The Return to Protectionism*

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Abstract

We analyze the short-run impacts of the 2018 trade war on the U.S. economy. We estimate import demand and export supply elasticities using changes in U.S. and retaliatory war tariffs over time. Imports from targeted countries decline 31.5% within products, while targeted U.S. exports fall 9.5%. We find complete pass-through of U.S. tariffs to variety-level import prices. We compute the aggregate and regional impacts of the war in a general equilibrium framework that matches these elasticities. Annual losses from higher costs of imports are $213 per person, while net losses are just $20 per person. U.S. tariffs favored sectors located in politically competitive counties, but retaliatory tariffs offset the benefits to these counties. Tradeable-sector workers in heavily Republican counties are the most negatively affected by the trade war.

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1 Introduction

After more than a half-century of leading efforts to lower international trade barriers, in 2018 the United States enacted several waves of tariff increases on specific products, sectors, and countries. Import tariffs increased from 2.6% to 17% on 12,007 products (67% of imported products) covering $303 billion (12.6%) of 2017 annual U.S. imports. These measures represent the most comprehensive protectionist trade policies implemented by the U.S. since the 1930 Smoot-Hawley Act, when the U.S. raised tariffs from 40% to 46% on a third of annual imports (Irwin, 1998).[1] In response, several large U.S. trade partners imposed retaliatory tariffs on U.S. exports. These counter-measures increased tariffs from 6.6% to 23% on 2,931 export products (34% of exported products) covering $96 billion (6.2%) of 2017 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 was the short-run impact of the trade war on the U.S. economy? Classical arguments in trade theory dictate that the impacts depend on the incidence of tariffs. Consumers and firms who buy foreign products lose from higher tariffs. In addition, the net reallocations into (or away from) domestic products induced by the U.S. and retaliatory tariffs lead to terms-of-trade effects (changes in foreign export prices relative to U.S. export prices).[2] The trade war may have also had distributional consequences across sectors—through demand reallocation and through input costs—and therefore across regions with different patterns of comparative advantages.

In this paper we estimate the impact of the trade war on several margins of the U.S. economy and quantify welfare impacts. As a first step, using solely the variation in U.S. and retaliatory tariffs observed during the trade war, we estimate structural demand and supply elasticities that (partly) determine the incidence of tariffs across countries. We estimate the impacts of tariffs war on U.S. exports, imports, and import prices, and we measure the portion of aggregate U.S. welfare changes corresponding to losses from higher tariff-inclusive import prices. Then, we combine these elasticities with a supply-side model of the U.S. economy to gauge the aggregate and regional impacts of U.S. and retaliatory tariffs in general equilibrium. Our regional analysis focuses on the relationship between tariff protection, political preferences, and welfare effects of manufacturing and agricultural workers across counties.

To implement the first step, we estimate a constant elasticity of substitution (CES) nested demand system. The system accommodates several margins for reallocation in response to the trade war: across varieties, across imported products, and between imports and exports within a sector.[3] To allow for terms-of-trade effects, we combine this system with upward sloping foreign export

[1] The more recent "Nixon shock" in 1971 raised imposed a 10% surcharge on roughly half of U.S. imports for four months (Irwin, 2013).

[2] Formally, in any model satisfying the assumptions of neoclassical trade theory, the aggregate welfare change from tariff changes Δt is approximated by $-m\left(\Delta t + \Delta p^*\right) + \Delta R$, where m is a vector of imports before tariffs change (so $-m$ are exports), Δp^* are changes in international prices, and ΔR is tariff revenue. See Dixit and Norman (1980).

[3] We define *sectors* as 4-digit NAICS industry codes, *products* as 10-digit Harmonized System (HS) classification codes, and *varieties* as country-product pairs.

supply for each variety. In estimating these elasticities, we make progress on a key methodological issue. The very few existing papers that use variation in tariffs over time to estimate structural elasticities have focused on estimating the import demand curve. However, measuring the incidence of tariffs also requires estimating the slope of the export supply curve. In this paper, we leverage the insight that if tariffs are uncorrelated with simultaneous demand and supply shocks over time—an assumption we devote significant effort to validating—a single tariff can be used to simultaneously instrument *both* the import demand and foreign export supply curves. This idea was recently introduced by Zoutman et al. (2018) in a public-finance setting, and we apply it here in the context of international trade.[4]

Using an event-study framework, we detect immediate and large impacts of tariffs on U.S. import and export volumes but not changes in before-tariff prices. The structural equations allow us to quantify the impacts of tariffs. Imports of varieties targeted by U.S. tariffs fall on average 31.5% (s.d. 15.5%) within products; imports of products targeted by tariffs fall 3.8% (s.d. 4.3%) within imports in each sector; and imports within targeted sectors decline 0.5% (s.d. 1.2%). Additionally, we estimate complete pass-through of tariffs to tariff-inclusive variety-level import prices faced by U.S. consumers and producers. Hence, we cannot reject horizontal foreign export supply curve, implying no evidence of market power gains for the U.S. over its imported varieties. On the export side, we find that retaliatory tariffs resulted in a 9.5% (s.d. 3.3%) decline in U.S. exports within products. We estimate a fairly inelastic foreign demand for U.S. varieties, which implies high pass-through of retaliatory tariffs to foreign consumers. We demonstrate that these elasticities are not confounded by pre-existing trends in import and export outcomes, and do not reflect anticipation of the tariff changes by importers.

The empirical finding of complete tariff pass-through makes calculating the losses to U.S. consumers and producers due to higher imported prices straightforward. Using the actual changes in tariffs, losses from tariffs are $68.8 billion, or approximately $213 per person. The aggregate impacts on the U.S. economy depend on tariff revenue and on export price changes. Calculating these margins requires a general equilibrium model. We embed the nested CES demand into a flexible U.S. production structure with input-output linkages across sectors, heterogeneity in specialization patterns across U.S. counties, sector-specific factors, and imperfect regional labor mobility.[5] We parametrize the model to be consistent with the estimated trade elasticities, and with observed patterns of variety-level trade and of economic activity across counties and sectors before the trade war.

We compute terms-of-trade gains in general equilibrium through higher export prices of $71

[4]The identification relies on the fact that tariffs create a wedge between what the importer pays for a variety and what the exporter receives. A tariff decreases importers' willingness to pay, shifting down the demand curve for any given price received by the exporter, thereby tracing the slope of the supply curve. Because the importer pays a price that is inclusive of the tariff, there is only one demand slope that can rationalize the new price she pays. To identify the upper tier demand elasticities, we construct an instrument based on the aggregation of the tariffs to the product and sector levels implied by the model.

[5]Caliendo et al. (2017) study the diffusion of shocks in a model of the U.S. with input-output linkages across sectors and regional heterogeneity across states.

per person. Overall, if tariff revenue is further weighed in, the trade war lowered aggregate U.S. welfare in the short-run by just $20 person, or 0.03% of GDP. If trade partners had not retaliated, the terms-of-trade gains would have been larger, and the aggregate welfare loss would have been negligible at one third of the actual negative impact. Hence, we find substantial redistribution from buyers of foreign goods to U.S. producers and the government, but a small loss for the U.S economy as a whole.

The small aggregate effects of the trade war mask heterogeneous impacts across regions. If workers are regionally immobile—a reasonable assumption over this short time horizon—sectoral-level heterogeneity in U.S. and foreign tariffs generates unequal impacts for workers in different regions. We find a standard deviation of real wages in the tradeable sectors across counties of 0.4%, relative to an average real increase of 0.6%.

We probe the hypothesis that the structure of protection was driven by electoral incentives.[6] We document that U.S. import tariffs were biased toward sectors concentrated in electorally competitive (less polarized) counties, as measured by their 2016 Presidential vote share, suggesting an *ex ante* electoral rationale for the U.S. tariffs increases during the trade war. Our counterfactuals suggest that, if trade partners had not retaliated, these U.S. import tariffs would have relatively favored workers in tradeable sectors living in electorally competitive counties. Further taking into account foreign retaliations alters the regional consequences. Counties that lean Democratic are relatively better-off (that is, experience the smallest losses) while workers in very Republican counties bear the brunt of the costs of trade war, in part because retaliations disproportionately targeted agricultural sectors, and in part because U.S. tariffs raised the costs of inputs used by these counties.

A large literature studies the impacts of changes in trade costs or foreign shocks through quantitative and empirical 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 tariffs are a key policy instrument for governments and the main policy instrument of the 2018 trade war. One of our contributions is to offer an approach to measure the aggregate impacts of tariffs using estimated trade elasticities from actual tariff variation, as opposed to hypothetical changes in trade costs. Although we focus on the short-run consequences, our method easily extends to studying long-run consequences.

One approach to studying the impacts of trade policy uses *ex post* variation in tariffs across sectors to assess impacts on regions (e.g., Kovak 2013), firms (e.g., Amiti and Konings (2007) and Goldberg et al., 2010) or workers (e.g., McCaig and Pavcnik 2018). A key challenge in this literature is to address the potential endogeneity of tariff changes. These papers offer substantial empirical support for using tariffs as source of identifying variation, as we do in our setting through a battery of tests for pre-existing trends. These studies focus on trade liberalization episodes in

[6] A strand of endogenous trade policy theory emphasizes electoral competition. Mayer (1984) first studied a factor endowments model with majority voting over tariffs. Grossman and Helpman (2005) characterize the trade policy that emerges when elected legislators represent geographic regions hosting different industries. More recently, Ma and McLaren (2018) study a model of electoral competition with electoral-college votes, and show evidence that the tariff changes in the years leading up to NAFTA were biased towards industries located in swing states.

developing countries, while we study a large return to protectionism in the U.S. Moreover, their research designs do not attempt to quantify the aggregate implications of the trade reforms on an economy by uncovering structural elasticities needed for the computation.

A complementary approach uses quantitative models to simulate aggregate impacts of changes in tariffs, such as the Nash equilibrium of a global trade war (Ossa, 2014) or tariff cuts in the context of regional and multilateral trade liberalizations (such as Caliendo and Parro (2015) and Caliendo et al. (2015)).[7] A key aspect of our approach is the parametrization of how trade volumes change with actual trade policy. We use variation in *changes* in trade caused by *changes* in tariffs to estimate both demand and supply elasticities. As a result, when we aggregate the impacts of tariffs through the model, the effects of tariffs on variety-level prices and on sector, product, and variety-level trade flows are estimated rather than imposed. Only a very small set of papers, including Spearot (2013) and Spearot (2016), uses actual tariff variation over time to estimate the demand elasticity. In constrast, research efforts have relied on alternative sources of variation to estimate trade elasticities.[8]

Finally, our finding of complete pass-through deserves some discussion. A large literature in trade and international macroeconomics has estimated incomplete pass-through. Typically, these papers have examined pass-through of exchange rate shocks. An exception is Feenstra (1989) who finds symmetry in the pass-through between tariffs and exchange-rate movements in the vehicle sector. Our estimates therefore appear at odds with this literature. One explanation is that the nature of this shock–tariff increases–may yield different pass-through estimates, as well as the short-run time horizon we consider. This finding is surprising, in particular if tariff changes are deemed to be temporary and suppliers are willing to absorb the tariff increases to keep the duty-inclusive price stable. In contrast, exchange rate shocks have been shown to be highly persistent. At any rate, we consider the difference between exchange rate and tariff pass-through to be an interesting result that deserves further exploration in future research.

The remainder of the paper is as follows. Section 2 summarizes the data used for the analysis. Section 3 outlines the demand-side framework that guides the estimation of the elasticities and discusses the identification strategy in detail. Section 4 presents the elasticity estimates. Section 5 then introduces the full general equilibrium structure necessary to compute the aggregate and distributional effects. Section 6 concludes.

[7] Recent survey articles by Goldberg and Pavcnik (2016) and Ossa (2016) survey the existing literature studying the impacts of trade policy.

[8] Head and Mayer (2014) review these alternative strategies. Some papers have used cross-sectional variation in tariffs, rather than over time, to estimate trade elasticities. Caliendo and Parro (2015) use cross-sectional tariff variation prior to tariff changes that occurred through NAFTA. Some prominent approaches to estimating elasticities rely on gravity estimates of the cross-sectional relationship between trade and proxies of exporters marginal costs (e.g., Eaton and Kortum (2002), Costinot et al. (2012) and Donaldson (2018)), GMM identification via heteroskedasticity of supply and demand shocks (e.g., Feenstra (1994) and Broda and Weinstein (2006)); and price gaps (e.g., Simonovska and Waugh (2014) and Atkin and Donaldson (2015)).

2 Data and Timeline

This section describes the public data sources used throughout the analysis and provides a timeline of key events of the trade war.

2.1 Data

We build a monthly panel dataset of U.S. statutory import tariff rates using publicly available tariff schedules from the U.S. International Trade Commission (USITC). In years prior to 2018, USITC released an annual baseline tariff schedule in January and a revised schedule in July; changes in the tariff schedule typically reflected expected and long-standing treaty commitments. In 2018, by contrast, USITC issued 14 schedule revisions, reflecting a rapid series of tariff increases. Tariff increases were almost always set at the 8-digit Harmonized System (HS) level.[9] The new ad-valorem tariffs went into effect quickly, always within 1-3 weeks following a press release by the Office of the U.S. Trade Representative.

We obtain retaliatory tariffs on U.S. exports enacted by trade partners 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 a country- and product-specific monthly panel of retaliatory statutory tariffs on U.S. exports, we use the annual WTO database of Most Favored Nation (MFN) tariff rates, and compute the retaliatory tariff rate for each country-product as the sum of the MFN rate and the announced tariff rate change. We measure export tariffs at the HS-6 level, since HS-8 codes are not directly comparable across countries.

We use monthly administrative U.S. import and export data from the U.S. Census Bureau that record values and quantities of trade flows at the 10-digit Harmonized System Tariff (HS) level. The time span covers through November 2018. For imports, the data also include the value of duties collected. We construct applied (ad-valorem) tariff rates directly from the import data as the ratio of duties collected to the CIF import value. Duty-inclusive unit values are constructed as (value + duties)/quantity. Since we do not observe the duties collected by foreign governments on U.S. exports, we cannot compute the applied rate for exports. We define duty-inclusive unit value for exports as the unit value multiplied by the ad valorem retaliatory statutory rate.

At different stages of the analysis we also require sector-level data on prices, employment, wages,

[9] A total of 18 Chinese varieties received tariff exemptions at the 10-digit level. These varieties have a 2017 annual value of $1 million. Since our trade-flow analysis is performed at the HS10-country level, we are able to account for these narrowly tailored exemptions. For a very small fraction of products, ad-valorem tariffs apply only after surpassing a quota threshold. For example, the US made a quota allowance of 50,000 annually imported for imports of varieties with the HS-8 stub 84509020 (household laundry machines). As another example, four countries (Australia, Argentina, South Korea, and Brazil) were exempt from steel tariffs unless they surpass a quota threshold of 500,000 kg of imports in a 3-month period. In all, quotas affect only $16 million of targeted imports. Our compilation of tariff line changes match those collected by Chad Bown, available in https://piie.com/blogs/trade-investment-policy-watch/trump-trade-war-china-date-guide. We find 99.8% overlap in the value of targeted import products between his compilation and our independent compilation.

output, and input linkages. The BLS Producer Price Index (PPI) measures the prices received by producers for their output at the sector level, and covers virtually all tradeable domestic output. We use the BLS Current Employment Statistics database for information on domestic employment and wages, and the Federal Reserve G17 Industrial Production Index as a measure of domestic sector output.[10] All data are collected at monthly frequency, and we define sectors at the level of 4-digit NAICS industry codes. None of these monthly industry measures include the farm sector, which either is not covered by these datasets or is only available at coarse frequencies. We classify NAICS sectors as tradable if they match to an HS code using the concordance of Pierce and Schott (2012).[11] To construct input-output linkages we use the 2016 Bureau of Economic Analysis (BEA) annual "use" tables from input-output (I-O) accounts.

For the analysis of regional exposure to the trade war we use the Census County Business Patterns (CBP) database, which provides annual industry employment and wage data at the county-level for non-farm sectors. For the farm sector, we use the BEA Local Area Personal Income and Employment database. From each data source, we use the most recently available data from 2016 to compute the industry employment share of each county. We obtain county-level demographic statistics from the Census American Community Survey and county-level voting data from the U.S. Federal Election Commission.

2.2 Timeline

Table 1 provides a timeline of how the trade war unfolded over time. Panel A reports the total affected imports, and shows that import tariffs have targeted 12,007 products and a total of 25,066 varieties. In 2017, these imports were valued at $303 million, or 12.6% of imports. The average statutory tariff rate increased from 2.6% to 17.0%.[12] A key feature of the tariffs is that they were discriminatory across countries, which allows us to exploit variation in tariff changes across varieties within products.

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. The U.S. implemented a second wave in March 2018 on 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. implemented tariffs on approximately $50 billion of Chinese imports, and the 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 have targeted 11,173 imported products worth $247 billion,

[10] The G17 Industrial Production Index is a monthly database covering the manufacturing, mining, and electricity and gas sectors. It tracks real output and index values are computed as a Fisher index, with weighted constructed from yearly estimated of value added.

[11] NAICS codes with the following stubs 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.

[12] 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.

and increased tariffs, on average, from 3.1% to 15.9%. A total of 48.8% of 2017 imports from China were targeted with tariffs.

Panel B of Table 1 reports the retaliatory tariffs imposed on U.S. exports by trade partners. Canada, China, Mexico, Russia, Turkey, and the European Union enacted retaliatory tariffs against the US. Collectively, these retaliations cover $96 billion (6.2%) of annual U.S. exports across 2,931 products. The average statutory tariff rate on these exports increased from 6.5% to 23.3%.

Figure 1 plots the tariff changes over time.[13] Panel A shows the statutory tariffs on targeted varieties for each tariff wave, and Panel B plots the average applied tariffs. The applied tariff rates generally increase at a lag relative to the statutory rates, because the monthly data aggregate shipments arriving before the tariffs are enacted with those arriving after. Differences between the statutory and applied rates also reflect measurement error (discussed in detail below). Panel C shows the retaliatory statutory tariffs on U.S. exports over time. Appendix Figure A.1 shows the monthly changes in import duties collected by the U.S. over time.

2.3 Structure of Protection

Table 2 reports summary statistics for targeted import and export varieties across three-digit NAICS industry codes. For imports, we report the number of HS10 products and varieties targeted, and the mean and standard deviation across HS10 products within NAICS-3 codes of the increase in statutory import tariffs due to the trade war. In sectors where only China was targeted, the number of targeted products equals the number of varieties. The table also reports the corresponding statistics for the retaliatory tariffs on U.S. exports.

The table conveys three important facts. First, the sectors that receive the most protection are primary metals, machinery, computer products, and electrical equipment and appliances. These sectors contain intermediate inputs, comprise a large share of targeted varieties and products, and saw steep tariff increases relative to most other sectors. Second, it is not the case that U.S. trading partners simply retaliated on the same set of products and sectors targeted by the U.S; the sector-level correlation is 0.47. In particular, foreign governments applied large tariff increases on U.S. agriculture exports, even though the U.S. did not significantly raise tariffs on agriculture imports. Third, import and export protection rates of targeted varieties are similar across sectors, and the standard deviation of tariff changes within sectors is low (and most often, zero).

The synchronous variation in tariff changes is informative about the economic rationale for the tariffs, or its lack thereof. Since Johnson (1953), work on optimal tariffs shows that governments can maximize national income by setting higher tariffs on sectors with more inelastic foreign export supply, and Broda et al. (2008a) offer empirical support. However, the tariff changes are extremely similar across sectors. Appendix Figure A.2 illustrates this point further 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%. In fact,

[13] Tariffs are often enacted in the middle of the month, but we only observe trade flow data at a monthly frequency. Figure 1 shows the tariff increase in the initial month that it is implemented.

virtually all varieties (99.8%) were hit with either 10% or 25% tariff changes. The right panel shows that, although trading partners have retaliated with a slightly more diverse range of tariff hikes, most of the rate increases were also concentrated at those two values. These patterns are suggestive that neither the U.S. nor retaliatory tariffs were primarily driven by a terms-of-trade rationale, as in that case we would expect tariff changes to vary substantially across sectors instead of bunching at few round numbers.[14]

This variation across sectors is also suggestive that the tariff changes are unlikely to have been driven by special interests. Explanations in this tradition argue that sectors make political campaign contributions and engage in costly lobbying activities in order to secure import protection from policymakers.[15] However, these explanations also rely on variation in protection across sectors. Hence, a "protection for sale" hypothesis is unlikely to explain the undifferentiated pattern of protection observed in the data. We explore this idea further by tabulating financial campaign contributions made to candidates for the U.S. House of Representatives in the 2016 election cycle, using data from the Center for Responsible Politics. Appendix Figure A.3 plots financial contributions against tariff changes at the sector-level, and shows that there is no systematic relationship. These results suggest it is unlikely that campaign contributions were the main determinant of protectionism during the trade war.

3 Trade Framework and Identification

We now describe the trade framework used for the estimation of key elasticities. We present the equations for aggregate import demand in the U.S., and for export supply and import demand in its trade partners. We defer the supply-side and general-equilibrium assumptions in the U.S. to Section 5. Those supply side assumptions will be consistent with the aggregation properties of the demand side we introduce here, but are not needed for the estimation.

3.1 U.S. Import Demand

There are S traded sectors corresponding to 4-digit NAICS industry codes (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 HS10 level of aggregation. Within the nest of imported products, there is differentiation by country of origin.

[14] When we plot the sectors' 2018 tariff level against the foreign export supply elasticities estimated by Broda et al. (2008b), we find a flat correlation. Results available upon request.

