$\Delta \ln p^X_{igt}(1+\tau^*_{igt})$						-0.40
						(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
Variety FE	Yes	Yes	Yes	Yes	Yes	Yes
1st-Stage F					2.2	105.0
R2	0.09	0.09	0.08	0.08	.	0.31
N	9,171,659	7,031,740	7,031,740	7,031,740	7,031,740	7,031,740

Notes: Table reports the variety-level export responses to retaliatory tariffs, controlling for long-run variety-specific time trends. 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 variety, product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-6. Sample: Monthly variety-level export data from 2017:1 to 2019:4. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.8: Product Fixed Effects

	(1) $\Delta \ln p^*_{gt} m_{gt}$, fe	(2) $\Delta \ln m_{gt}$, fe	(3) $\Delta \ln p^*_{gt}$, fe	(4) $\Delta \ln p_{gt}$, fe
$\Delta \ln(1+\tau_{gt})$, fe	-1.71***	-1.69***	-0.09	0.46**
	(0.33)	(0.38)	(0.20)	(0.20)
Sector-Time FE	Yes	Yes	Yes	Yes
R2	0.02	0.02	0.01	0.01
N	318,889	285,077	285,077	285,077

Notes: Outcomes are the product-time fixed effects from variety-level regressions of changes in import values, quantities, unit values, and tariff-inclusive unit values on product-time, country-time, and country-sector fixed effects. Regressor is the product-time fixed effect from a regression of the change in the import tariff on product-time, country-time, and country-sector fixed effects. Standard errors clustered by HS-8. Specification is a product-level regression from 2017:1 to 2019:4.

Table A.9: Variety Tariff Pass-Through, Final vs. Intermediates

Panel A: Import Unit Values and Import Tariffs

	(1)	(2)	(3)
	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$
$\Delta \ln(1+\tau_{igt})$	0.01	0.01	-0.00
	(0.08)	(0.08)	(0.07)
$\Delta(1+\tau_{igt})\times$ BEC Final Good (0/1)	-0.44		
	(0.30)		
$\Delta(1+\tau_{igt})\times$ CPI Final Good (0/1)		-0.21	
		(0.22)	
$\Delta(1+\tau_{igt})\times$ Part or Component (0/1)			0.12
			(0.32)
FEs	gt,it,is	gt,it,is	gt,it,is
R2	0.11	0.11	0.11
N	2,449,311	2,454,023	2,454,023

Panel B: Export Unit Values and Retaliatory Tariffs

	(1)	(2)	(3)
	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	0.01	0.02	-0.05
	(0.21)	(0.18)	(0.16)
$\Delta(1+\tau^*_{igt})\times$ BEC Final Good (0/1)	-0.16		
	(0.31)		
$\Delta(1+\tau^*_{igt})\times$ CPI Final Good (0/1)		-0.25	
		(0.28)	
$\Delta(1+\tau^*_{igt})\times$ Part or Component (0/1)			0.47
			(0.42)
FEs	gt,it,is	gt,it,is	gt,it,is
R2	0.06	0.06	0.06
N	2,557,707	2,564,731	2,564,731

Notes: Table reports the variety-level tariff pass-through for before-duty import and export unit values across binary classifications of final versus intermediate goods. Column 1 interacts the tariff with a final good indicator constructed from BEC codes. Column 2 classifies final goods according to whether there is a direct match in the description of the HS product code with the entry-line items from the BLS Consumer Price Index. Column 3 classifies intermediate goods as those with HS product descriptions that contain the words "parts" or "components." All regressions include product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level import data from 2017:1 to 2019:4.

Table A.10: Variety Import Tariff Pass-Through, Product Characteristics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$
$\Delta \ln(1+\tau_{igt})$	0.01	-0.01	0.04	0.03	0.10	0.08	0.06	0.02	0.02	-0.07	-0.61
	(0.08)	(0.09)	(0.10)	(0.08)	(0.11)	(0.09)	(0.07)	(0.10)	(0.11)	(0.13)	(0.77)
$\Delta(1+\tau_{igt})\times$ K (2010) Quality Ladder	0.00										
	(0.05)										
$\Delta(1+\tau_{igt})\times$ dLEU (2016) Markup		-0.02									
		(0.07)									
$\Delta(1+\tau_{igt})\times$ Coefficient of Price Variation			0.04								
			(0.07)								
$\Delta(1+\tau_{igt})\times$ BW (2006) Demand Elasticity				-0.17*							
				(0.09)							
$\Delta(1+\tau_{igt})\times$ CP (2015) Demand Elasticity					-0.05						
					(0.09)						
$\Delta(1+\tau_{igt})\times$ N (2007) Contract Intensity						0.05					
						(0.06)					
$\Delta(1+\tau_{igt})\times$ NS (2008) Price Stickiness							-0.01				
							(0.08)				
$\Delta(1+\tau_{igt})\times$ ACFH (2012) Upstreamness								-0.03			
								(0.07)			
$\Delta(1+\tau_{igt})\times$ (Inventories / Shipments)									-0.01		
									(0.10)		
$\Delta(1+\tau_{igt})\times$ R (1999) Differentiated (0/1)										0.11	
										(0.14)	
$\Delta(1+\tau_{igt})\times$ Durable (0/1)											0.61
											(0.76)
FEs	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is
R2	0.11	0.11	0.11	0.11	0.12	0.11	0.11	0.11	0.11	0.11	0.11
N	1,345,844	2,434,673	2,335,058	1,580,846	1,536,403	2,265,752	1,896,505	2,344,122	2,291,029	2,454,023	2,449,311

Notes: Table reports the variety-level tariff pass-through for before-duty import unit values for products with different characteristics. Each specification interacts the import tariff with the (standardized) product characteristic: 1) HS-10 quality ladders from Khandelwal (2010); 2) sector markups from De Loecker et al. (2018); 3) the HS-10 coefficient of unit value variation; 4) HS-6 elasticities of substitution from Broda and Weinstein (2006); 5) sectoral trade elasticities from Caliendo and Parro (2015); 6) HS-6 contract intensity from Nunn (2007); 7) the inverse frequency of sectoral micro-level price adjustments from Nakamura and Steinsson (2008) (a higher value denotes more price stickiness); 8) sectoral upstreamness from (Antràs et al., 2012); 9) sector inventory to sales ratios in 2016 from Census; 10) indicator of product differentiation from Rauch (1999); 11) durable good indicator from BEC. We trim the top and bottom 1% of continunous product characteristic measures, with the exception of markups, which varies only at the level of 2-digit NAICS sectors. All regressions include product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level import data from 2017:1 to 2019:4.

Table A.11: Variety Retaliatory Tariff Pass-Through, Product Characteristics

	(1) $\Delta \ln p^X_{igt}$	(2) $\Delta \ln p^X_{igt}$	(3) $\Delta \ln p^X_{igt}$	(4) $\Delta \ln p^X_{igt}$	(5) $\Delta \ln p^X_{igt}$	(6) $\Delta \ln p^X_{igt}$	(7) $\Delta \ln p^X_{igt}$	(8) $\Delta \ln p^X_{igt}$	(9) $\Delta \ln p^X_{igt}$	(10) $\Delta \ln p^X_{igt}$	(11) $\Delta \ln p^*_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	0.06	-0.04	-0.02	0.22	0.22	-0.02	0.10	0.04	-0.01	-0.02	-0.32
	(0.35)	(0.14)	(0.18)	(0.36)	(0.23)	(0.17)	(0.17)	(0.16)	(0.18)	(0.15)	(0.32)
$\Delta(1+\tau^*_{igt})\times$ K (2010) Quality Ladder	-0.14										
	(0.21)										
$\Delta(1+\tau^*_{igt})\times$ dLEU (2016) Markup		-0.05									
		(0.12)									
$\Delta(1+\tau^*_{igt})\times$ Coefficient of Price Variation			-0.08								
			(0.12)								
$\Delta(1+\tau^*_{igt})\times$ BW (2006) Demand Elasticity				-0.50*							
				(0.26)							
$\Delta(1+\tau^*_{igt})\times$ CP (2015) Demand Elasticity					-0.18						
					(0.21)						
$\Delta(1+\tau^*_{igt})\times$ N (2007) Contract Intensity						-0.14					
						(0.16)					
$\Delta(1+\tau^*_{igt})\times$ NS (2008) Price Stickiness							0.21*				
							(0.12)				
$\Delta(1+\tau^*_{igt})\times$ ACFH (2012) Upstreamness								-0.06			
								(0.10)			
$\Delta(1+\tau^*_{igt})\times$ (Inventories / Shipments)									-0.24		
									(0.18)		
$\Delta(1+\tau^*_{igt})\times$ R (1999) Differentiated (0/1)										-0.06	
										(0.30)	
$\Delta(1+\tau^*_{igt})\times$ Durable (0/1)											0.33
											(0.43)
FEs	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is	gt,it,is
R2	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
N	1,013,889	2,531,498	2,405,765	1,197,602	1,969,044	2,314,216	2,179,087	2,426,772	2,337,130	2,564,731	2,557,707