[15] Early theoretical studies in this tradition include the tariff-formation function approach Findlay and Wellisz (1982), the political-support function of Hillman (1982), and the political-competition model of Magee et al. (1989). Grossman and Helpman (1994) develop a model in which special interests make financial contributions in exchange for favorable trade policies, and Goldberg and Maggi (1999) and Gawande and Bandyopadhyay (2000) find support for this model. In a model of supply chains it is not obvious *a priori* whether businesses should prefer high or low tariffs. Blanchard et al. (2016) provide evidence that greater input market integration is linked with lower tariffs.

The U.S. trades with I countries (collected in the set $\mathcal{I}$ and indexed by country i). Varieties are product-origin pairs.

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

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

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

The value of imports for product g in sector s is

$$p_{Mg}m_g = P_{Ms}M_s a_{Mg} \left(\frac{p_{Mg}}{P_{Ms}}\right)^{1-\eta}, \tag{2}$$

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

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

$$m_{ig} = m_g a_{ig} \left(\frac{p_{ig}}{p_{Mg}}\right)^{-\sigma}. \tag{3}$$

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 that the domestic price is:

$$p_{ig} = (1 + \tau_{ig})\, p^*_{ig}. \tag{4}$$

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).[16]

3.2 Foreign Export Supply and Import Demand

Trade partners are represented with export-supply and import-demand curves at the variety level. We allow for terms-of-trade effects of U.S. trade policy through potentially upward sloping foreign export supply. Each foreign country i supplies the quantity m_{ig} that solves the following profit maximization problem:

$$\max p^*_{ig}m_{ig} - \frac{1}{\omega^* + 1}\frac{(\delta_{ig}m_{ig})^{\omega^*+1}}{Z^*_{ig}}, \tag{5}$$

In this expression, δ_{ig} is a bilateral iceberg trade cost specific to product g (so that $\delta_{ig}m_{ig}$ units must be produced for m_{ig} to arrive) and Z^*_{ig} is a foreign marginal cost shifter. The foreign export

[16]The three-tier demand system is the same as in Broda et al. (2008b) and is motivated by what we observe in 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 estimate the elasticities and to quantify the model in general equilibrium. We do not require information on import shares within each product g, or about the differential import share of consumers relative to producers within each sector, which are not observed in publicly available data but would be required under alternative nesting assumptions. We acknowledge that a potential shortcoming of this structure is that the imports m_g of any particular product g in sector s impact the domestic expenditures of that same product only through the sector-level shifter $P_{Ms}M_s$.

supply curve is:

$$m_{ig} = \left(z_{ig}^* p_{ig}^*\right)^{\frac{1}{\omega^*}} \tag{6}$$

where $z_{ig}^* \equiv \delta_{ig}^{\omega^*+1}/e_i Z_{ig}^*$ summarizes the impact of trade frictions and productivity.

The parameter ω^* is the *inverse* of the foreign export supply elasticity. It is a key determinant of the welfare effects of U.S. trade policy as it drives the magnitude of the reduction in foreign prices when U.S. tariffs are imposed. (Before-tariff) import prices fall more sharply the larger is ω^*. If $\omega^* \approx 0$, tariffs are fully passed to U.S. consumers.

Each foreign country demands a quantity x_{ig} of US exports of good g. Foreign import demand for U.S. varieties is similar to (3) on the U.S. side, but with a potentially different demand shifter and demand elasticity:

$$x_{ig} = a_{ig}^* \left(\left(1 + \tau_{ig}^*\right) p_{ig}^X\right)^{-\sigma^*}, \tag{7}$$

where x_{ig} is the U.S. exports of product g to country i, p_{ig}^X is export price faced 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.

3.3 Identification

Our goal is to estimate the elasticities $\{\sigma, \eta, \kappa, \sigma^*, \omega^*\}$ that characterize U.S. import demand and foreign export and import curves. Import tariffs are used to identify U.S. import demand elasticities $\{\sigma, \eta, \kappa\}$ and the foreign export supply elasticity $\{\omega^*\}$, and the retaliatory tariffs are used to identify the foreign import demand elasticity $\{\sigma^*\}$. This section discusses the identification strategy and its potential threats.

3.3.1 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 idea of identifying two elasticities with one instrument was recently introduced by Zoutman et al. (2018) in the context of applications to public finance.

Identification of both elasticities using a single tariff follows from the fact that tariffs introduce a wedge between the price the importer pays and the price the exporter receives. Consider the equilibrium of the system of import demand and export supply equations of varieties imported by the U.S., equations (3) and (6). The import demand equation (3) can be written as a function $m_{ig}^M(\cdot)$ of the duty-inclusive price p_{ig},

$$m_{ig} = m_{ig}^M\left(\left(1 + \tau_{ig}\right) p_{ig}^*\right) = m_{ig}^M\left(p_{ig}\right), \tag{8}$$

whereas the export supply equation (6) can be written as function $m_{ig}^X(\cdot)$ of the price before duties,

$$m_{ig} = m_{ig}^X\left(p_{ig}^*\right) = m^X\left(\frac{p_{ig}}{1 + \tau_{ig}}\right). \tag{9}$$

Consider first equation (8). Conditioning on the export price p_{ig}^*, an increase in τ_{ig} acts as a (negative) demand shifter. This shift traces the supply curve. Now consider equation (9). Conditioning

on the tariff-inclusive price p_{ig}, an increase in τ_{ig} acts as a (negative) supply shifter in (9). This shift traces the demand curve.[17]

Adding a time subscript and log-differencing over time, the structural equations (3) and (6) can be written as:[18]

$$\Delta \ln m_{igt} = \alpha_{gt}^M + \alpha_{it}^M + \alpha_{is}^M - \sigma \Delta \ln p_{igt} + \varepsilon_{igt}^M \tag{10}$$

$$\Delta \ln m_{igt} = \alpha_{gt}^X + \alpha_{it}^X + \alpha_{is}^X + \frac{1}{\omega} \Delta \ln p_{igt}^* + \varepsilon_{igt}^X, \tag{11}$$

where the α_{gt} are product-time fixed effects, α_{it} are country-time fixed effects, and α_{is} are country-sector fixed effects (s is the sector of product g). The error term of the import demand equation is structurally interpreted as the change in the residual demand shock, $\varepsilon_{igt}^M \equiv \Delta \ln (a_{igt})$. For now, suppose that tariffs are uncorrelated with unobserved import demand and export supply shocks, an issue we return to below at the end of this section. Then, import demand σ is identified by instrumenting the (change in) tariff-inclusive price with the (change in) tariff. The export supply ω is identified by instrumenting the (change in) before-tariff price with the (change in) tariff. The first stage F-statistic of the instrument is informative of whether or not the incidence of the tariff is shared by both parties (Zoutman et al., 2018). Specifically, if the first-stage F-statistic for the supply curve is low, this is indicative of full pass-through to the importer. Thus, the first-stage estimates of before-tariff and tariff-inclusive prices on the tariff are critical for determining the shape of the supply and demand curves.

Equilibrium in the market of variety i of product g requires equalization of (3) and (6). As shown in Appendix equation ((A.2)), the structural equations can also be written in reduced-form as:

$$y_{ig} = \alpha_{gt}^M + \alpha_{it}^M + \alpha_{is}^M - \beta^y \Delta \ln (1 + \tau_{igt}) + \varepsilon_{igt}^y \tag{12}$$

for $y = \{p^*, m\}$. The structural elasticities can then be recovered from the reduced-form parameters: $\omega^* \equiv \frac{\beta^{p^*}}{\beta^m}$ and $\sigma \equiv -\frac{\beta^m}{1+\beta^{p^*}}$.

3.3.2 U.S. Import Product Elasticity (η)

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

$$\Delta \ln (s_{Mgt}) = \psi_{st} + (1 - \eta) \Delta \ln (p_{Mgt}) + \varepsilon_{Mgt}, \tag{13}$$

[17] This intuition can also be seen in a standard textbook model of supply and demand curves, expressed in log-units. Point A in Appendix Figure A.4 illustrates the initial equilibrium price and quantity. If an exogenous tariff is imposed, the consumer's willingness to pay will shift down by the amount of the tariff. The equilibrium quantity and price that the exporter receives moves to point B. The movement from A to B traces the slope of the supply curve. However, since importers pay the tariff (which goes to the government, not the exporter), the tariff-inclusive price $\ln p^* + \ln (1 + \tau)$ is point C. There is only one slope of the demand curve that can rationalize point C. Hence, the wedge generated by the tariff simultaneously pins down the slopes of both curves.

[18] We write the log changes in import demand shifter as $\Delta \ln \left(m_{gt} p_{gMt}^{\sigma} \right) \equiv \alpha_{gt}^M + \alpha_{it}^M + \alpha_{is}^M$ and $\varepsilon_{igt}^M \equiv \Delta \ln (a_{igt})$. For the supply curve, we the log changes in export supply shifters are $-\Delta \ln \left(z_{ig}^{*1/\omega^*} \right) \equiv \alpha_{gt}^X + \alpha_{it}^X + \alpha_{is}^X + \varepsilon_{igt}^X$.

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

Estimating (13) requires the price index of product g. We leverage the structure of the demand system to build this index exactly from the variety-level data. When doing so, we also account for the entry and exit of varieties by applying the a variety correction from Feenstra (1994). Combining (A.8) and (3) we obtain the following exact expression for the change in the product price index:

$$\Delta\ln p_{Mgt} = \frac{1}{1-\sigma}\ln\left(\sum_{i\in\mathcal{C}_{gt}} s_{igt}e^{(1-\sigma)\Delta\ln\left(p^*_{igt}(1+\tau_{igt})\right)+\Delta\ln a_{igt}}\right) - \frac{1}{1-\sigma}\ln\left(\frac{S_{g,t+1}(\mathcal{C}_{gt})}{S_{g,t}(\mathcal{C}_{gt})}\right), \quad (14)$$

where s_{igt} is the share of continuing variety i in all continuing varieties, $\mathcal{C}_{gt}$ be the set of continuing varieties in product g between t and $t+1$, and $S_{g,t}(\mathcal{C})$ is the share of the varieties in the set $\mathcal{C}$ in the total imports of product g at time t.[19] Notice that the price index includes two pieces from the estimation in the previous step: the estimated σ and the residuals, which reflect mean-zero demand shocks $\Delta\ln(a_{igt})$.[20]

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. We construct an instrument that is a simple average of changes in tariffs across the continuing varieties:[21]

$$\Delta\ln Z_{Mgt} = \ln\left(\frac{1}{N^{\mathcal{C}}_{gt}}\sum_{i\in\mathcal{C}_{gt}} e^{\Delta\ln(1+\tau_{igt})}\right), \quad (15)$$

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

3.3.3 U.S. Import Sector 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 (1), 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 (A.7) and (A.6):

$$\Delta\ln\left(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}}\right) = \psi_s + (1-\kappa)\Delta\ln\left(\frac{P_{Mst}}{P_{Dst}}\right) + \varepsilon_{st}. \quad (16)$$

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

[20] This step to construct a product level price index from aggregation residuals in the lower tier is the same as in Costinot et al. (2016), who estimate a nested CES demand over agricultural products and varieties.

[21] We use a simple average in constructing the instrument since using value weights may induce mechanical correlations with the left-hand side of equation (13).

The fixed effect and residual components capture to relative demand shocks. We proceed analogously to the previous step to construct the sector import price index, P_{Mst}, and to instrument for it using variety-level tariffs. The import price index of sector s changes according to:

$$\Delta \ln P_{Mst} = \frac{1}{1-\eta} \ln \left(\sum_{g \in \mathcal{C}_t^s} s_{gt} e^{(1-\eta)\Delta \ln p_{gMt} + \Delta \ln\left(a_{gMt}\right)} \right) - \frac{1}{1-\eta} \ln \left(\frac{S_{t+1}^s\left(\mathcal{C}_t^s\right)}{S_t^s\left(\mathcal{C}_t^s\right)} \right), \tag{17}$$

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 products in sector s between t and $t+1$. Notice again that (17) relies on the the estimated η and the residuals at this step which reflect mean-zero demand shocks.

We construct $\Delta \ln P_{Mst}$ using the residuals $\varepsilon_{Mgt} = \Delta \ln(a_{gMt})$ estimated from (13), and we instrument for the relative price of imports, $\Delta \ln(P_{Mst}/P_{Dst})$, using

$$\Delta \ln Z_{Mst} \equiv \ln \left(\frac{1}{N_{st}^{\mathcal{C}}} \sum_{g \in \mathcal{C}_t^s} e^{\Delta \ln Z_{gMt}} \right), \tag{18}$$

where Z_{gMt} is the instrument defined in (15) at the product level and $N_{st}^{\mathcal{C}}$ is the number of continuing varieties in product g between t and $t+1$.

3.3.4 Foreign Import Variety Elasticity (σ^*)

The foreign import demand is estimated using an equation similar to (10). We consider how U.S. exports respond to retaliatory tariffs. From (7), decomposing the log-change of the foreign demand shifter $\Delta \ln\left(a_{igt}^*\right)$ into a product-time effect α_{gt}^X, country-time effect α_{it}^X, country-sector effect α_{is}^X, and a residual ε_{igt}^X, we obtain:

$$\Delta \ln x_{igt} = \alpha_{gt}^X + \alpha_{it}^X + \alpha_{is}^X - \sigma^* \Delta \ln\left(\left(1+\tau_{igt}^*\right) p_{igt}^X\right) + \varepsilon_{igt}^X, \tag{19}$$

where p_{igt}^X is the before-tariff price observed in the U.S. To identify σ^*, we instrument the change in the tariff-inclusive price with the change in retaliatory tariffs, $\Delta \ln\left(\left(1+\tau_{igt}^*\right) p_{igt}^X\right)$. Similarly to the import tariffs, a potential concern is the correlation between the retaliatory tariffs τ_{igt}^* and the foreign import demand shocks, ε_{igt}^X. In the next section, we also provide evidence supporting that this correlation was not present in the tariff war.

3.3.5 Threats to Identification

There are three main threats of identification to using tariffs to identify the elasticities. First, the simultaneous identification of $\{\sigma, \omega^*\}$ requires that the tariff affects importers' willingness to pay. If importers can evade the tariff or do not base their demand on tariff-inclusive prices, the tariffs will not cause inward shifts of the import demand curve. In our setting, we do not believe either concern is 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 consumers always observe the after-tariff prices. Moreover, tariff evasion is a larger concern in developing countries (e.g., Sequeira, 2016).

Second, as previously mentioned, we require that the tariff changes are uncorrelated with unobserved import demand and export supply shocks. The system of equations are all run in first differences and control flexibly for potential demand and supply shocks at each step, thereby mitigating this concern. In the next section, we further offer a battery of checks that support this key identification assumption.[22]

Third, importers may have anticipated looming tariffs in the months before implementation. If so, they may have shifted forward their imports which could bias the elasticities because of a mismatch in timing of imports and tariff changes. The next section also checks this concern by implementing dynamic specifications that allow lags and leads of tariffs to affect outcomes.[23]

4 Elasticities

This section presents the estimates for the elasticities. We begin by addressing the threats to identification raised above, and then present the elasticity estimates.

4.1 Pre-existing Trends

A key assumption to identify the elasticities is that the tariff changes are uncorrelated with import demand and export supply shocks. We provide three pieces of evidence that support this assumption.

First, we correlate import and export outcomes before the 2018 trade war—values, quantities, unit values, and duty-inclusive unit values—with the future tariff changes. We compute these outcomes as the monthly average change between January 2013 and December 2017, and regress them against the 2017-18 change in statutory tariff rates (τ):

$$\Delta_{2013-17} \ln \bar{y}_{ig} = \alpha_g + \alpha_{is} + \beta \Delta_{2017-18} \ln(1 + \tau_{ig}) + \epsilon_{igt} \tag{20}$$

The regression controls for HS10 product (α_g) and country-sector (α_{is}) fixed effects. This specification is informed by the model's structure in Section 3.3 that uses variation from log of one plus tariffs, controlling for these sets of fixed effects, to identify the import demand and foreign export supply elasticities. Standard errors are clustered by country and HS8 (for imports) or HS6 (for exports). We plot the residualized outcomes and tariffs after controlling for the fixed effects to visualize the relationship, and report the regression output at the top of each panel. Panels A and B of Figure 2 plot the regression relationship using the 2017 statutory and applied tariff levels as the left-hand side variable in (20). We observe no correlation between level of pre-war import tariffs and war tariff changes. This implies that imports with lower pre-war tariffs were not more likely

[22] Note that the identification strategy is not threatened if the tariff changes reflect the differences between the preferences for redistribution towards specific sectors of the policymakers that were elected in 2016 and the previous policymakers. Rather, it only requires those preference changes over sectors to be uncorrelated with unobserved shocks to changes in demand and supply over the time period in which the tariff changes take place.

[23] A final caveat applies to the fact that the analysis assumes export supply curves derived under perfect competition. Conditional on a particular parametric family of demand and a log-linear marginal cost function, the approach readily extends to monopolistic, Cournot, or Bertrand competition.

to be targeted by higher tariffs during the war. The subsequent panels plot the relationship for changes in import outcomes. Here, too, we observe no statistically significant relationship, suggesting that targeted import varieties were not on differential trends prior to the war. We document the same flat relationship for U.S. export outcomes in Figure 3: pre-war tariff levels and export outcomes trends do not correlate with retaliatory war tariff changes. This suggests that trading partners, too, did not target U.S. varieties on the basis of pre-war tariff levels or export trends.

Second, we further rule out confounding pre-trends through an event-study framework that demonstrates similar trends in key outcomes for targeted relative to untargeted varieties prior to the war. The event study also illustrates whether or not changes in trade outcomes coincide with the timing of the tariff changes, which our (static) model predicts. We compare the trends of targeted varieties (those directly hit by a tariff increase) to varieties not targeted in the following specification:

$$\ln y_{igt} = \alpha_{ig} + \alpha_{gt} + \alpha_{it} + \sum_{j=-6}^{3} \beta_{0j} I\left(event_{ig} = j\right) + \sum_{j=-6}^{3} \beta_{1j} I\left(event_{ig} = j\right) \times target_{ig} + \epsilon_{igt}. \quad (21)$$

This specification includes variety (α_{ig}), country-time (α_{it}) and product-month (α_{gt}) fixed effects. Varieties targeted by tariffs are captured with 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. 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.[24] Non-targeted varieties within the same HS10 product code 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 sector 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$\geq$3 together and exclude event time$\leq$-7. Standard errors are clustered by country and HS8 (for import outcomes) and HS6 (for export outcomes).[25]We plot the the β_{1j} dummies that capture the relative trends of targeted varieties.

Figure 4 illustrates the sharp increase in import and export tariff rates as a result of the trade war. Prior to the date of implementation, we do not observe divergent trends between targeted and exempt varieties. We observe increases in $\ln(1+\tau)$ of approximately 1,445 in the import statutory rate, 1,174 in the import applied rate, and 1,767 in the retaliatory rate.

Figure 5 shows the event study results for the import outcomes. 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 and virtually immediate declines in trade flows. Import values decline on average by 20% and quantities decline

[24]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.

[25]Recall that import tariffs and retaliatory tariffs are set at the HS8 and HS6 level, respectively.

by 23%. In the bottom-left panel, unit values exclusive of duties do not change. However, duty-inclusive unit values increase sharply for targeted varieties by 9%, on average. These two panels are initial evidence of complete pass-through of the tariffs to import prices.

The event study also directly addresses the the third identification threat mentioned in Section 3.3.5: tariff anticipation. The figures suggest anticipatory effects occurring three months before the tariff changes, but they are quantitatively small (the coefficient on import values at event time of -3 is 36%). Hence, the concern that importers shifted forward their purchases in order to avoid paying tariffs is mild. Below, we further assess this potential threat through dynamic specifications in Section 4.6.

Figure 6 repeats the event study exercise using the export data and the retaliatory tariffs faced by U.S. exporters. Although the magnitudes are smaller, the patterns are similar to what we observe for imports. We find that, at implementation, export values decline on average by 21% and quantities fall by 25%. Again, we observe no change in the unit values before tariff duties. Inclusive of duties, unit values increase by 19%. These two panels are initial evidence of complete pass-through of the retalitory tariffs to foreign import prices. We observe no clear pattern of anticipation.

The third check examines domestic sectoral-level outcomes. While the analysis shows that targeted import/export varieties were not on differential trends prior to the war, it could be that recent trends in domestic sectoral outcomes triggered the U.S. to raise tariffs on imports. We assess this concern by analyzing the time path of key U.S. sector variables–PPI, production index, employment, and nominal wages–through the following event-study framework:

$$\ln y_{st} = \alpha_s + \alpha_{mt} + \sum_{j=-6}^{3} \beta_{0j} I\left(event_s = j\right) + \sum_{j=-6}^{3} \beta_{1j} I\left(event_s = j\right) \times target_s + \epsilon_{st}, \tag{22}$$

where s denotes a (NAICS4) sector and m denotes a two-digit NAICS code. The α_{mt} fixed effects control for monthly trends that may be different for broader sectors of the economy, such as manufacturing and agriculture. Event time for sector-level outcomes is harder to define than for trade-level otucomes because products within sectors may experience multiple tariff changes throughout the year. Additionally, retaliatory tariffs are often enacted after import tariffs in the same sector. We define the event time by assigning the event month as the month in which the sector experiences the largest (percentage point) increase in import tariffs. Targeted sectors cover 94 of 266 sectors in the sample. Our sample includes all sectors for which we observe at least one of the four outcomes, but we do not observe all outcomes for all sectors.[26]

Figure 7 presents the sector-level event study plots. Prior to the increase in protection, we observe no trends in sectoral outcomes. This is reassuring as it suggests that, like the trade outcomes, the tariffs did not respond to short-run trends in domestic employment, producer prices or production.

[26]The results are similar when we use a subsample of 266 sectors for which we observe all four outcomes.

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

This subsection estimates the variety level import demand and foreign export supply elasticities following the approach described in Section (3.3.1).

We face a choice between using either the applied import tariff or the statutory tariff as the policy variable. The applied tariff is appealing because it is based on the actual duties paid by the importers. However, there are reasons to be concerned about using applied rates as the source of identifying variation. As noted above, applied rates are constructed as the ratio between actual duties collected and import values, both of which could be measured with error. While classical measurement errors would attenuate the elasticities, the larger concern is non-classical measurement error; for instance, measurement error in import values induces a mechanical correlation between the applied rates and unit values. We present the elasticities with respect to the applied rates, but we also address these measurement error concerns by instrumenting the applied tariff with the statutory tariff. This approach has the advantage of exclusively relying on the tariff variation generated by the trade war.[27]

Table 3 reports the elasticites using the applied rate, and Table 4 instruments the applied rates with the statutory rates. Columns 1-4 of Table 3 report the reduced-form specifications in (12) for the four outcomes: values (mp^*), quantities (m), unit values (p^*), and duty-inclusive unit values ($p^*(1+\tau)$). Each specification is run in first-differences and includes fixed effects for product-time, country-time and country-sector. Standard errors are two-way clustered by country and HS8, and use data from January 2017 to November 2018.[28] Column 1 shows that import values drop sharply with tariff increases. The point estimate is a statistically significant -2.45 (s.e.=0.08). Column 2 shows that this import value decline is closely matched by changes in quantities. Column 3 indicates a positive impact of the tariff increases on the unit values, which is puzzling but disappears below once we instrument with statutory tariff changes.[29] This is verified in column 4, which indicates that for a one percent increase in the applied tariff, duty-inclusive unit values increase by 1.09% (s.e.=0.04%). Based on these reduced-form regressions, the data suggest essentially complete pass-through of the tariffs to import prices.

We recover the elasticities $\{\sigma, \omega^*\}$ from the structural IV estimates using (10) and (11) in columns 5-6. Column 5 reports the supply curve elasticity, $1/\hat{\omega}$. The first stage for this specification is Column 3. The coefficient is negative, which is consistent with more-than-complete pass-through from the corresponding first-stage regression (column 3), and implies $\hat{\omega}$=-0.03 (s.e.=0.01). Moreover, as discussed in Section (3.3.1), low first-stage F-statistic are particularly useful for deter-

[27] A few changes in statutory rates are observed in January 2018 and July 2018 as part of pre-existing commitments made by the U.S. through regional trade agreements. We only use statutory tariff changes that occur during the trade war documented in Section 2.

[28] We have also run the specifications in levels with variety fixed effects and we found very similar elasticities. We choose to work in first differences because it suggested by the model, and reduces computational burden, particularly when we allow for variety-specific trends. We choose January 2017 as the starting point of the analysis because it one year before the Trade War began and it is the first month that the U.S. administration implementing the tariffs took office.

[29] The number of observations in columns 2-4 differ from column 1 because of missing quantities.

mining who bears the incidence of the tariffs. The first-stage F-statistic is low (6.2), indicating that we cannot reject a horizontal supply curve. Therefore, we do not find strong evidence that U.S. tariffs have caused foreign exporters to reduce their before-tariff prices in the short-run. Column 6 reports the estimate of import demand elasticity. The first-stage F-statistic, from the first-stage regression in column 4, is large. The estimate implies $\hat{\sigma}$=2.32 (s.e.=0.07).

To address the potential concerns with measurement error in the applied rates discussed above, we now exploit the statutory tariff variation as an instrument in Table 4.[30] The first column reports the first-stage regression of the change in the applied tariffs on the change in statutory tariffs. The coefficient is tightly estimated, as expected, but is less than a perfect correlation (consistent with measurement error). Columns 2-5 report the impacts of the instrumented applied rate on import outcomes. We continue to detect no relationship between before-tariff unit values and the statutory tariffs (column 4).

Columns 8 and 9 report the structural IV regressions for the supply and demand curves using the statutory tariff to instrument the before-tariff and tariff-inclusive unit values. The corresponding first-stage regressions are in columns 6 and 7. These specifications yield $\hat{\omega}$=-0.02 (s.e.=0.05). As before, the F-statistic for the supply curve is low. This is again consistent with a horizontal foreign export supply curve in the short run. The import demand elasticity remains precisely estimated $\hat{\sigma}$=2.47 (s.e.=0.26), and is our preferred estimate since it relies on the statutory tariff variation.

Using the estimated elasticities $\hat{\sigma}$=2.47 and $\omega^* = 0$ and the average change in statutory tariffs, we compute the average change in import values of targeted varieties:

$$\overline{\Delta \ln \left(m_{igt} p^*_{igt} \right)} = - \underbrace{\sigma \frac{1+\omega}{1+\omega\sigma}}_{2.47} \underbrace{\overline{\Delta \ln \left(1+\tau_{igt}\right)}}_{12.75\%} = 31.5\%,$$

with standard deviation of 15.5% across targeted varieties.

4.3 U.S. Import Product Elasticity (η)

Table 5 presents estimates of the product elasticity (η) following the steps described in Section 3.3.2. The regressions are run in first differences, control for sector-time pair fixed effects, and cluster standard errors at the sector level. We construct the price index from equation (14) using $\hat{\sigma}$ and the residuals from the mport variety demand equation. We first construct this index using the estimates from column 6 of Table 3, and build the instrument $\Delta \ln Z_{gMt}$ in (15). Columns 1-3 report results using applied tariffs to build the instrument and columns 4-6 report results that instrument with statutory tariffs.

Column 1 regresses the change in product shares, $\Delta \ln (s_{Mgt})$, directly on the instrument (i.e., the reduced form). Higher (product-level) tariffs result in lower relative product-level expenditures. Column 2 reports the first-stage where we regress the tariff-inclusive price index on the instrument. The sign is consistent with what we should expect: higher tariffs raise the product price index.

[30] Since the statutory tariffs change during the middle of the month, we scale the tariff changes by the number of days in the month that they are in effect. We adopt this scaling because the monthly import data includes transactions that arrive before the tariff went into affect.

Column 3 reports the IV estimate which regresses the change in product shares on the change in the instrumented price index. The estimate implies $\hat{\eta}$ =3.25 (s.e. 0.71).

Columns 4-6 report the results that instrument using the estimates from the statutory tariffs (column 9 of Table 4). The results are consistent with the previous columns but now the elasticities are lower because there is less variation over time in the statutory rates (which change only during the trade war) compared to the applied rates. The coefficient in column 6 implies $\hat{\eta}$ =1.81 (s.e. 0.48). As before, this is our preferred estimate because it is estimated using the statutory tariff variation.

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 have fallen 3.8% (s.d. 4.3% across targeted products).[31]

4.4 U.S. Import Sector Elasticity (κ)

Table 6 reports estimates of the sector elasticity (κ) following the steps described in Section 16. The regressions control for sector fixed effects and cluster standard errors at the sector level. As shown in (16), estimating this elasticity requires data on changes imports and domestic expenditures at the sectoral level.

The monthly changes on 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. Estimating this elasticity also requires data on the price index of domestically produced goods, $\Delta \ln (P_{Dst})$. The production structure we assume below implies 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: $\Delta \ln P_{Dst} = \Delta \ln p_{st} + \Delta \ln \varepsilon^{p}_{st}$.[32] This allows us to implement equation 16 with the PPI instead of the consumer price index of domestically produced goods. Hence, our specification uses $\Delta \ln (P_{Mst}/p_{st})$ instead of $\Delta \ln (P_{Mst}/P_{Dst})$ in (16).

The change in the price index, $\Delta \ln P_{Mst}$, is constructed from (17) using the estimated $\hat{\sigma}$ and $\hat{\eta}$ from the previous two steps, and the corresponding residuals from these regressions. As before, we can construct the price index from either the applied tariffs (which uses estimates from column 6 of Table 3 and column 3 of Table 5) or statutory tariffs (which uses estimates from column 9 of Table 4 and column 6 of Table 5).

Column 1-3 use the applied tariffs as the source of variation. 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. We do not detect precise coefficients with these specifications. However, we do observe stronger results in columns 4-6, which use the statutory tariff as the identifying variation. Column 5 regresses the relative import price index directly on the instrument (i.e., the first stage). The coefficient is negative, suggesting that price propagation of the tariff through input-output

[31] This number is the average change in import values for targeted products obtained from $\Delta \ln p_{Mgt} m_{gt} = -(\eta - 1) \Delta \ln Z^{stat}_{gMt}$ where we set $\{\hat{\omega}^* = 0, \hat{\sigma} = 2.47, \hat{\eta} = 1.81\}$.

[32] See Section (5) for more details, and in particular, footnote 38.

linkages is strong and causes the domestic PPI to increase but is noisy. Column 6 reports the IV estimate. The coefficient is not statistically significant from zero but recall that the structural interpretation of the coefficient is $1-\kappa$. This implies a statistically significant $\hat{\kappa}$ =2.09 (s.e. 0.82).

Using this elasticity and the average change in sector-level statutory import tariffs, these estimates imply that import values for targeted sectors fell 0.5% (s.d. 1.2% across targeted sectors).[33]

4.5 Foreign Import Variety Elasticity (σ^*)

This subsection estimates the foreign import demand elasticity σ^* using equation (19). The regressions include product-time, destination-time and destination-sector fixed effects, and cluster standard errors by destination country and HS6. For completeness, we first report regressions of the four export outcomes on the retaliatory tariffs in columns 1-4 of Table 7. We observe a statistically significant decline in export values (marginal significance for export qualities), but no evidence that the retaliatory tariffs caused U.S. exports to lower (before tariff) unit values.

Column 5 reports the IV estimate of equation (19) to estimate σ^*. (The first-stage is column 4). We estimate $\hat{\sigma}^*$=.72 (s.e.=.3). 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 9.5% (s.d.=3.3%).[34]

4.6 Trends and Dynamic Specifications

We demonstrated in Section 4.1 that pre-existing trends and tariff anticipation are unlikely to be concerns. Now, we estimate the elasticities using specifications that check the sensitivity to pre-existing trends and lagged impacts.

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 3 in Appendix Table A.1. The results are essentially unchanged. Table A.2 adds variety trends to the specifications that instrument using the statutory rates, and again the results are hardly effected. For the product elasticity, Appendix Table A.3 repeats the analysis with product fixed effects which is equivalent to controlling for product-specific trends. Again, the results hardly change. These findings are consistent with the evidence provided in Section 4.1 that pre-existing trends are unlikely to be confounders.

The second concern is that importers may have anticipated the changes in tariffs and shifted their purchasing decisions forward to avoid the duties. This concern means that, even though there is a real impact of tariffs on trade, in a contemporaneous regression of changes in imports on changes in tariffs the estimated elasticities may be biased. As proposed by Coglianese et al. (2017) and Suarez Serrato and Zidar (2016), anticipatory and lagged effects effects can be checked

[33] This number is the average change in import values for targeted sectors obtained from $\Delta \ln\left(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}}\right) = (1-\kappa)\,\Delta \ln Z^{stat}_{Mst}$ where we set $\{\hat{\omega}^*=0, \hat{\sigma}=2.47, \hat{\eta}=1.81, \hat{\kappa}=2.09\}$.

[34] This number is the average change in export values for targeted varieties obtained from $\Delta \ln\left(p^X_{igt}x_{igt}\right) = -\sigma^*\Delta \ln\left(1+\tau^*_{igt}\right)$ where we set $\hat{\sigma}^*=.72$.

by allowing for leads and lags in the reduced-form variety-level equations (12):

$$\Delta \ln y_{igt} = \alpha_{gt} + \alpha_{ist} + \sum_{m=-6}^{m=3} \beta_m^y \left[\ln\left(1+\tau_{ig,t-m}\right) - \ln\left(1+\tau_{ig,t-1-m}\right)\right] + \epsilon_{igt}, \tag{23}$$

where we allow for leads up to six months before the tariff change and up to three months after the tariff changes. We present the specification that purges the applied rate of measurement error by first instrumenting it the statutory rate, and then constructing the lead and lag terms using the predicted value.[35] Figure 8 plots the estimated β_m coefficients for import values, quantities, unit values, and tariff-inclusive unit values at the variety level. The results show little evidence that U.S. importers shifted forward purchases prior to the trade war. All four panels show that, prior to the change in tariff, there is no relationship between import outcomes and future tariff changes. Upon the tariff increases, import quantities drop ($\beta_0^m > 0$). Figure 9 replicates the analysis for exported varieties, and further suggests no anticipation of exports to the retaliatory tariffs.

5 Aggregate and Regional Impacts

Our goal now is to compute the aggregate and regional impacts of the tariff war. We combine the previous demand structure with a supply-side framework of the U.S. economy. The mechanics of how tariffs impact the economy in general equilibrium depend on the elasticities we have estimated from tariff variation, and on the parametrization of the production side that we now introduce. This supply-side combines various margins of economic activity that are standard in quantitative trade models. We model input-output linkages across tradeable sectors assuming fixed expenditure shares as in Caliendo and Parro (2015), and linkages have a spatial dimension because regions vary in their specialization patterns as in Caliendo et al. (2017). Relative to these frameworks, we incorporate a flexible international demand and supply structure, involving the 3-tier demand system within each sector as well as the foreign import demand and export supply elasticities we have estimated. To capture distributional effects of the tariffs we assume specific factors and imperfect labor mobility across regions.

5.1 General Equilibrium Structure

The U.S. is divided into R counties (collected in the set $\mathcal{R}$ and indexed by r). In addition to the traded sectors there is one non-traded sector. In each region r there are L_r workers. Workers are immobile across regions, and may be either perfectly mobile or immobile across sectors. Within traded sectors, final goods are freely traded within the U.S. but face trade costs internationally.

Consumption in county r results from maximizing aggregate utility,

$$\beta_{NT} \ln C_{NT,r} + \sum_{s \in \mathcal{S}} \beta_s \ln \left(\prod_{s \in \mathcal{S}} C_{sr} \right), \tag{24}$$

[35] Since our data ends in November 2018, the forward tariff changes are missing in the six months prior to November. We replace these missing values with zeros, under the assumption of no future tariff changes. We include dummies if the tariff change was replaced from missing to zero in (23).

where $C_{NT,r}$ is consumption of a homogeneous non-traded good, C_{sr} is consumption of tradeable sector s, and $\beta_{NT} + \sum_{s\in\mathcal{S}} \beta_s = 1$. The price of the non-traded good is $P_{NT,r}$. Assuming no trade costs within the U.S., the price index P_s of sector s is the same in every region. Letting X_r be final consumer expenditures in region r, defined in (33) below, expenditures in the non-traded sector are $P_{NT,r}C_{NT,r} = \beta_{NT}X_r$, and in each traded sector they are $P_sC_{sr} = \beta_s X_r$.

Production of tradeable goods uses workers, intermediate inputs, and the sector-specific capital. The domestic production of tradeable sector s in region r is

$$Q_{sr} = Z_{sr}\left(\frac{I_{sr}}{\alpha_{I,s}}\right)^{\alpha_{I,s}}\left(\frac{L_{sr}}{\alpha_{L,s}}\right)^{\alpha_{L,s}}, \tag{25}$$

where Z_{sr} is local productivity, I_{sr} are intermediate inputs and L_{sr} is the number of workers. The factor shares add up to less than 1, and we let $\alpha_{K,s} \equiv 1 - \alpha_{I,s} - \alpha_{L,s}$ be the production share of the fixed factor. Intermediate inputs in sector s are first aggregated to the national level using a Cobb-Douglas technology and then freely allocated across regions. We let $\alpha_s^{s'}$ be the share of input s' in total sales of sector s. As a result, the cost of the bundle of intermediates used by sector s is:[36]

$$\phi_s \propto \prod_{s'\in\mathcal{S}} P_{s'}^{\alpha_s^{s'}/\alpha_{I,s}}. \tag{26}$$

The owners of fixed factors choose the quantities I_{sr} and L_{sr} to maximize profits Π_{sr}. Assuming away trade costs within the U.S., the producer price in tradeable sector s is p_s. We let w_{sr} be the wage per person in sector s and region r. The returns to the fixed factors of sector s in region r are:

$$\Pi_{sr} = \max_{Q_{sr}} p_s Q_{sr} - (1-\alpha_{K,s})\left(\frac{\phi_s^{\alpha_{I,s}} w_{sr}^{\alpha_{E,s}}}{Z_{sr}} Q_{sr}\right)^{\frac{1}{1-\alpha_{K,s}}}, \tag{27}$$

giving the the supply curve $Q_{sr} = \frac{\partial \Pi_{sr}}{\partial p_s}$ and the national supply in sector s, $Q_s = \sum_{r\in\mathcal{R}} Q_{sr}$.[37]

Non-traded output in region r uses only labor:

$$Q_{NT,r} = Z_{NT,r}L_{NT,r}, \tag{28}$$

where $L_{NT,r}$ is the employment in the non-traded sector in region r. The wage per person in the non-traded sector is $w_{NT,r} = P_{NT,r}Z_{NT,r}$. Market clearing in the non-traded sector implies $Q_{NT,r} = C_{NT,r}$.

Labor is immobile across regions, and we perform the benchmark analysis under the assumption that workers are immobile across sectors. In the first case case, wages are given by the expressions in Appendix (B.1). We also consider the implications of perfect mobility. In that case, $w_{sr} = w_{NT,r}$ for

[36] Formally, the technology that aggregates intermediates supplied to sector s to the national level before allocating them regionally has share $\alpha_s^{s'}/\alpha_{I,s}$ on inputs from sector s', where $\sum_{s'=1}^{S} \alpha_s^{s'} = \alpha_{I,s}$. The condition that total supply of intermediates used by sector s equals demand therefore is $\prod_{s'\in\mathcal{S}}\left(I_s^{s'}\right)^{\alpha_s^{s'}/\alpha_{I,s}} = \sum_{r\in\mathcal{R}} I_{sr}$ where $I_s^{s'}$ are the intermediate goods from sector s' used by sector s at the national level.

[37] Having defined the decisions of consumers and producers of tradeable goods, we now have an explicit expression for the aggregate demand shifters E_s entering previously in the import demand defined in (1): $E_s = \sum_{r\in\mathcal{R}} \beta_s X_r + \sum_{r\in\mathcal{R}}\sum_{s'\in\mathcal{S}} \alpha_{s'}^s p_{s'} Q_{s'r}$.The first component adds up the regional expenditures of final consumers, and the second term adds up the regional expenditures of producers in each sector.

all sectors and the level of wages adjusts such that the local labor market clears, $\sum_{s\in\mathcal{S}} L_{sr}+L_{NT,r} = L_r$.

Production by sector and region, defined before in (25), is allocated across products according to a constant marginal rate of transformation. Letting q_g be output of good g in sector s, the feasibility constraint for products in sector s is:

$$\sum_{g\in\mathcal{G}_s} \frac{q_g}{z_g} = Q_s, \tag{29}$$

where z_g is a product-level productivity shock. We assume this linear production structure because we only observe employment by region at the sector level (4-digit NAICS in our data) and not at the product level (HS10 codes in our data). This approach allows us to calibrate the production functions at the sector level using information from input-output tables. It also allows us to quantify the impact of tariffs using information on trade shares at the variety level (i.e., for each HS10 product-origin) and on the labor allocation at the sector-county level.

Assuming perfect competition, the price of the domestically produced variety of good g is $p_{Dg} = \frac{p_s}{z_g}$.[38] Given iceberg costs δ_{ig}, the price faced by importer i of product g is $p_{ig}^X = \delta_{ig} p_{Dg}$. Hence, market clearing in the U.S. variety of product g implies

$$q_g = d_g + \sum_{i\in\mathcal{I}} \delta_{ig} x_{ig}, \tag{30}$$

where d_g is the U.S. demand of product g and x_{ig} is the foreign import demand defined in (7). From the CES structure described in Appendix A, domestic demand for the U.S. variety of good g is:

$$d_g = (a_{Dg} D_s) \left(\frac{p_{Dg}}{P_{Ds}}\right)^{-\eta}, \tag{31}$$

where a_{Dg} is a demand shock, D_s is the aggregate U.S. consumption of domestic goods in sector s defined in (A.2), p_{Dg} is the domestic price of the domestic variety, and P_{Ds} is the price index of domestically produced goods defined in (A.6).

To close the model, we assume that labor income and profits are spent where they are generated. Total tariff revenue, defined as

$$R = \sum_{s\in\mathcal{S}} \sum_{g\in\mathcal{G}_s} \sum_{i\in\mathcal{I}} p_{ig}^* \tau_{ig} m_{ig}, \tag{32}$$

is distributed to each region in proportion b_r equal to its national population share. We allow the model to match the aggregate trade imbalance. For that, 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.[39] Final consumer expenditures in region r

[38] This production structure also implies that the price index of domestically produced goods defined in (A.6) equals producer prices times a function of demand and supply shocks at the food level: $P_{Ds} = p_s \varepsilon_s^P$, where $\varepsilon_s^P \equiv \left(\sum_{g\in G_s} \frac{a_{Dg}}{z_g^{1-\eta}}\right)^{\frac{1}{1-\eta}}$. We relied on this property to measure the price index of domestically produced goods in the estimation of κ in Section 3.3.3.

[39] Given our previous assumption of frictionless trade in the traded sector, the assumptions about how value added, tariff revenue and foreign imbalances are owned by different regions only matter to determine prices in the non-traded sector of each region. Since preferences are homothetic, we do not need to take a stand on how government revenue

therefore are

$$X_r = w_{NT,r} L_{NT,r} + \sum_{s \in \mathcal{S}} w_{sr} L_{sr} + \sum_{s \in \mathcal{S}} \Pi_{sr} + b_r \left(D + R \right). \tag{33}$$

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.