Notes: Table reports the variety-level retaliatory tariff pass-through for before-tariff export unit values for products with different characteristics. Each specification interacts the import tariff with the (standardized) product characteristic: 1) HS-10 quality ladders from Khandelwal (2010); 2) sector markups from De Loecker et al. (2018); 3) the HS-10 coefficient of unit value variation; 4) HS-6 elasticities of substitution from Broda and Weinstein (2006); 5) sectoral trade elasticities from Caliendo and Parro (2015); 6) HS-6 contract intensity from Nunn (2007); 7) the inverse frequency of sectoral micro-level price adjustments from Nakamura and Steinsson (2008) (a higher value denotes more price stickiness); 8) sectoral upstreamness from (Antràs et al., 2012); 9) sector inventory to sales ratios in 2016 from Census; 10) indicator of product differentiation from Rauch (1999); 11) durable good indicator from BEC. We trim the top and bottom 1% of continunous product characteristic measures, with the exception of markups, which varies only at the level of 2-digit NAICS sectors. All regressions include product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-8. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level export data from 2017:1 to 2019:4.

Table A.12: Tariff Pass-Through at Alternative Data Frequencies

Panel A: Import Unit Values and Import Tariffs

	(1)	(2)	(3)	(4)
	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$
$\Delta \ln(1+\tau_{igt})$	0.00	0.04	0.11	0.25*
	(0.08)	(0.07)	(0.07)	(0.14)
FEs	gt,it,is	gt,it,is	gt,it,is	gt,it,is
Data Frequency	Monthly	2 Months	3 Months	4 Months
R2	0.11	0.10	0.10	0.09
N	2,454,023	1,521,091	1,180,044	874,774

Panel B: Export Unit Values and Retaliatory Tariffs

	(1)	(2)	(3)	(4)
	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	-0.04	0.11	0.16	0.00
	(0.16)	(0.15)	(0.13)	(0.10)
FEs	gt,it,is	gt,it,is	gt,it,is	gt,it,is
Data Frequency	Monthly	2 Months	3 Months	4 Months
R2	0.06	0.06	0.05	0.05
N	2,564,731	1,710,275	1,370,953	1,045,078

Notes: Table reports the variety-level tariff pass-through to before-duty import (Panel A) and export (Panel B) unit values at different data frequencies. Each column estimates the regression in first differences at different data frequencies. Column 1 is the baseline monthly data (in the top panel, column 1 is the same as column 4 of Table IV and the bottom panel column 1 is the same as column 4 of Table VII. Columns 2-4 run the specification after aggregating the data to every two months, quarterly and every four months, respectively. All regressions include product-time, country-time and country-sector fixed effects. Standard errors clustered by country and HS-8 (for imports) or HS-6 (for exports). Significance: * 0.10, ** 0.05, *** 0.01. Sample: variety-level import and export data from 2017:1 to 2019:4.

Table A.13: Tariff Pass-Through with Alternative Fixed Effects

Panel A: Import Unit Values and Import Tariffs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$	$\Delta \ln p^*_{igt}$
$\Delta \ln(1+\tau_{igt})$	0.00	-0.01	0.04	0.01	0.01	0.19	0.26***	0.04
	(0.08)	(0.05)	(0.05)	(0.06)	(0.04)	(0.12)	(0.08)	(0.05)
Product × Time FE	Yes	No	No	Yes	No	Yes	No	No
Country × Time FE	Yes	Yes	Yes	No	No	No	No	No
Country × Sector FE	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Sector × Time FE	No	Yes	No	No	Yes	No	No	No
Country × Sector × Time FE	No	No	No	No	No	Yes	Yes	No
Time FE	No	No	No	No	No	No	No	Yes
R2	0.11	0.00	0.00	0.11	0.00	0.16	0.05	0.00
N	2,454,023	2,524,251	2,524,253	2,454,511	2,524,736	2,416,617	2,488,081	2,524,738

Panel B: Export Unit Values and Retaliatory Tariffs

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$	$\Delta \ln p^X_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	-0.04	-0.02	-0.01	-0.03	-0.02	0.06	0.03	0.01
	(0.16)	(0.15)	(0.14)	(0.14)	(0.14)	(0.19)	(0.17)	(0.15)
Product × Time FE	Yes	No	No	Yes	No	Yes	No	No
Country × Time FE	Yes	Yes	Yes	No	No	No	No	No
Country × Sector FE	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Sector × Time FE	No	No	No	No	Yes	No	No	No
Country × Sector × Time FE	No	No	No	No	No	Yes	Yes	No
Time FE	No	No	No	No	No	No	No	Yes
R2	0.06	0.01	0.01	0.06	0.00	0.14	0.08	0.00
N	2,564,731	2,591,089	2,591,090	2,564,999	2,591,357	2,504,753	2,531,680	2,591,358