5.2 Parametrization

To simulate the impact of the tariff we derive a system of first-order approximations to the impact of tariff shocks around the pre-war equilibrium.[40] The system is fully characterized by (A.15)-(A.31) in Appendix B.2. In response to a simulated shock to U.S. and foreign tariffs, the system gives the impact on every outcome as a function of the demand and supply elasticities estimated from tariff variation in Section 4: $\{\hat{\sigma} = 2.47, \hat{\eta} = 1.81, \hat{\kappa} = 2.09, \hat{\omega}^* = 0, \hat{\sigma}^* = .72\}$.

In addition, the system requires information on benchmark preference and technology parameters $\left\{\beta_{NT}, \beta_s, \alpha_{L,s}, \alpha_{I,s}, \alpha_s^{s'}\right\}$, and on observable shares of economic activity in the equilibrium before the war. To obtain these parameters, we use the input-output (IO) tables from 2016, which is the most recent year before the tariff war for which the IO information is available.We construct total sales ($p_s Q_s$ in the model), sales from sector s' to sector s ($P_{s'} I_s^{s'}$), consumption expenditures by sector ($P_s C_s$), exports by sector, import expenditures by sector ($P_{Ms} M_s$), total labor compensation ($w_s L_s$), and gross operating surplus ($\sum_r \Pi_{sr}$). The trade deficit D is defined as the difference between total imports and exports. The technology parameters $\alpha_{I,s}$ and $\alpha_s^{s'}$ are defined as intermediate input shares of sales, and $\alpha_{K,s}$ is the gross operating surplus share of sales. The average intermediate and capital shares across sectors are 0.39 and 0.17. The residual sales accrue to the labor share $\alpha_{L,s}$. 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 $\beta_{NT} = 0.6$, computed as the fraction of expenditures observed in the 2016 consumer expenditure survey (CEX) in the non sectors of our data (listed in Footnote 11).

Implementing the system (A.15)-(A.31) also requires information on labor income and employment shares by counties. We allocate the total labor compensation from IO tables across US counties using the regional labor compensation shares from the 2016 County Business Patterns. 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. Finally, implementing the system requires information on import

or foreign factor ownership is distributed across factors within a region.

[40] A potential concern is that U.S. tariffs increased in varieties with initially zero tariffs. Therefore we use a second-order approximation to the change in tariff revenue.

and export flows by variety. We apply the import and export shares within each 4-digit NAICS sector in the trade dataset for 2016 to the sector level import and export flows of the IO table. For this step 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).

In sum, we simulate the impact of the tariff war by matching the model to 2016 data on economic activity for 3067 US counties, 88 traded sectors (4-digit naics), 71 trade partners, 10242 imported HS products at 10 digits, 213,668 imported varieties (unique product-country origin), 3,688 exported products and 53,469 unique product-destination countries.

5.3 Aggregate Impacts

We use the model to quantify the aggregate 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 factors we obtain the aggregate equivalent variation for the U.S. economy as a whole. The aggregate equivalent variation, EV, can be written as a function of initial trade flows, and price and revenue changes:

$$EV = \underbrace{-\mathbf{m}'\Delta\mathbf{p}^M}_{EV^M} + \underbrace{\mathbf{x}'\Delta\mathbf{p}^X}_{EV^X} + \Delta R \tag{34}$$

where $\mathbf{m}$ is a column vector with the imported quantities of each variety before the war, $\mathbf{x}$ is a column with all the quantities exported of each product to each destination, $\Delta\mathbf{p}^m$ are changes in tariff-inclusive import prices, and $\Delta\mathbf{p}^x$ are changes in export prices.[41]

The expression (34) highlights where the general-equilibrium structure is needed to assess the aggregate impact of the tariff war. The pre-tariff war levels of imports and exports, $\mathbf{m}$ and $\mathbf{x}$, 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. Details of the economy, such as its input-output structure, matter in the aggregate inasmuch as they affect prices and tariff revenue.

The top panel of Table 8 shows each of the components of EV in response to the trade war. EV^M and EV^X correspond to import and export price components of EV defined in equation (34). The first row of each panel reports the monetary equivalent on an annual basis at 2016 prices, the second row reports numbers relative to GDP, and the third row reports the number per capita using the 2016 US population. The first column, which reports EV^M, shows that U.S. consumers lost in aggregate \$68.8billion (or 0.37% of GDP) because of higher tariff-inclusive prices, a loss of \$213 per person. This number comes precisely from our estimation of a complete pass-through, which implies a perfectly elastic export supply elasticity ($\omega^* = 0$). Since the U.S. has no pricing power on its imports, tariff-inclusive price changes equal the US tariff changes. The EV^M term is therefore decomposed as the product of the import share of value added (20%), the fraction of US

[41] Explicitly, in terms of our notation above: $\mathbf{m}'\Delta\mathbf{p}^M \equiv \sum_{s\in\mathcal{S}}\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}} m_{ig}\Delta p_{ig}$ and $\mathbf{x}'\Delta\mathbf{p}^X \equiv \sum_{s\in\mathcal{S}}\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}} x_{ig}\Delta p^X_{ig}$.

imports targeted by tariff increases (13%), and the average import price increase among targeted varieties (14%).

The second column shows the EV^X component. This 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 is stronger than the reallocations away from these goods as a result of the tariff changes. As discussed in more detail in Appendix B.4, our model captures several margins that lead to these reallocations, including changes in the importance of sectors with different input structures in aggregate demand, as well as changes in demand due to domestic or foreign tariffs. As shown in Appendix B.4, the intensity of these effects relies on the estimated demand elasticities. We estimate an increase of EV^X of \$23.0 billion (0.12% of GDP). This aggregate number equals a 1.2% increase in producer prices that we find in the model (weighted by each sector share in total exports) times a 10% observed share of exports in GDP.

The final component of the decomposition is the increase in tariff revenue. Our general equilibrium model yields a 70% increase in tariff revenue, equivalent to \$39.4 billion of annual revenue. This increase is larger than the 42% increase in tariff revenue observed in the actual data. The difference arises because the estimated model isolates the increase in tariff revenue from tariff shocks that affect tariff revenue directly and indirectly through trade flows and prices. In reality, tariff revenue also changed due to shocks besides tariffs leading to changes in trade flows and prices.

These numbers imply large and divergent consequences of the war on consumers and producers. However, these effects approximately balance out, leading to a small aggregate effect 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 \$6.4 billion or 0.03% of GDP.[42]

The second panel reports the aggregate outcomes of a hypothetical scenario where foreign trade partners did not retaliate against the U.S. tariffs. In this scenario, the aggregate losses would have been *one third* lower than the actual impacts: a decline of 0.01% of GDP. The impact of the retaliation operates almost exclusively through export prices: by lowering demand for U.S. exports, our estimates imply 20% larger producer gains without retaliation.[43] However, even in that scenario, the U.S. economy still experiences a small aggregate loss.

5.4 Regional Impacts

We now examine distributional effects of the tariff war across regions.

Figure 10 illustrates large variation in the 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

[42]These impacts assume that workers are immobile across sectors, which is the appropriate assumption in the short-run. Table A.4 in the Appendix replicates Table 8 assuming perfect labor mobility. In that case the consumer losses are the same as when workers are immobile but the producer gains are larger, leading to an aggregate welfare loss of \$5.3 billion. In addition, these impacts do not take into account general-equilibrium effects in foreign markets, which would enter through endogenous changes in the foreign demand and supply shifters in (6) and (7).

[43]Since we have estimated $\omega^* = 0$, our model implies that the EV^M is identical to the full war scenario. Tariff revenue raised in both scenarios is very similar.

computing the trade-weighted import and retaliatory tariff changes for each NAICS sector and then mapping them to counties based on counties' employment structure.[44] The maps show a clear contrast between the structure of U.S. protection and retaliation. The Great Lakes region of the Midwest, parts of the industrial Northeast and the West Coast, and some areas of Florida received larger tariff protection , while the agricultural counties of the Midwestern plains as well some areas of the Northwest bore the brunt of the retaliatory tariffs.

We construct the model implied welfare effects on tradeable sectors across counties in response to the tariff war. On average across counties, the nominal wages for workers in tradeable sectors increases by 0.7% (s.d. 0.4%). However, these income gains at initial prices are more than offset by higher cost of living, as the CPI of tradeable goods increases by 1.5% on average across sectors, partly due to an average 2.0% increase in import prices. The full CPI, accounting for non-traded consumption, increases by 1.3% across counties. As a result, the real wages in the tradable sector falls by 0.6% (sd 0.4%) on average.[45]

Figure 11 shows the impacts of the trade war across counties associated with these tariff changes.[46] The top map shows the county-level reduction in real wages in tradeable sectors in a hypothetical scenario where the U.S. trade partners did not retaliate, and the bottom figure shows the real wage losses from the full war. All but 3,033counties experience a reduction in tradeable real income. The counties with the smaller relative loss 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 10 because of input-output linkages across sectors. The counties hit hardest by the war are those concentrated in the Midwestern Plains, both because of input-output links as well as because of the retaliatory tariffs.

5.5 Tariff Protection, GOP Voting Patterns, and Wage Effects

As discussed in Section 2, the pattern of tariff changes across sectors does not a priori support the view that protection was waged by contributions of special interests nor by incentives to maximize national income (and we uncover no evidence of aggregate real income gains in the short-run). We

[44] 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 shocks as the labor-compensation weighted average of the NAICS-level tariff shocks. In the notation of the model, the import shock 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 shock 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.

[45] We use A.16 to construct the change in wages. Assuming no factor mobility, the returns to specific capital change in the same proportion and the returns to labor. The county-level distribution of losses is mitigated under the assumption of perfect labor mobility across sectors. In that case, the average increase in nominal income of all factors in tradeable sectors is 0.9% (instead of 0.6% without mobility) and the average real loss of 0.4% (instead of a loss of 0.7%0.6%).

[46] The real tradeable wage change in region r is defined as $\hat{w_{T,r}} - \hat{P_r}$, where $\hat{w_{T,r}} = \frac{\sum_{s\in\mathcal{S}} w_{sr}L_{sr}\hat{w_{sr}}}{\sum_{s\in\mathcal{S}} w_{sr}L_{sr}}$ 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. Equations (A.15) gives the solution for the wage change as function of price changes. Equations (A.21) to (A.24) characterizes the block of the model with the solution to the price changes as function tariffs and expenditure shifters.

now probe a third major hypothesis from the political economy of trade protection literature that policy-makers pursued an electoral rationale when setting tariffs by targeting regions according to their political leanings. Specifically, we examine the relationship between the county-level tariff exposure shown in Figure 10 and the voting pattern 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.[47] We then contrast the *ex ante* incentives of policy-makers suggested by the relationship between tariffs and voting with the distributional consequences of their policies.

Figure 12 presents a non-parametric plot of county-level import and retaliatory tariff changes against the Republican vote share, weighted by county population. The figure starkly reveals two different patterns of protection for U.S. and retaliatory tariffs. For U.S. tariffs, we observe an inverted-U shape, implying that counties with a 40-60% Republican vote share received more protection that heavily Republican or Democratic counties. Hence, U.S. tariffs appear targeted towards politically competitive counties, where voters are not overwhelmingly Republican or Democrat. By contrast, trading partners retaliated by targeting exports from heavily Republican counties.

Tables A.5 and A.6 in Appendix C examine the strength of these patterns by controlling county characteristics. Importantly, this spatial pattern of tariffs and GOP vote shares does not simply reflect the spatial concentration of U.S. manufacturing employment or the spatial distribution of declining sectors. For U.S. tariffs, the inverted-U pattern with county GOP vote share remains even after controlling for manufacturing and agriculture employment shares (and their quadratics), socioeconomic controls, and pre-trend changes in employment and income. For retaliation, the positive relationship with county GOP vote share is not robust once we control for the county's agriculture employment share, which has a large, positive and statistically significant coefficient.

This evidence suggests some electoral motivations for the structure of tariff protection. However, the impact of the tariff war across counties is complex. Tariff protection is helpful towards workers in protected sectors because it reallocates domestic expenditures. At the same time, tariffs also increase the cost of intermediate inputs and regions vary in their intensity of intermediate input use. Additionally, the price of consumption also rises. Finally, the ultimate impact of the tariff war on the distribution of real wage changes across counties also depends on the tariff structure of retaliation.

We use the estimated model to assess if the tradeable real wage of the electorally competitive counties indeed experience the highest (relative) gains. Figure 13 plots tradeable real wages (defined in Footnote 46) 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.[48]

The model suggests reductions in tradeable real wages for almost all counties (as noted above).

[47] Helpman (1995) characterize 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

[48] To implement counterfactuals that shut off the IO structure, we implement the parametrization of Section 5.2 except that $\alpha_{I,s}$ is assumed to be zero in every sector.

However, the curves illustrate different degrees of losses across counties. In the scenario where foreigners do not retaliate (dash curve), the impacts are fairly even across less polarized counties. There is no sharp peak, and the relationship is 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 35% larger. The black curve reveals the impacts from the full war. The peak of the full war scenario shifts leftward and is more pronounced. The war relatively favors tradeable workers in Democrat-leaning counties that had a 2016 Presidential vote share of roughly 35%. Moreover, workers in Republican counties (85-95% vote share) bear the largest cost of the full war. The losses in these counties are 58% larger than in a heavily Democratic county (a 5-15% vote share).

6 Conclusion

This paper analyzes the impacts of the 2018 trade war on the U.S. economy. Using the tariff changes on U.S. imports and retaliations on U.S. exports, we estimate key elasticities of trade outcomes. The elasticities are precisely estimated and reveal large and immediate impacts of the war on imports and exports. A key finding is that the foreign export supply curve is horizontal and as a result, U.S. consumers have borne the full incidence of the U.S. tariffs on import prices. Likewise, we estimate imperfectly inelastic foreign demand for U.S. exports which implies that foreign consumers have largely borne the incidence of their retaliation tariffs.

The finding of complete pass-through of the tariffs implies that the U.S. economy has lost $68.8 billion due to higher import prices. Using a general equilibrium plus the estimated elasticities allow us to compute gains in general equilibrium of $23.0 billion, from higher domestic prices, and $39.4 billion in tariff revenue collected. These large distributional consequences of the war, however, net out to a small loss of $6.4 billion for the overall U.S. economy. In the absence of foreign retaliations, aggregate losses to the U.S. economy would be one third lower.

The spatial model also allows us to explore heterogeneity across U.S. counties. The pattern of protection suggests that tariffs are biased towards protecting the most electorally competitive counties, while foreign retaliations targeted Republican counties. We estimate that tradeable real wages fall the most in heavily GOP counties because of the war. This is largely because these counties specialize in sectors that were targeted by foreign retaliation. In the absence of foreign retaliation, electorally competitive counties would have fared relatively better from U.S protection.

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A Appendix to Section 3 (Trade Framework and Identification)

A.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:

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

where D_s and M_s are composite domestic and imported products,

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

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

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 $g \in \mathcal{G}_s$, the quantity imported is

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

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

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

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

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

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

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

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 (A.4),

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

where p_{ig} is the domestic price defined in (4).

A.2 Reduced Form System

Solving for imports m_{ig} and CIF prices p^*_{ig}, adding a time subscript and log-differencing over time, we obtain:

$$\Delta \ln p^*_{igt} = \Delta \ln A^{p^*}_{igt} + \beta^{p^*} \Delta \ln (1 + \tau_{igt}), \tag{A.9}$$

$$\Delta \ln m_{igt} = \Delta \ln A^{m}_{ig} + \beta^{m} \Delta \ln (1 + \tau_{igt}). \tag{A.10}$$

The intercepts in (A.9) and (A.10) correspond to log changes of the following functions of demand and supply shocks:

$$A^{p^*}_{ig} \equiv (m_g a_{ig} p_{Mg})^{\frac{\omega^*}{1+\omega^*\sigma}} \left(z^*_{ig}\right)^{\frac{1}{1+\omega^*\sigma}}, \tag{A.11}$$

$$A^{m}_{ig} \equiv (m_g a_{ig} p_{Mg})^{\frac{\omega^*}{1+\omega^*\sigma}} \left(z^*_{ig}\right)^{\frac{1}{1+\omega^*\sigma}}. \tag{A.12}$$

We assume that these intercepts can be decomposed into a product-time, country-time, country-sector fixed effects, and a residual component:

$$\Delta \ln A^{y}_{igt} = \alpha^{y}_{gt} + \alpha^{y}_{it} + \alpha^{y}_{is} + \varepsilon^{y}_{igt}$$

for $y = p^*, m$. As a result, (A.9) and (A.10) can be written as in (12).

B Appendix to Section 5 (Aggregate and Distributional Effects)

B.1 Wages

The labor demand curve resulting from profit maximization (27) yields

$$w_{sr} = \left(\frac{Z_{sr} p_s}{(L_{sr}/\alpha_{L,s})^{\alpha_{K,s}} \phi_s^{\alpha_{I,s}}} \right)^{\frac{1}{1-\alpha_{I,s}}}, \tag{A.13}$$

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

$$w_{NT,r} = \beta_{NT} \frac{X_r}{L_{NT,r}}. \tag{A.14}$$

B.2 General-Equilibrium System in Changes

We derive the model solution in a counterfactual equilibrium as a system of first-order approximations around an initial equilibrium corresponding to the period before the tariff war. We use this system for all the numerical experiments in sections 5.

Letting $\hat{x} \equiv d \ln x$ be the infinitesimal log-change in variable x, the system gives the change in each endogenous given shocks to US 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 by sector $\{\hat{p}_s\}$, 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 $\{\hat{p}_{Mg}\}$, domestic 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 expenditures in intermediates by sector $\left\{\hat{P_s I_s}\right\}$, national sales by sector $\{p_s Q_s\}$, and final consumer expenditures by region $\left\{\hat{X}_r\right\}$.

We now describe the full system of equations that characterizes the solution to these outcomes as function of elasticities, demand and production parameters, values of endogenous variables in the initial equilibrium, and shocks. To organize the presentation of the system, it is convenient to split it in 4 separate 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 that equals 1 if labor is assumed to immobile. From (A.13) to (A.14):

$$\hat{w_{sr}} = \frac{\chi^I}{1-\alpha_{I,s}}\left(\hat{p}_s - \alpha_{I,s}\hat{\phi}_s\right) + \left(1-\chi^I\right)\hat{w_{T,r}} \tag{A.15}$$

$$\hat{w_{T,r}} = \left(1-\chi^I\right)\frac{\sum_{s\in\mathcal{S}}\left(\frac{w_{sr}L_{sr}}{w_{T,r}L_r^T}\right)\frac{\hat{p}_s-\alpha_{I,s}\hat{\phi}_s}{\alpha_{K,s}} - \hat{L_r^T}}{\sum_{s\in\mathcal{S}}\left(\frac{w_{sr}L_{sr}}{w_{T,r}L_r^T}\right)\frac{1-\alpha_{I,s}}{\alpha_{K,s}}} + \chi^I\sum_{s\in\mathcal{S}}\left(\frac{w_{sr}L_{sr}}{w_{T,r}L_r^T}\right)\frac{\hat{p}_s-\alpha_{I,s}\hat{\phi}_s}{1-\alpha_{I,s}} \tag{A.16}$$

$$\hat{w_{NT,r}} = \chi^I\hat{X}_r + \left(1-\chi^I\right)\hat{w_{T,r}}, \tag{A.17}$$

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

$$\hat{L_r^T} = \left(1-\chi^{\mathrm{I}}\right)\left(\hat{w_{T,r}} - \hat{X}_r\right)\frac{L_r^{NT}}{L_r^T}. \tag{A.18}$$

Finally, using the market clearing condition 30 for each variety, using the sector supply 29 to aggregate to the sector level, and the domestic and foreign demands 31 and 7, the producer price in sector s changes according to:

$$\hat{p_s} = \frac{\frac{P_{Ds}D_s}{p_s^P Q_s}\left(\hat{E}_s + (\kappa-1)\hat{P}_s\right) + \frac{\alpha_{I,s}}{\alpha_{K,s}}\hat{\phi}_s + \sum_{r\in\mathcal{R}}\frac{p_s Q_{sr}}{p_s Q_s}\frac{\alpha_{L,s}}{\alpha_{K,s}}\hat{w_{sr}} - \sigma^*\sum_{g\in G_s}\sum_{i\in\mathcal{I}}\frac{p_{Dg}x_{ig}}{p_s Q_s}\frac{d\tau_{ig}^*}{1+\tau_{ig}^*}}{\frac{1-\alpha_{K,s}}{\alpha_{K,s}} + \frac{P_{Ds}D_s}{p_s Q_s}\kappa + \left(1-\frac{P_{Ds}D_s}{p_s Q_s}\right)\sigma^*} \tag{A.19}$$

Both the wages per efficiency unit $\hat{w_{sr}}$ and the producer prices $\hat{p_s}$ depend on the price index of intermediates, which using (26) is:

$$\hat{\phi}_s = \sum_{s'\in\mathcal{S}}\frac{\alpha_s^{s'}}{\alpha_{I,s}}\hat{P}_{s'}. \tag{A.20}$$

In addition the producer prices depend on the change import price index.

Consumer and Import Prices

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 (A.5), the sector level price index changes according to

$$\hat{P}_s = \frac{P_{Ds}D_s}{E_s}\hat{p_s} + \left(1 - \frac{P_{Ds}D_s}{E_s}\right)\hat{P}_{Ms}. \tag{A.21}$$

From (A.7), (A.8), (3), (6), (1), the import price index $\hat{P}_{Ms}$ of imported goods in sector s changes according to

$$\hat{P_{Ms}} = \sum_{g\in\mathcal{G}_s}\left(\frac{p_{Mg}m_g}{P_{Ms}M_s}\right)\hat{p_{Mg}}, \tag{A.22}$$

where the product level import price index changes according to

$$\hat{p}_{gM} = \sum_{i\in\mathcal{I}}\left(\frac{p_{ig}m_{ig}}{p_{Mg}m_g}\right)\hat{p}_{ig}, \tag{A.23}$$

where the CIF price changes according to

$$\hat{p_{ig}} = \frac{\omega^*}{1+\omega^*\sigma}\left(\hat{E}_s + (\kappa-1)\hat{P}_s + (\eta-\kappa)\hat{P}_{Ms} + (\sigma-\eta)\hat{p}_{gM}\right) + \frac{1}{1+\omega^*\sigma}\frac{d\tau_{ig}}{1+\tau_{ig}}. \tag{A.24}$$

Sector and Region Demand Shifters

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

$$\hat{E}_s \equiv \frac{P_sC_s}{E_s}\hat{X} + \left(1 - \frac{P_sC_s}{E_s}\right)\hat{P_sI_s}. \tag{A.25}$$

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

$$\hat{X} = \frac{Y}{X}\hat{Y} + \frac{R}{X}\hat{R}, \tag{A.26}$$

where net income of all factors changes according to

$$\hat{Y} = \sum_{r\in\mathcal{R}}\left(\frac{P_{NT,r}Q_{NT,r}}{Y}\right)\hat{X}_r + \sum_{s\in\mathcal{S}}(1-\alpha_{I,s})\left(\frac{p_sQ_s}{Y}\right)\sum_{r\in\mathcal{R}}\left(\frac{p_sQ_{sr}}{p_sQ_s}\right)\left(\hat{p_s} + \hat{Q_{sr}}\right). \tag{A.27}$$

Aggregate expenditures $\hat{P_sI_s}$ in intermediates from sector s also enter as demand shifters in the determination of the producer price index, and is given by

$$\hat{P_sI_s} = \sum_{s'\in\mathcal{S}}\alpha^s_{s'}\sum_{r\in\mathcal{R}}\frac{p_{s'}Q_{s'r}}{P_sI_s}\left(\hat{p_{s'}} + \hat{Q_{s'r}}\right). \tag{A.28}$$

In turn, final expenditures in region r, entering as determinant of non-tradeable income and therefore income by region, changes from (33) according to

$$\hat{X}_r = \frac{\sum_{s\in\mathcal{S}}\frac{p_{sr}Q_{sr}}{X_r}(1-\alpha_{I,s})\left(\hat{p_s} + \hat{Q_{sr}}\right) + \frac{b_rR}{X_r}\hat{R}}{1 - \frac{P_{NT,r}Q_{NT,r}}{X_r}}. \tag{A.29}$$

Using local labor market clearing, we obtain change in sales of sector s in region r entering in the

last three expressions:

$$\hat{p_s} + \hat{Q_{sr}} = \frac{1}{\alpha_{K,s}}\hat{p_s} - \frac{\alpha_{I,s}}{\alpha_{K,s}}\hat{\phi_s} - \frac{\alpha_{L,s}}{\alpha_{K,s}}\hat{w_{sr}}. \tag{A.30}$$

Tariff Revenue

The previous system determines all the model outcomes to a first order approximation given a change in tariff revenue, $\hat{R}$. We use a second-approximation to tariff revenue. From the definition of tariff revenue in (32) we obtain:

$$\begin{aligned}\hat{R} = &\sum_s \sum_{g\in G_s} \sum_i \frac{p^*_{ig} m_{ig}}{R} \frac{d\tau_{ig}}{1+\tau_{ig}} + \sum_s \sum_{g\in G_s} \sum_i \left(\frac{p^*_{ig}\tau_{ig} m_{ig}}{R}\right)(\hat{p_{ig}} + \hat{m_{ig}}) \\ &+ \sum_s \sum_{g\in G_s} \sum_i \frac{p^*_{ig} m_{ig}}{R}(\hat{p_{ig}} + \hat{m_{ig}}) \frac{d\tau_{ig}}{1+\tau_{ig}} - \sum_s \sum_{g\in G_s} \sum_i \frac{p^*_{ig} m_{ig}}{R}\left(\frac{d\tau_{ig}}{1+\tau_{ig}}\right)^2,\end{aligned}$$

where, from the equilibrium in the market for each variety that results from combining (3) and (6), using the solution for $\hat{p_{ig}} + \hat{m_{ig}}$ we obtain:

$$\begin{aligned}\hat{R} = &\sum_s \sum_{g\in G_s} \sum_i \left(\tau_{ig} + \frac{d\tau_{ig}}{1+\tau_{ig}}\right) \frac{p^*_{ig} m_{ig}}{R} \frac{1+\omega^*}{1+\omega^*\sigma}\left(\hat{E}_s + (\kappa-1)\hat{P}_s + (\eta-\kappa)\hat{P}_{Ms} + (\sigma-\eta)\hat{p}_{gM}\right) \\ &+ \sum_s \sum_{g\in G_s} \sum_i \left(1 - \tau_{ig}\frac{\sigma-1}{1+\omega^*\sigma}\right) \frac{p^*_{ig} m_{ig}}{R} \frac{d\tau_{ig}}{1+\tau_{ig}} - \sum_s \sum_{g\in G_s} \sum_i \frac{p^*_{ig} m_{ig}}{R} \sigma \frac{1+\omega^*}{1+\omega^*\sigma}\left(\frac{d\tau_{ig}}{1+\tau_{ig}}\right)^2.\end{aligned} \tag{A.31}$$

B.3 Numerical Implementation

To implement the system (A.15)-(A.31) we first re-write it in reduced form as a system of the form $A\hat{x} - Bd\tau = 0$, where $\hat{x}$ is a column vector stacking all the endogenous variables, $d\tau$ stacks the U.S. and retaliatory tariff shocks, and the matrixes A and B collect all the elasticities and shares. The reduced-form of the system, giving the solution for endogenous variables as function of shocks, takes the form $\hat{x} = (A^{-1}B)\, d\tau$. We check numerically that the matrix A has full rank and that therefore the equilibrium in changes is uniquely defined. The vector x includes $1,020,045$ endogenous variables, hence the matrix A has 10^{12} elements. We exploit that the matrix A is very sparse, making this inversion computationally feasible and quick. The reason why 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 thousand correspond to the variety prices $\hat{p_{ig}}$, which only enter in the rows of A corresponding to import prices and tariff revenue.

B.4 Producer Price Increases under Perfect Pass-Through

When foreign export supply is perfectly elastic ($\omega = 0$), we can combine our previous solution for the increase in the producer price index from (A.19) with the price indexes (A.21) to (A.24) to

obtain the following decomposition of the change in producer prices in response to a tariff shock:

$$\hat{p_s} = \frac{1}{\Phi_s}\left(DomExpenditure_s + TariffShock_s + CostShock_s\right) \tag{A.32}$$

where

$$DomExpenditure_s \equiv \frac{P_{Ds}D_s}{p_sQ_s}\hat{E_s}$$

$$TariffShock_s \equiv \sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}}\frac{P_{Ds}D_s}{p_sQ_s}\left(1-\frac{P_{Ds}D_s}{E_s}\right)(\kappa-1)\left(\frac{p_{ig}m_{ig}}{P_{Ms}M_s}\right)\frac{d\tau_{ig}}{1+\tau_{ig}} - \sigma^*\sum_{g\in\mathcal{G}_s}\sum_{i\in\mathcal{I}}\frac{p_{Dg}x_{ig}}{p_sQ_s}\frac{d\tau^*_{ig}}{1+\tau^*_{ig}}$$

$$Cost_s \equiv \frac{\alpha_{I,s}}{\alpha_{K,s}}\hat{\phi}_s + \sum_{r\in\mathcal{R}}\frac{p_sQ_{sr}}{p_sQ_s}\frac{\alpha_{L,s}}{\alpha_{K,s}}\hat{w_{sr}}$$

$$\Phi_s \equiv \frac{1-\alpha_{K,s}}{\alpha_{K,s}} + \frac{P_{Ds}D_s}{p_sQ_s}\frac{P_{Ds}D_s}{E_s} + \frac{P_{Ds}D_s}{p_sQ_s}\left(1-\frac{P_{Ds}D_s}{E_s}\right)\kappa + \left(1-\frac{P_{Ds}D_s}{p_sQ_s}\right)\sigma^*$$

This decomposition highlights the multiple general-equilibrium effects on domestic producer prices taken into account when US 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 changes in the shares of different 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, leading to higher or lower domestic price increases. The third component shows that domestic prices change with costs, either through input linkages or wage increases in those regions where the sector is more concentrated. The intensity of these effects is mediated by the estimated elasticities σ^* and κ, entering directly through the tariff component and through the constant Φ_s. Neither σ or η enter in this calculation because $\omega = 0$. However, $\sigma$and η enter directly in our calculations of the tariff revenue increase as they determine the changes in imports, and indirectly because they affect our estimation of κ and η when we construct the instrument.

B.5 Correlates of County-Level Protection

Appendix Table A.5 shows a series of regression specifications in which we add controls to examine whether the inverted-U relationship between Republican (GOP) vote shares and tariff protection is robust. Column 1 replicates the figure with no controls and confirms that the quadratic relationship is statistically significant. Column 2 controls for county-level manufacturing and agriculture employment shares, and the inverted-U pattern continues to hold. Column 3 adds several demographic controls: share of unemployed workers, share with a college degree, share of the population that is white, and log mean household income. The quadratic relationship between protection and GOP vote share continues to hold, as it does in column 4 when we include quadratic terms for each control. In column 5, we control for pre-trends by including the 2013-16 changes in household income, the unemployment rate, and manufacturing and agriculture employment shares. The inverted-U pattern between import protection and a county GOP vote share remains.

Appendix Table A.6 repeats this exercise by exploring the relationship between retaliatiory tariffs and vote shares. Since the figure suggests a linear relationship with the GOP vote share, we

replicate this linear relationship in column 1 with no controls. Column 2 includes manufacturing and agriculture employment shares. The vote share now flips in sign and the coefficient on the agriculture employment share is large, positive and statistically significant (since these variables have the same scale, the coefficients are comparable). Column 3 adds additional demographic controls, column 4 adds pre-existing trends, and, for completeness, column 5 includes quadratic terms. The positive coefficient on the agriculture remains statistically significant. Based on these regressions, we conclude that foreign retaliations targeted agricultural counties, even after controlling for other county demographics and the political leanings in the 2016 election.

C Main Tables and Figures

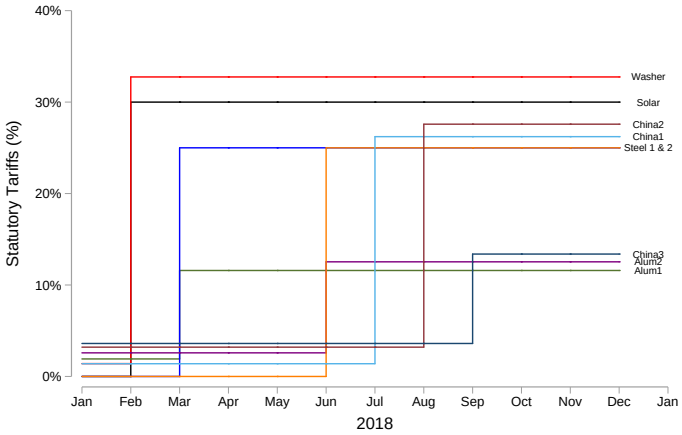
Table 1: The Global Trade War

Panel A: Tariffs on U.S. Imports Enacted by U.S. in 2018						
Tariff Wave	Date Enacted	Products	2017 Imports		Tariff (%)	
		(# HS10)	(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	33.9
Aluminum	Mar-Jun, 2018	65	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	1,668	33,510	1.4	1.2	26.2
China 2	Aug 23, 2018	429	14,101	0.6	2.7	27.6
China 3	Sep 24, 2018	9,076	199,264	8.3	3.4	13.4
Total		**12,007**	**302,970**	**12.6**	**2.6**	**17.0**
Panel B: Retaliatory Tariffs on U.S. Exports Enacted by Trading Partners in 2018						
Retaliating Country	Date Enacted	Products	2017 Exports		Tariff (%)	
		(# HS10)	(mil USD)	(%)*	2017	2018
China	Apr-Sep, 2018	1,997	60,522	3.9	7.8	22.7
Mexico	Jun 5, 2018	232	6,746	0.4	9.5	27.4
Turkey	Jun 21, 2018	240	1,554	0.1	9.9	30.1
European Union	Jun 22, 2018	303	8,244	0.5	4.0	29.3
Canada	Jul 1, 2018	323	17,818	1.2	2.1	20.1
Russia	Aug 6, 2018	162	268	0.0	5.0	36.7
Total		**3,135**	**96,045**	**6.2**	**6.5**	**23.3**

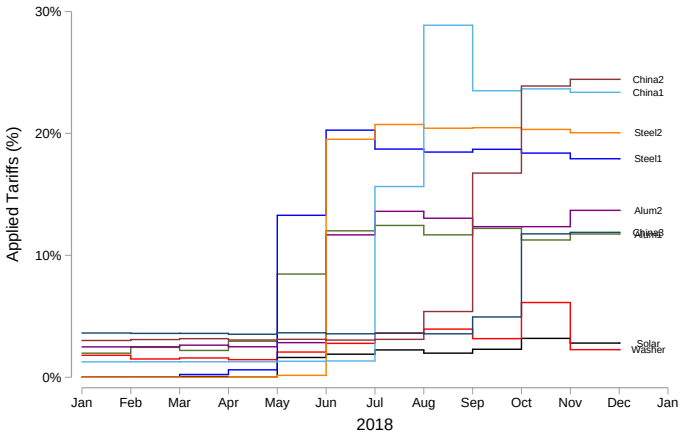
Notes: Denominator for import (export) share is the total 2017 annual USD value of all US imports (exports). Panels display unweighted monthly HS10-country average statutory tariff rates. The 2018 rates are computed using the post-tariff increase period. The total tariff rates row is computed as the trade-weighted average of table values. The US government announced import tariffs on aluminum and steel products on March 23 but granted exemptions for Canada, Mexico, and the European Union; those exemptions were lifted on June 1. The dates of Chinese retaliations are: April 6, July 2, August 23, and September 24. See text for data sources.

Figure 1: Tariff Timeline

Panel A: U.S. Statutory Import Tariffs



Panel B: U.S. Applied Import Tariffs



Panel C: Trade Partners Retaliatory Export Tariffs

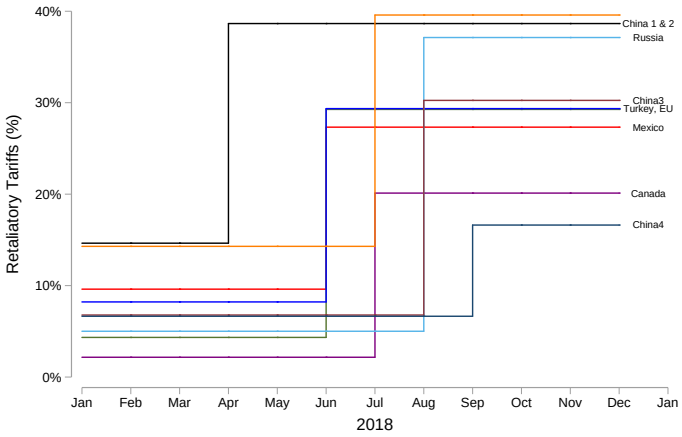
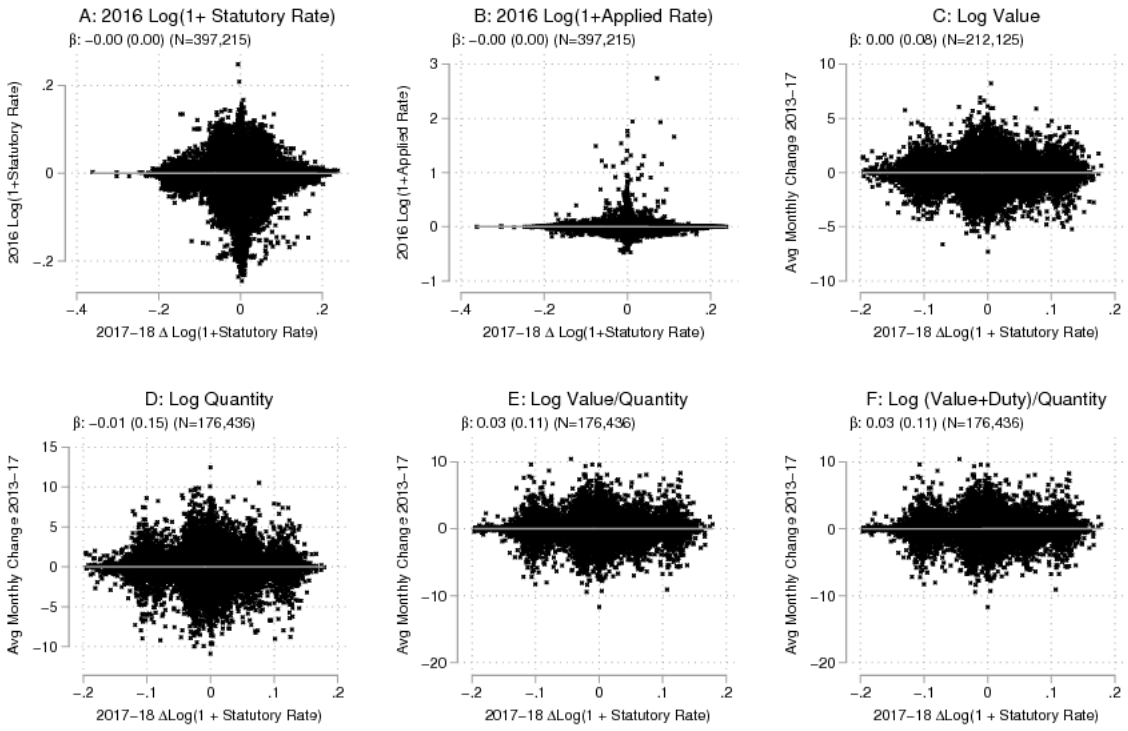


Table 2: Sectoral Variation in Tariff Rate Changes

Tariff Changes for Targeted Import Varieties and Export Products, by NAICS3 Code								
		Imports				Exports		
				Δ Statutory τ			Δ Retaliatory τ	
Sector	NAICS-3	# Varieties	# HS10	Mean	STD	# HS10	Mean	STD
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Crop and Animal Production	111-2	111	111	0.10	0.01	83	0.23	0.06
Forestry and Logging	113	14	14	0.10	0.00	11	0.20	0.07
Fishing, Hunting and Trapping	114	145	145	0.10	0.00	75	0.25	0.00
Oil and Gas Extraction	211	4	4	0.10	0.00	3	0.25	0.00
Mining (except Oil and Gas)	212	47	47	0.10	0.00	5	0.20	0.08
Food	311	363	363	0.10	0.01	176	0.22	0.06
Beverage and Tobacco Product	312	10	10	0.09	0.03	31	0.25	0.04
Textile Mills	313	916	916	0.10	0.00	6	0.25	0.00
Textile Product Mills	314	146	146	0.10	0.02	10	0.23	0.05
Apparel	315	91	91	0.10	0.00	42	0.25	0.00
Leather and Allied Product	316	134	134	0.10	0.00	17	0.23	0.05
Wood Product	321	259	259	0.10	0.00	35	0.11	0.03
Paper	322	207	207	0.11	0.04	69	0.16	0.07
Printing and Related Activites	323	14	14	0.10	0.00	19	0.18	0.08
Petroleum and Coal Products	324	24	24	0.14	0.07	32	0.24	0.04
Chemical	325	1,167	1,167	0.11	0.04	289	0.17	0.08
Plastics and Rubber Products	326	236	236	0.15	0.07	40	0.15	0.09
Nonmetallic Mineral Product	327	314	314	0.10	0.03	26	0.25	0.03
Primary Metal	331	6,607	987	0.22	0.06	245	0.23	0.04
Fabricated Metal Product	332	728	567	0.12	0.06	84	0.25	0.05
Machinery	333	1,112	1,112	0.20	0.07	198	0.14	0.08
Computer and Electronic Product	334	717	535	0.21	0.07	149	0.12	0.05
Electrical Equipment and Appliances	335	488	386	0.19	0.10	57	0.21	0.06
Transportation Equipment	336	272	272	0.14	0.07	117	0.21	0.07
Furniture and Related Product	337	144	144	0.10	0.01	15	0.23	0.05
Miscellaneous	339	96	96	0.12	0.05	43	0.21	0.07

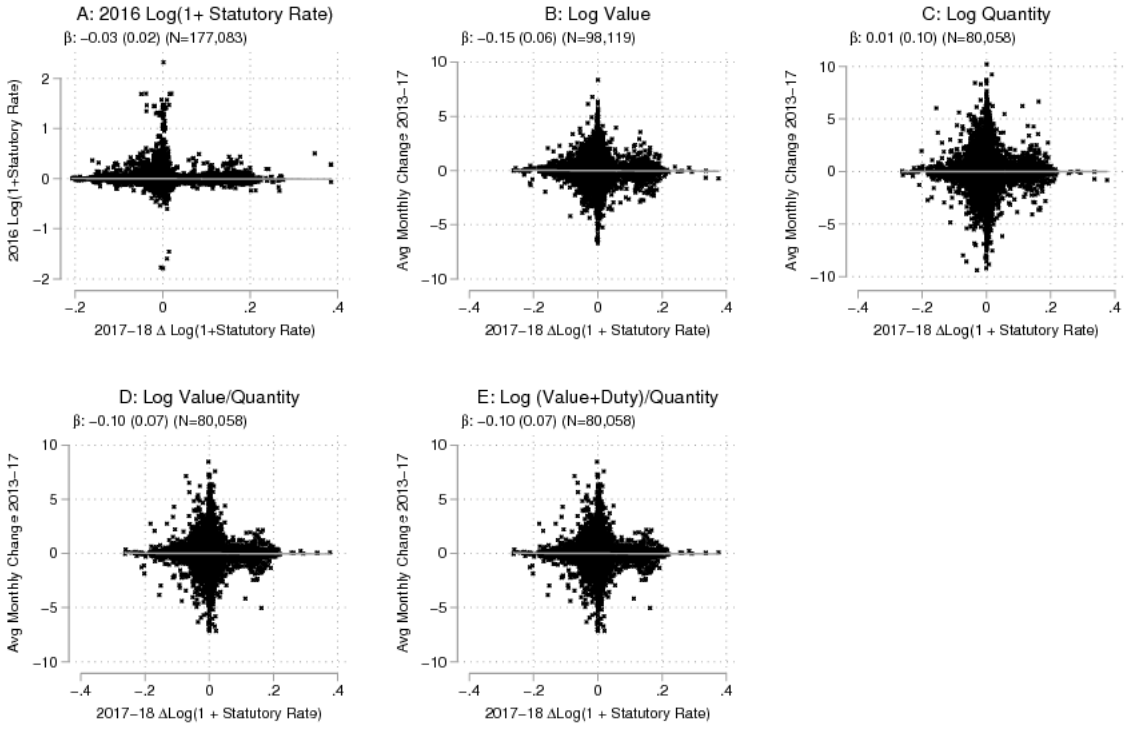
Notes: Table shows the mean and standard deviation of tariff rate increases for all tariff measures across 3-digit NAICS sectors. A 0.10 means 10% change. Sectors with the same number of targeted varieties and products in Columns 3 and 4 reflect tariffs solely targeting Chinese imports.