Notes: Table reports the variety-level tariff pass-through to before-duty import (Panel A) and export (Panel B) unit values using alternative sets of fixed effects. In the top panel, column 1 is the same as column 4 of Table IV. In the bottom panel, column 1 is the same as column 4 of Table VII. Standard errors clustered by country and HS-8 (for imports) or HS-6 (for exports). Significance: * 0.10, ** 0.05, *** 0.01. Sample: variety-level import and export data from 2017:1 to 2019:4.

Table A.14: BLS PPI, Import and Export Price Indexes

	(1)	(2)	(3)	(4)	(5)	(6)
	$\Delta \ln p_{st}^{PPI}$	$\Delta \ln p_{st}^{PPI}$	$\Delta \ln p_{st}^{XPI}$	$\Delta \ln p_{st}^{XPI}$	$\Delta \ln p_{st}^{MPI}$	$\Delta \ln p_{st}^{MPI}$
$\Delta \ln(1+\tau_{st})$	0.26**	0.22**	0.23	0.28	0.10	0.05
	(0.11)	(0.10)	(0.14)	(0.21)	(0.08)	(0.08)
$\Delta \ln(1+\tau_{st}^{*})$	0.10	0.17	-2.31**	-1.96*	-0.52	-0.41
	(0.15)	(0.16)	(1.09)	(1.06)	(0.31)	(0.37)
Time FE	No	Yes	No	Yes	No	Yes
Sector FE	No	Yes	No	Yes	No	Yes
R2	0.01	0.07	0.02	0.07	0.00	0.05
N	2,399	2,399	1,099	1,099	1,596	1,596

Table reports impacts of sector-level import and retaliatory tariffs on official BLS PPI, import price (MPI) and export price (XPI) indexes. Sectoral tariffs are constructed as averages of variety-level tariffs. Standard errors clustered by sector. Sample: Monthly panel of NAICS-4 manufacturing sectors. Significance: * 0.10, ** 0.05, *** 0.01. Sample: monthly variety-level export data from 2017:1 to 2019:4.

Table A.15: Correlates of County-Level Tariff Exposure

Panel A: Outcome is County Import Tariff Exposure

	(1)	(2)	(3)	(4)
	$\Delta(\tau_r)$	$\Delta(\tau_r)$	$\Delta(\tau_r)$	$\Delta(\tau_r)$
2016 GOP Pres. Vote Share	0.03***	0.02**	0.01**	0.02**
	(0.01)	(0.01)	(0.01)	(0.01)
2016 GOP Pres. Vote Share Sq.	-0.03***	-0.01*	-0.01**	-0.01**
	(0.01)	(0.01)	(0.01)	(0.01)
Ag Employment Share		-0.07***	-0.07***	-0.07***
		(0.01)	(0.01)	(0.01)
Demographic Controls	No	No	Yes	Yes
Pre-Trends	No	No	No	Yes
R2	0.03	0.13	0.14	0.15
N	3,111	3,111	3,111	3,111

Panel B: Outcome is County Export Tariff Exposure

	(1)	(2)	(3)	(4)
	$\Delta(\tau_r^*)$	$\Delta(\tau_r^*)$	$\Delta(\tau_r^*)$	$\Delta(\tau_r^*)$
2016 GOP Pres. Vote Share	0.03***	0.00*	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.01)
2016 GOP Pres. Vote Share Sq.				-0.00
				(0.01)
Ag Employment Share		0.28***	0.25***	0.25***
		(0.02)	(0.02)	(0.02)
Demographic Controls	No	No	Yes	Yes
Pre-Trends	No	No	No	Yes
R2	0.09	0.40	0.43	0.44
N	3,111	3,111	3,111	3,111

Notes: Unit of analysis is U.S. counties. Outcome variables are the 2017-18 change in import and export tariff exposure due to the trade war, defined as the county-specific tradeable wage-weighted average of sector-level tariff increases. Employment and demographic variables measured in 2016 from Census CBP and 5Y ACS. Agriculture industries defined as NAICS codes beginning with 11. Demographic controls are: share unemployed, share white, share with a college degree, and log mean income. Pre-trend controls are 2013-2016 changes in: manufacturing and agriculture employment shares, share unemployed, and log mean income. Regressions weighted by county population. Standard errors clustered by state.