Figure 2: Pre-Trends and Statutory Import Tariffs (Imports)



Figures plot (residuals of) variety-level outcomes against (residuals of) change in statutory tariffs, controlling for product and country-sector fixed effects. Outcomes in Panels A-D are average monthly changes from 2013/1-2017/12. Outcome in Panel E is the pre-war 2016 statutory tariff rate. Standard errors clustered by HS8 and country

Figure 3: Pre-Trends and Retaliatory Export Tariffs (Exports)



Figures plot (residuals of) variety-level outcomes against (residuals of) change in statutory tariffs, controlling for product and country-sector fixed effects. Outcomes in Panels A-D are average monthly changes from 2013/1-2017/12. Outcome in Panel E is the pre-war 2016 statutory tariff rate. Standard errors clustered by HS6 and country

Figure 4: Event Study: Tariff Changes

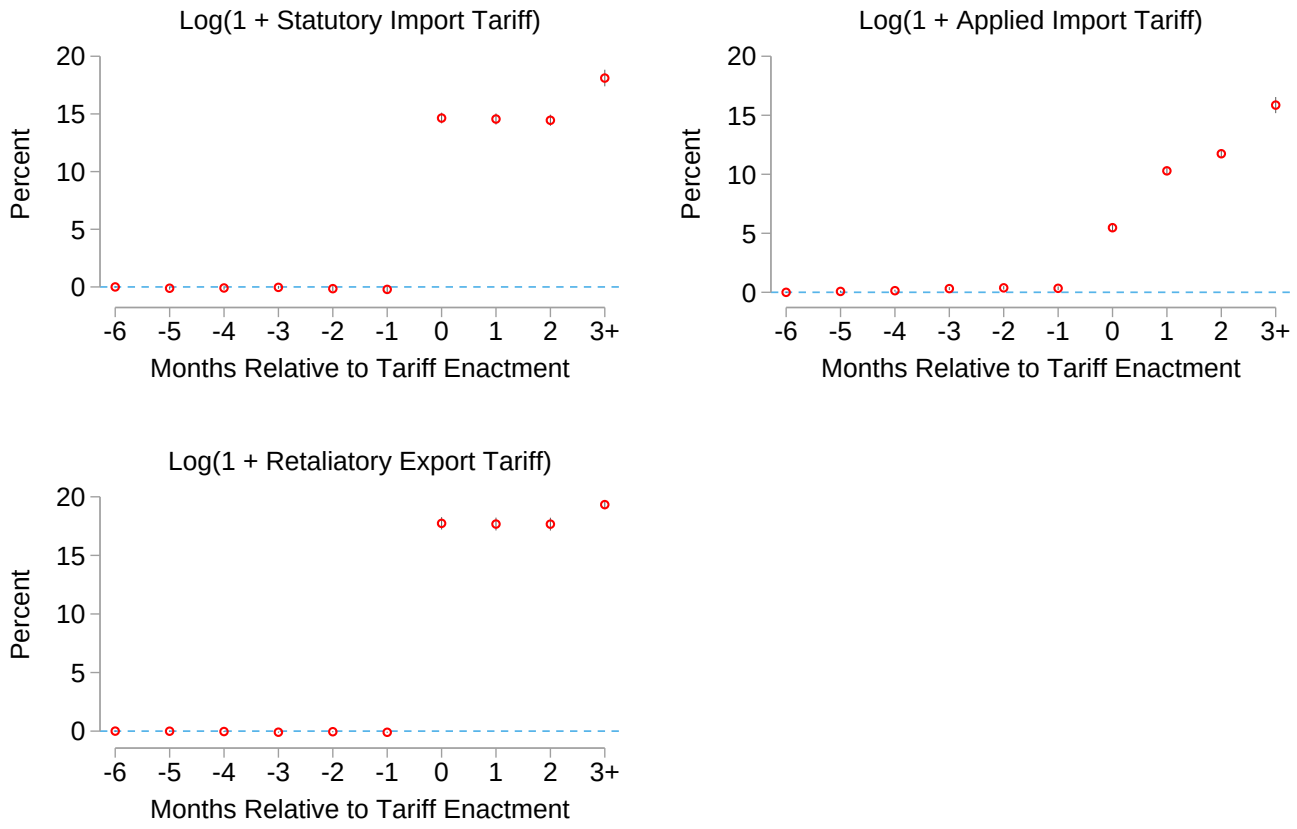


Figure plots event time dummies for targeted products relative to exempt and all other products. Regressions include variety and time fixed effects. Standard errors clustered by HS8 for imports and HS6 for exports. Error bars show 95% CIs. Event periods before -6 are dropped, and event periods >=3 are binned.

Figure 5: Event Study: Import Outcomes

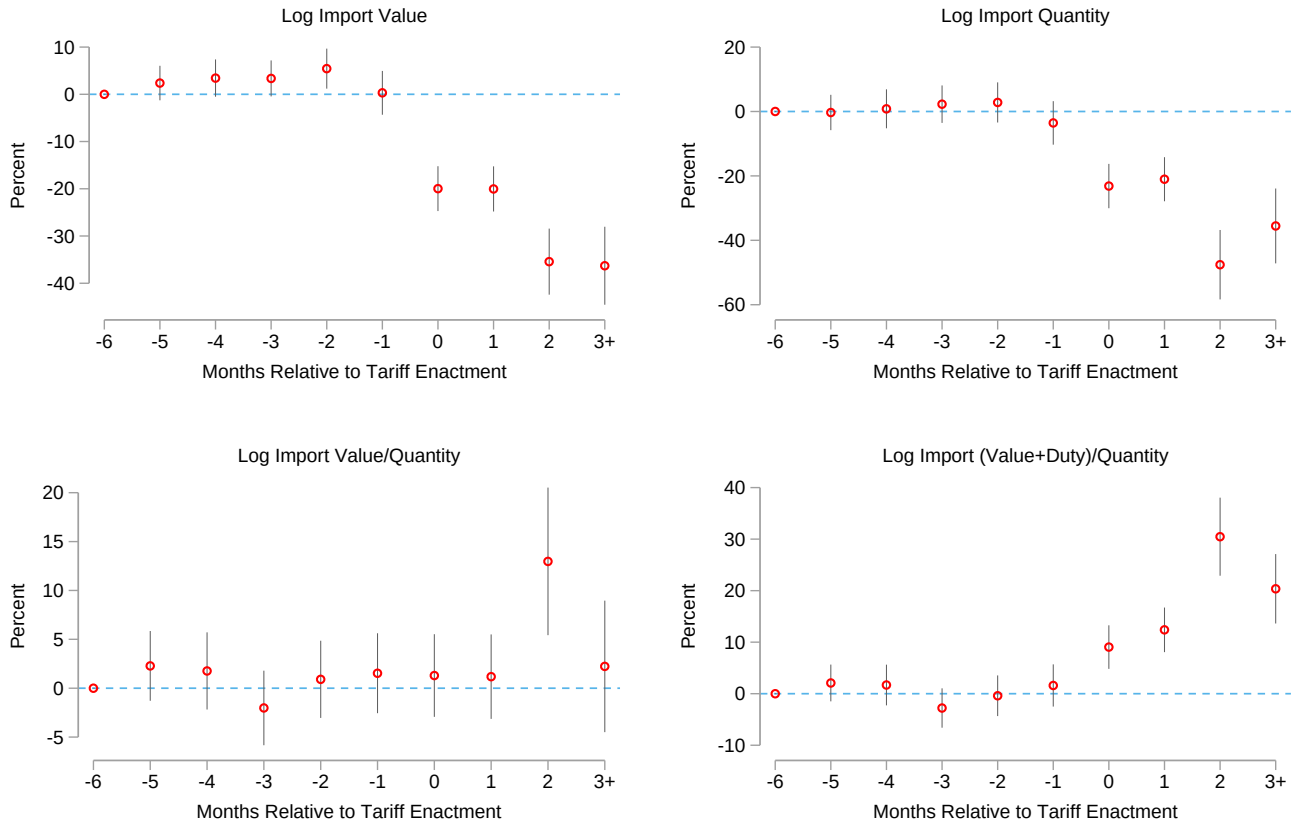


Figure plots event time dummies for targeted products relative to all other products. Regressions include country-product, product-time, and country-time fixed effects. Standard errors clustered by hs8. Error bars show 95% CIs. Event periods before -6 are dropped, and event periods >=3 are binned.

Figure 6: Event Study: Export Outcomes

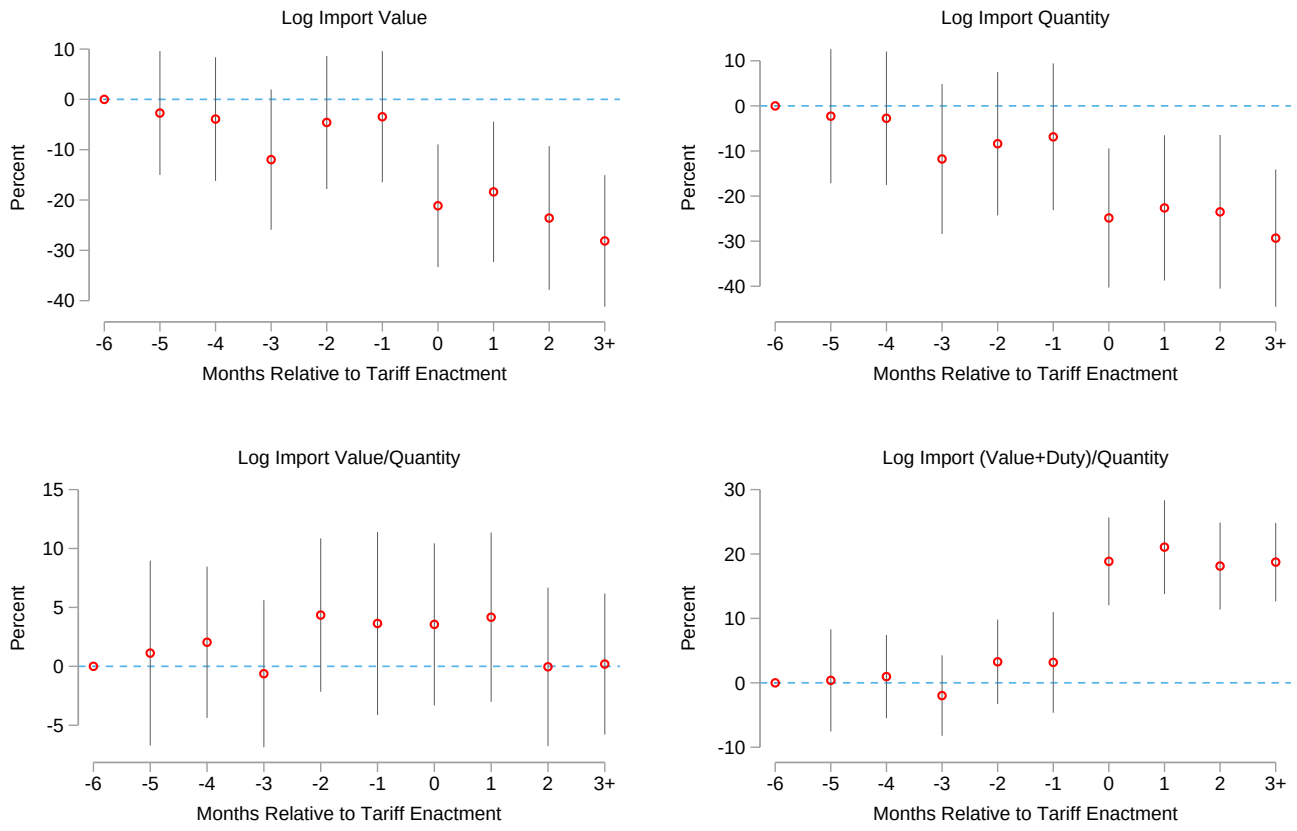


Figure plots event time dummies for targeted products relative to all other products. Regressions include country-product, product-time, and country-time fixed effects. Standard errors clustered by hs6. Error bars show 95% CIs. Event periods before -6 are dropped, and event periods >=3 are binned.

Figure 7: Event Study: Sector Outcomes

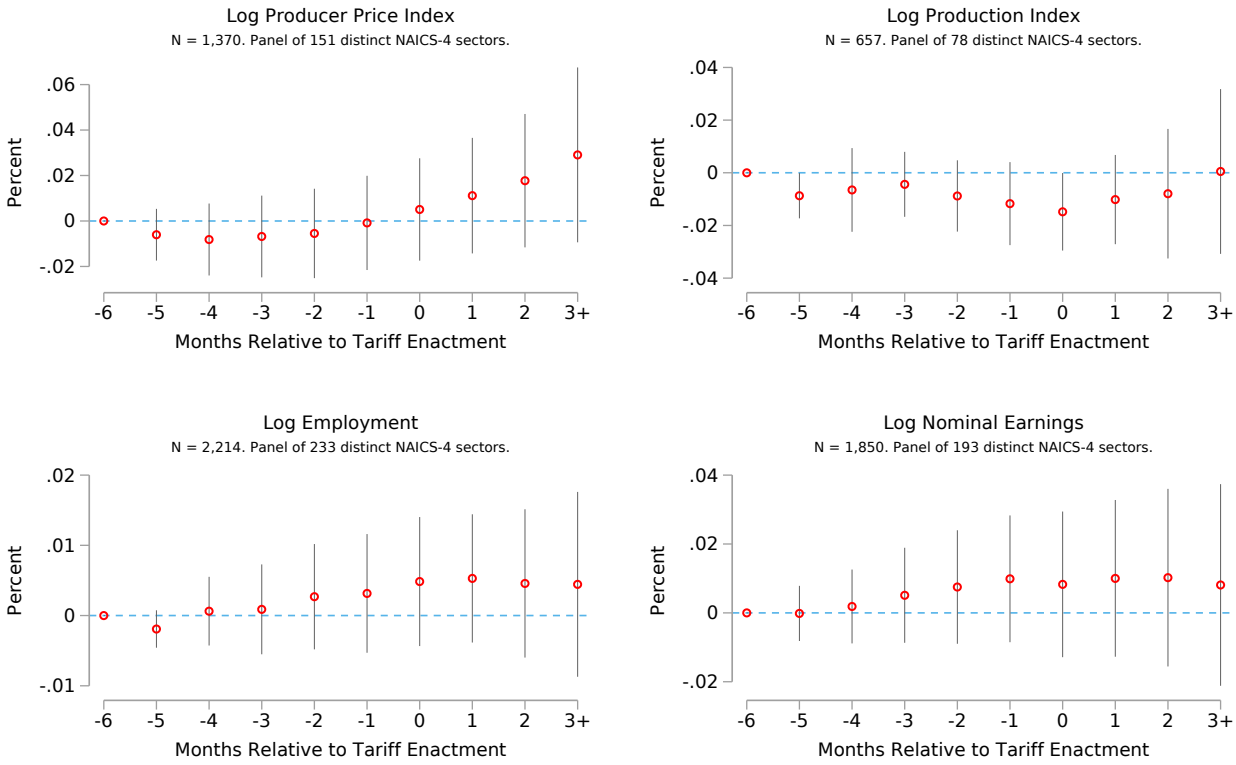


Figure plots event time dummies for a panel of NAICS4 sectors. Regressions include NAICS4 and NAICS2-time fixed effects. Standard errors clustered by NAICS4. Error bars show 95% CIs. Event periods before -6 are dropped, and event periods >=3 are binned.

Table 3: Variety Import Demand (σ) and Foreign Export Supply (σ),

	(1) $\Delta \ln m_{igt} p^*_{igt}$	(2) $\Delta \ln m_{igt}$	(3) $\Delta \ln p^*_{igt}$	(4) $\Delta \ln p^*_{igt}(1+\tau_{igt})$	(5) $\Delta \ln m_{igt}$	(6) $\Delta \ln m_{igt}$
$\Delta \ln(1+\tau_{igt})$	-2.45***	-2.53***	0.09**	1.09***		
	(0.08)	(0.09)	(0.04)	(0.04)		
$\Delta \ln p^*_{igt}$					-28.71***	
					(11.01)	
$\Delta \ln p^*(1+\tau_{igt})$						-2.32***
						(0.07)
product × time FE	yes	yes	yes	yes	yes	yes
cty × time FE	yes	yes	yes	yes	yes	yes
cty × sector FE	yes	yes	yes	yes	yes	yes
variety FE	no	no	no	no	no	no
1st-stage F					6.2	942.0
$\hat{\omega}$ (se[$\hat{\omega}$])					-0.03 (0.01)	
$\hat{\sigma}$ (se[$\hat{\sigma}$])						2.32 (0.07)
r2	0.14	0.13	0.11	0.11	.	.
obs	2,441,121	1,980,198	1,980,198	1,980,198	1,980,198	1,980,198

Notes: Columns 1-4 report the reduced-form outcomes of import values, quantities, unit values, and duty-inclusive unit values regressed on $\Delta \ln(1+\tau_{igt})$, where τ_{igt} is the applied tariff; see equation (12). Column 5 reports the foreign export supply curve IV regression, equation (11); the first-stage is column 3. Column 6 reports the import demand curve IV regression, equation (10); the first-stage is column 4. The implied $\hat{\omega}$ and $\hat{\sigma}$ and their standard errors are reported at the bottom of the table. All regressions include product-time, country-time and country-sector fixed effects. Standard errors clustered by country and product. Significance: * 0.10, ** 0.05, *** 0.01.

Table 4: Applied Tariffs Instrumented with Statutory Tariffs

	(1) $\Delta(1+\ln\tau_{igt})$	(2) $\Delta\ln m_{igt}p^*_{igt}$	(3) $\Delta\ln m_{igt}$	(4) $\Delta\ln p^*_{igt}$	(5) $\Delta\ln p^*_{igt}(1+\tau_{igt})$	(6) $\Delta\ln p^*_{igt}$	(7) $\Delta\ln p^*_{igt}(1+\tau_{igt})$	(8) $\Delta\ln m_{igt}$	(9) $\Delta\ln m_{igt}$
$\Delta\ln(1+\tau^{stat}_{igt})$	0.61***					0.02	0.60***		
	(0.07)					(0.08)	(0.13)		
$\Delta\ln(1+\tau_{igt})$		-2.49***	-2.57***	0.04	1.04***				
		(0.15)	(0.24)	(0.14)	(0.14)				
$\Delta\ln p^*_{igt}$								-64.44	
								(222.28)	
$\Delta\ln p^*(1+\tau_{igt})$									-2.47***
									(0.26)
product × time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
cty × time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
cty × sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
variety FE	no	no	no	no	no	no	no	no	no
1st-stage F		80.3	76.8	76.8	76.8			0.1	20.8
$\hat{\omega}$ (se[$\hat{\omega}$])								-0.02 (0.05)	
$\hat{\sigma}$ (se[$\hat{\sigma}$])									2.47 (0.26)
r2	0.15	0.01	0.01	0.00	0.00	0.11	0.11	.	.
obs	2,441,121	2,441,121	1,980,198	1,980,198	1,980,198	1,980,198	1,980,198	1,980,198	1,980,198

Notes: Column 1 reports the first stage of the applied tariff, $\Delta\ln(1+\tau_{igt})$, on the statutory tariff, $\Delta\ln(1+\tau^{stat}_{igt})$. Columns 2-5 shows the second-stage results of import values, quantities, unit values, and duty-inclusive unit values regressed on the instrumented applied tariff. Columns 5 and 6 regress unit values and duty-inclusive unit values on the statutory tariff, respectively. Columns 7 reports the foreign export supply curve IV regression, equation (11), using statutory tariffs as the instrument (the first stage is column 5). Columns 8 reports the import demand curve IV regression, equation (10), using statutory tariffs as the instrument (the first stage is column 6). The implied $\hat{\omega}$ and $\hat{\sigma}$ and their standard errors are reported at the bottom of the table in columns 7 and 8. All regressions include product-time, country-time and country-sector fixed effects. Standard errors clustered by country and product. Significance: * 0.10, ** 0.05, *** 0.01.

Table 5: Product Elasticity η

	(1) $\Delta \ln(s^m_{gMt})$	(2) $\Delta \ln p^*_{gMt}$	(3) $\Delta \ln(s^m_{gMt})$	(4) $\Delta \ln(s^m_{gMt})$	(5) $\Delta \ln p^*_{gMt}$	(6) $\Delta \ln(s^m_{gMt})$
$\Delta \ln Z_{gMt}$	-0.68***	0.28***				
	(0.09)	(0.09)				
$\Delta \ln p^*_{gMt}$			-2.25***			-0.81*
			(0.71)			(0.48)
$\Delta \ln Z^{stat}_{gMt}$				-0.77**	0.62*	
				(0.39)	(0.36)	
sector-time FE	yes	yes	yes	yes	yes	yes
product FE	no	no	no	no	no	no
1st-stage F			10.9			6.5
$\hat{\eta}$ (se[$\hat{\eta}$])			3.25 (0.71)			1.81 (0.48)
r2	0.01	0.06	.	0.01	0.07	.
obs	301,882	317,716	301,882	301,882	317,716	301,882

Notes: Columns 1-3 build the price index using the $\hat{\sigma}$ from column 6 of Table 3 and constructs the instrument using applied tariffs. Column 1 reports the reduced form, column 2 reports the first stage, and column 3 reports the second stage. Columns 4-6 repeats the analysis using a price index constructed from $\hat{\sigma}$ from column 9 of Table 4 and an instrument constructed from the statutory tariffs. The implied $\hat{\eta}$ and its standard error are noted at the bottom of the table in columns 3 and 6. All regressions include sector and time fixed effects. Standard errors clustered by product. Significance: * 0.10, ** 0.05, *** 0.01.

Table 6: Sector Elasticity κ

	(1) $\Delta \ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$	(2) $\Delta \ln\left(\frac{P_{Mst}}{p^P_{st}}\right)$	(3) $\Delta \ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$	(4) $\Delta \ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$	(5) $\Delta \ln p^*_{gMt}$	(6) $\Delta \ln(\frac{P_{Mst}M_{st}}{P_{Dst}D_{st}})$
$\Delta \ln Z_{Mst}$	1.95**	-1.92				
	(0.85)	(1.16)				
$\Delta \ln\left(\frac{P_{Mst}}{p^P_{st}}\right)$			-0.93			-1.09
			(0.89)			(0.82)
$\Delta \ln Z^{stat}_{Mst}$				1.23	-0.75	
				(0.80)	(0.67)	
sector FE	yes	yes	yes	yes	yes	yes
1st-stage F			2.0			3.1
$\hat{\kappa}$ (se[$\hat{\kappa}$])			1.93 (0.89)			2.09 (0.82)
r2	0.01	0.55	.	0.00	0.55	.
obs	1,647	2,332	1,647	1,647	2,332	1,647

Notes: Columns 1-3 build the price index using the $\hat{\sigma}$ from column 6 of Table 3 and $\hat{\eta}$ from column 3 of Table 5. The instrument is constructed using applied tariffs. Column 1 reports the reduced form, column 2 reports the first stage, and column 3 reports the second stage. Columns 4-6 repeats the analysis using a price index constructed from $\hat{\sigma}$ from column 9 of Table 4 and $\hat{\eta}$ from column 6 of Table 5, and an instrument constructed from the statutory tariffs. The implied $\hat{\kappa}$ and its standard error are noted at the bottom of the table in columns 3 and 6. All regressions include sector fixed effects. Standard errors clustered by sector. Significance: * 0.10, ** 0.05, *** 0.01.

Table 7: Foreign Import Demand σ^*

	(1) $\Delta \ln x_{igt} p_{igt}$	(2) $\Delta \ln x_{igt}$	(3) $\Delta \ln p_{igt}$	(4) $\Delta \ln p_{igt}(1+\tau^*_{igt})$	(5) $\Delta \ln x_{igt}$
$\Delta \ln(1+\tau^*_{igt})$	-0.89***	-0.73**	-0.12	1.02***	
	(0.25)	(0.34)	(0.13)	(0.13)	
$\Delta \ln p(1+\tau^*_{igt})$					-0.72**
					(0.30)
product × time FE	yes	yes	yes	yes	yes
cty × time FE	yes	yes	yes	yes	yes
cty × sector FE	yes	yes	yes	yes	yes
variety FE	no	no	no	no	no
1st-stage F					61.0
$\hat{\sigma}^*$ (se[$\hat{\sigma}^*$])					0.72 (0.30)
r2	0.07	0.07	0.06	0.06	0.46
obs	2,703,423	2,069,922	2,069,922	2,069,922	2,069,922

Notes: Columns 1-4 report reduced form regressions of export values, quantities, unit values, and duty-inclusive unit values on $\Delta \ln(1+\tau^{*,stat}_{igt})$, the change in retaliatory export tariffs. Column 5 reports the second-stage IV regression of quantities on the retaliatory tariffs (the first stage is column 4). The implied $\hat{\sigma}^*$ and its standard error are reported at the bottom of the table in column 5. All regressions include product-time, country-time and country-sector fixed effects. Standard errors clustered by country and six-digit HS code. Significance: * 0.10, ** 0.05, *** 0.01.

Figure 8: Dynamic Impacts: Imports

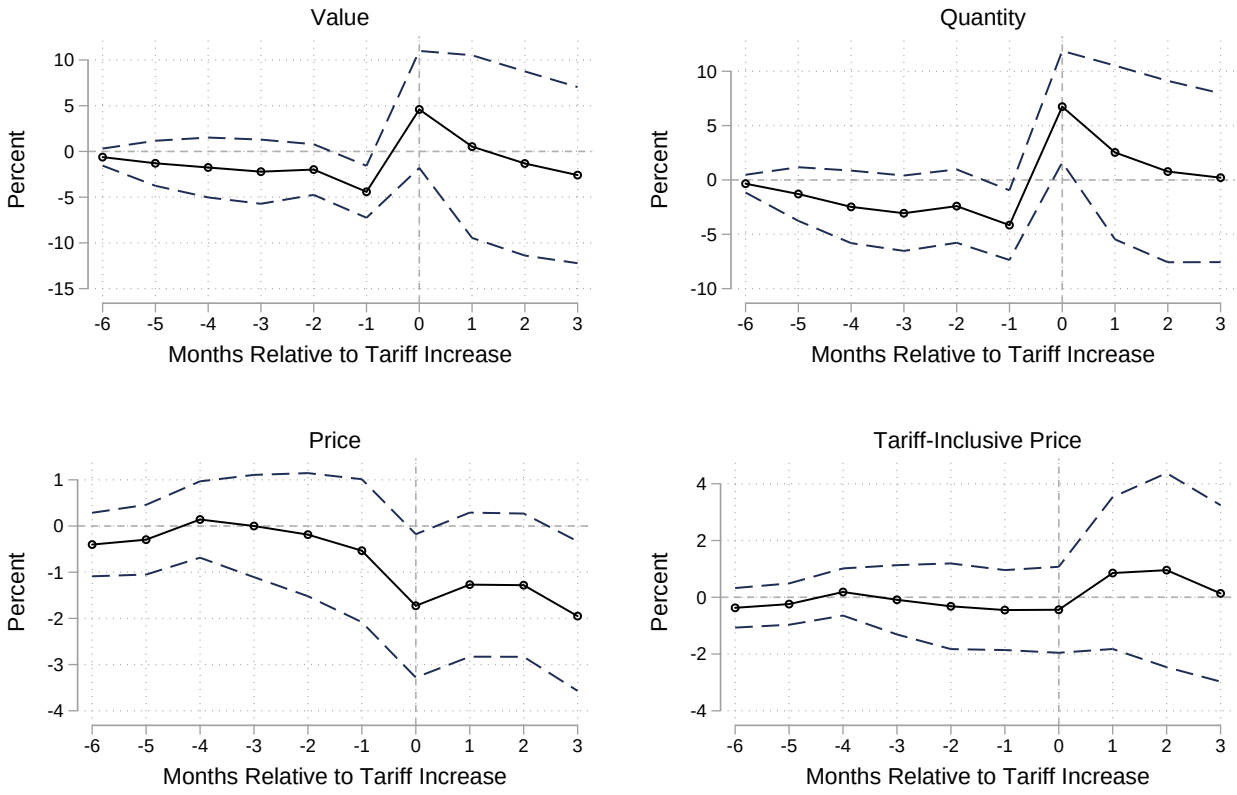


Figure plots IV regressions of changes in each outcome on leads and lags of changes in the applied import tariff rate, instrumented with the statutory rate. Regressions include product-time and country-sector-time fixed effects. Standard errors clustered by product and country. Error bands show 95% CIs. Event periods <-6 or >3 are dropped.

Figure 9: Dynamic Impacts: Exports

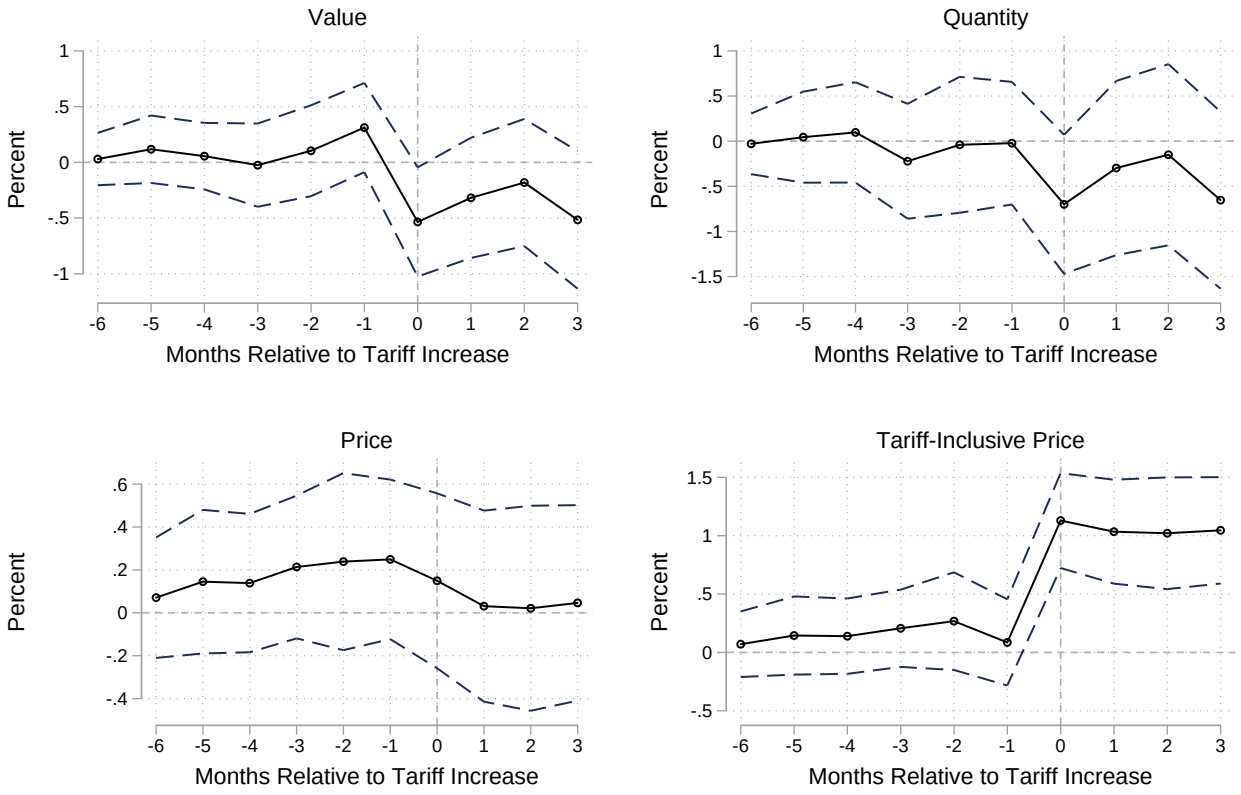


Figure plots reduced form regressions of changes in each outcome on leads and lags of changes in the statutory export tariff rate. Regressions include product-time and country-sector-time fixed effects. Standard errors clustered by product and country. Error bands show 95% CIs. Event periods <-6 or >3 are dropped.

Table 8: Aggregate Impacts

	EV^M	ΔR	EV^X	EV
	(1)	(2)	(3)	(4)
	Full War			
Change ($ bil)	-68.8	39.4	23.0	-6.4
Change (% GDP)	-0.37	0.21	0.12	-0.03
Change ($ capita)	-213	122	71	-20
	No Retaliation			
Change ($ bil)	-68.8	39.6	27.2	-2.0
Change (% GDP)	-0.37	0.21	0.15	-0.01
Change ($ capita)	-213	122	84	-6

Notes: Table reports the aggregate impacts of the trade war in column 4, and the decomposition into EV^M, tariff revenue (R) and EV^X in columns 1-3. The bottom panel reports 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 second row scales by 2016 GDP. The third row scales by 2016 population. These numbers are computed using the model described in Section 5 and sets $\{\hat{\sigma} = 2.47, \hat{\eta} = 1.81, \hat{\kappa} = 2.09, \hat{\omega}^* = 0, \hat{\sigma}^* = .72\}$.

Figure 10: Regional Variation in U.S. and Retaliatory Tariffs

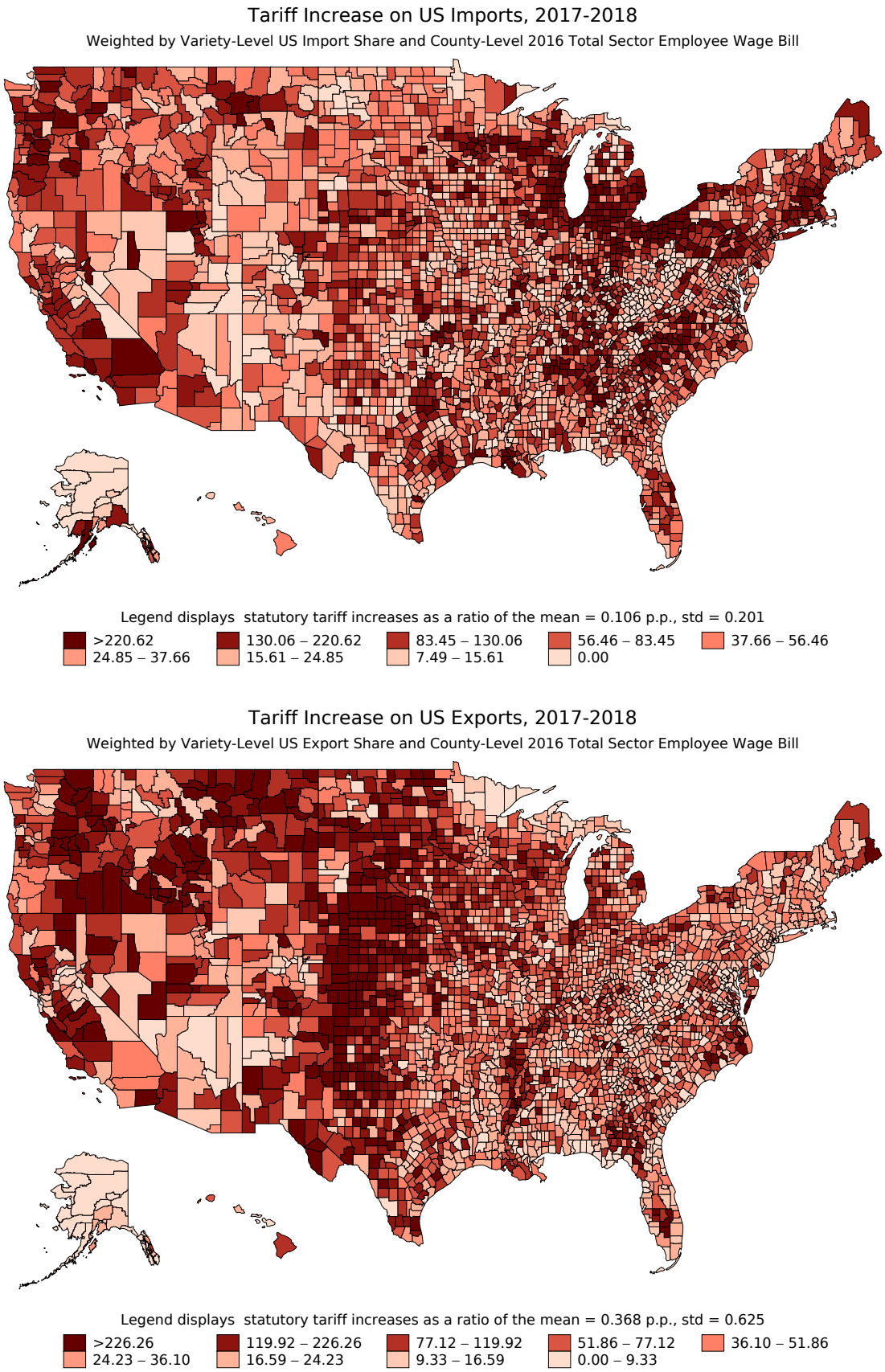


Figure 11: Real Tradeable Wages in Model-Based Counterfactuals of the Trade War

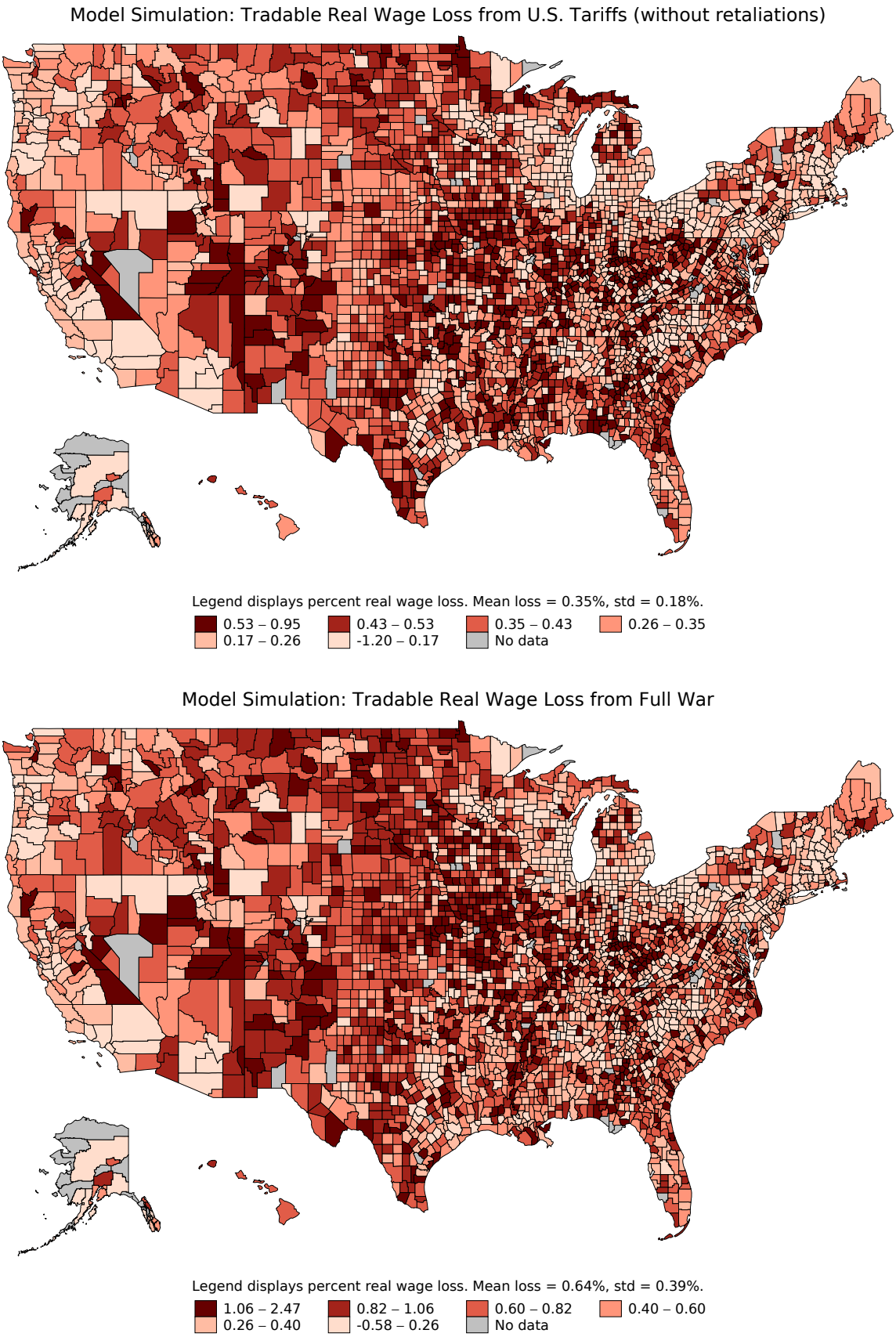
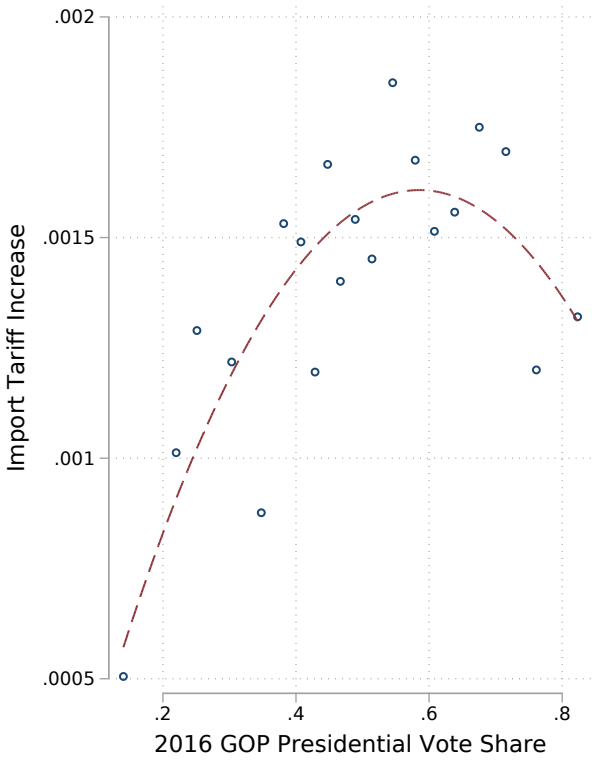
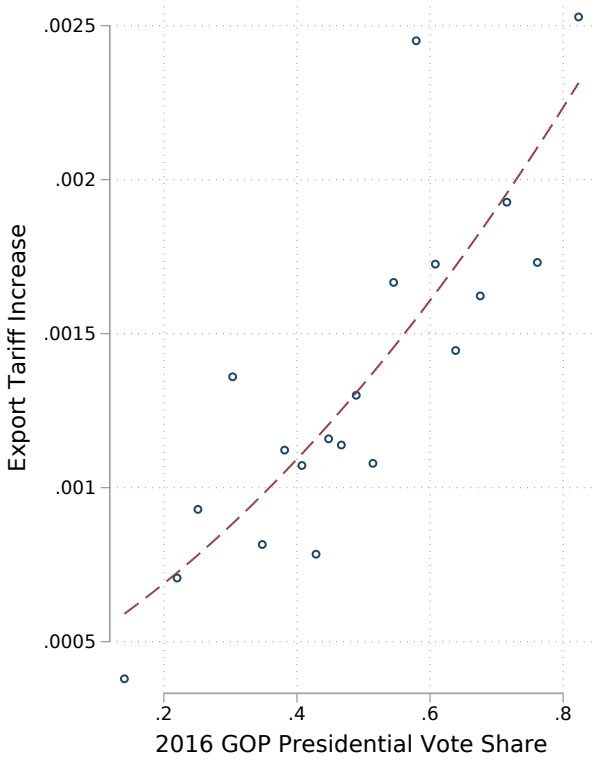


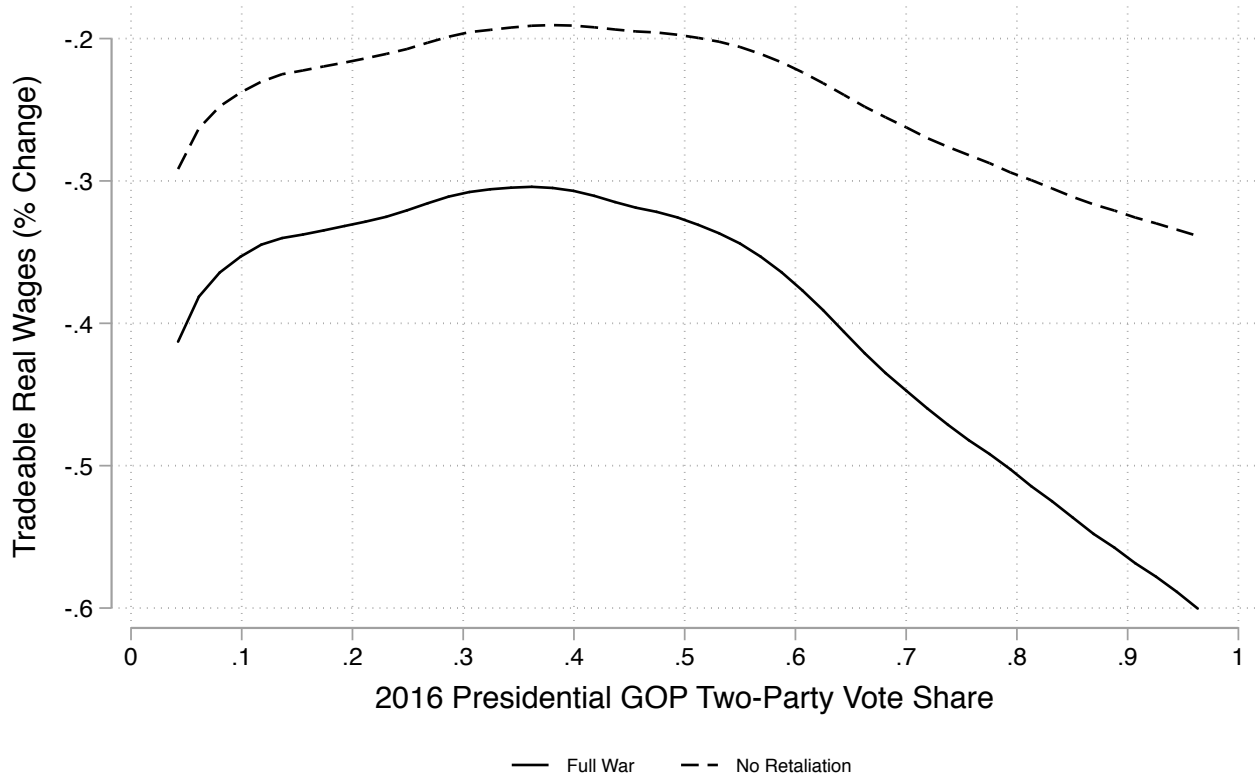
Figure 12: 2017-18 Tariff Changes vs. 2016 Republican Vote Share





Binscatter of N = 3145 U.S. counties. Population-weighted quadratic fit.

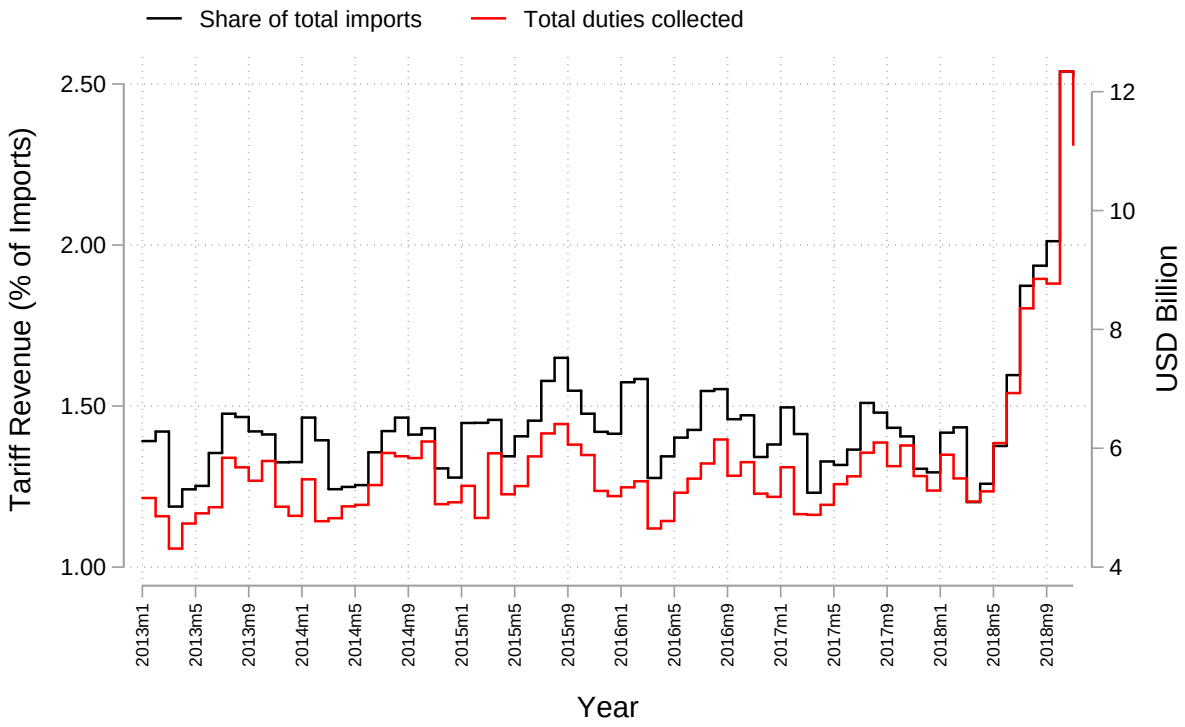
Figure 13: Impacts on Tradeable Real Wages and GOP Shares



Non-parametric curves weighted by 2016 county population.

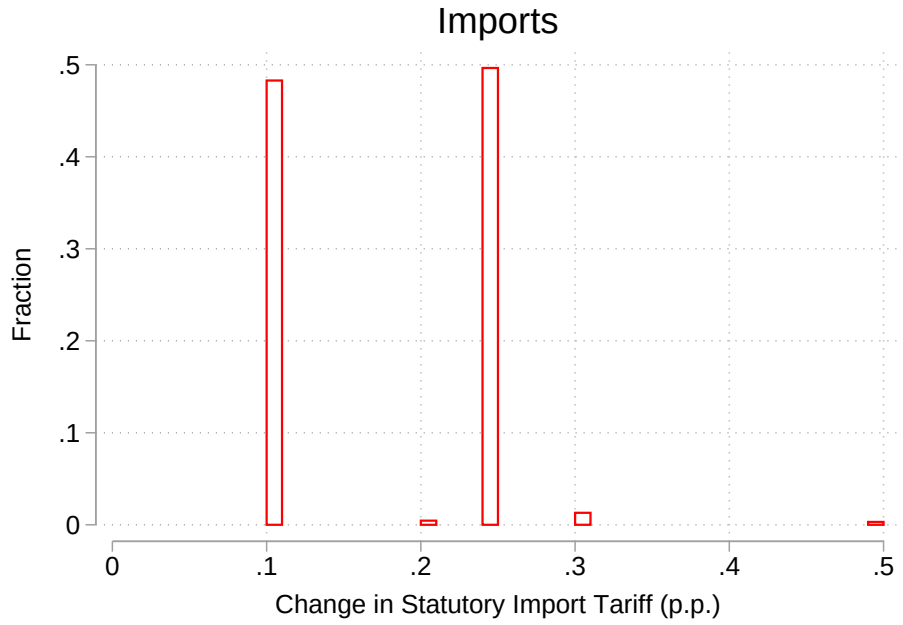
D Appendix Tables and Figures

Figure A.1: Tariff Revenue Collected

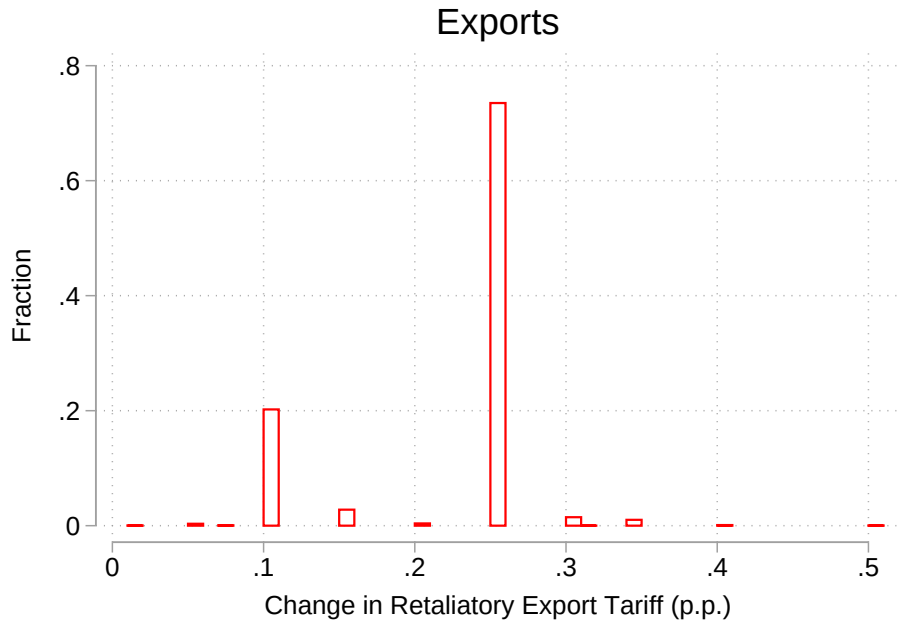


Total tariff revenue collected in 2016, 2017 and 2018 from Jan-Nov is $59.4 billion, $60.7 billion, and $84.2 billion, respectively.

Figure A.2: Statutory Tariff Changes



On average, tariffs on targeted varieties increase 17.9 p.p., or a 15.5% increase in Δlog(1 + tariff).



On average, tariffs on targeted varieties increase 21.8 p.p., or a 18.3% increase in Δlog(1 + tariff).

Plots show the distribution of tariff changes from Jan 2018 to Nov 2018 due to the trade war.

Figure A.3: Political Contributions and Statutory Tariff Changes

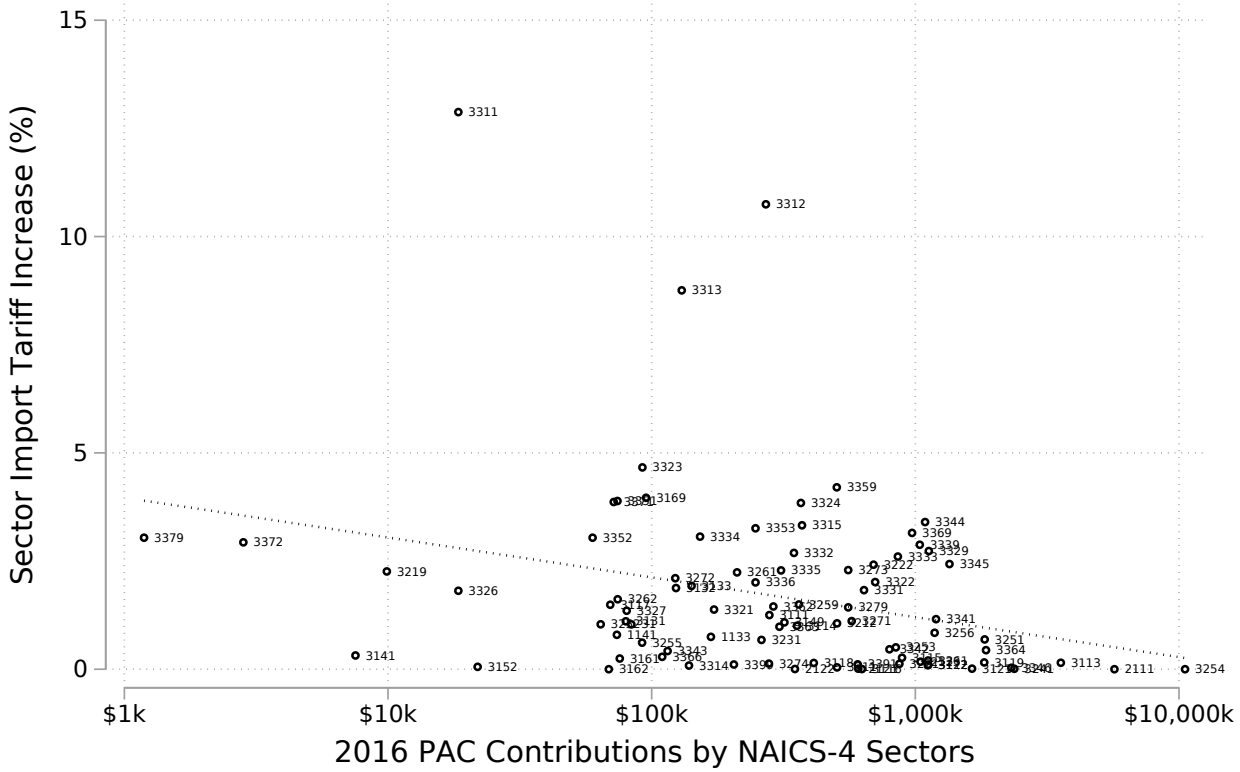
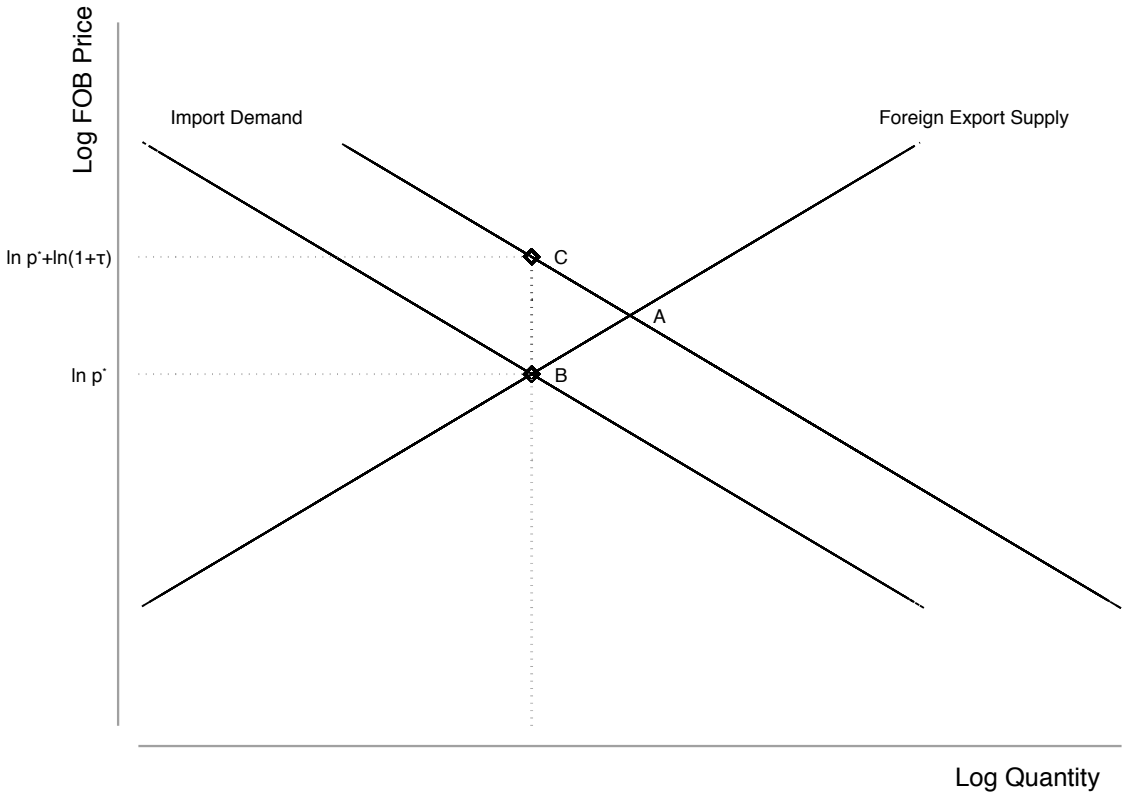


Figure plots 2016 financial campaign contributions against tariff changes at the sector level. Campaign contributions are measured using legal disclosure data compiled by the Center for Responsive Politics and cover contributions to candidates for the U.S. House of Representatives during the 2016 election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

Figure A.4: Identification of Import Demand and Foreign Export Supply



A denotes the pre-tariff equilibrium. If the tariff increases, import demand falls.
B denotes the price the exporter receives. C denotes the price the importer pays. The government collects the tariff.

Table A.1: Import Demand (σ) and Foreign Export Supply (σ), Applied Tariffs and Trends

	(1) $\Delta \ln m_{igt} p^*_{igt}$	(2) $\Delta \ln m_{igt}$	(3) $\Delta \ln p^*_{igt}$	(4) $\Delta \ln p^*_{igt}(1+\tau_{igt})$	(5) $\Delta \ln m_{igt}$	(6) $\Delta \ln m_{igt}$
$\Delta \ln(1+\tau_{igt})$	-2.46***	-2.54***	0.09***	1.09***		
	(0.08)	(0.09)	(0.03)	(0.03)		
$\Delta \ln p^*_{igt}$					-28.18***	
					(10.14)	
$\Delta \ln p^*(1+\tau_{igt})$						-2.33***
						(0.07)
product × time FE	yes	yes	yes	yes	yes	yes
cty × time FE	yes	yes	yes	yes	yes	yes
cty × sector FE	yes	yes	yes	yes	yes	yes
variety FE	yes	yes	yes	yes	yes	yes
1st-stage F					7.0	1022.5
$\hat{\omega}$ (se[$\hat{\omega}$])					-0.04 (0.01)	
$\hat{\sigma}$ (se[$\hat{\sigma}$])						2.33 (0.07)
r2	0.17	0.17	0.15	0.15	.	.
obs	2,405,233	1,949,262	1,949,262	1,949,262	1,949,262	1,949,262

Notes: Columns 1-4 report the reduced-form outcomes of import values, quantities, unit values, and duty-inclusive unit values regressed on $\Delta \ln(1+\tau_{igt})$, where τ_{igt} is the applied tariff. Column 5 reports the second-stage IV regression of import quantities on unit values (the first stage is column 3). Column 6 reports the second-stage IV regression of import quantities on duty-inclusive unit values (the first-stage regression is column 4). The implied $\hat{\omega}$ and $\hat{\sigma}$ and their standard errors are reported at the bottom of the table. All regressions include variety, product-time, country-time and country-sector fixed effects. Standard errors clustered by country and product. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.2: Import Demand (σ) and Foreign Export Supply (σ), Statutory Tariffs and Trends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	$\Delta(1+\ln\tau_{igt})$	$\Delta\ln m_{igt}p^*_{igt}$	$\Delta\ln m_{igt}$	$\Delta\ln p^*_{igt}$	$\Delta\ln p^*_{igt}(1+\tau_{igt})$	$\Delta\ln p^*_{igt}$	$\Delta\ln p^*_{igt}(1+\tau_{igt})$	$\Delta\ln m_{igt}$	$\Delta\ln m_{igt}$
$\Delta\ln(1+\tau^{stat}_{igt})$	0.61***					0.04	0.62***		
	(0.06)					(0.09)	(0.13)		
$\Delta\ln(1+\tau_{igt})$		-2.44***	-2.56***	0.07	1.07***				
		(0.16)	(0.26)	(0.14)	(0.14)				
$\Delta\ln p^*_{igt}$								-37.10	
								(75.15)	
$\Delta\ln p^*(1+\tau_{igt})$									-2.40***
									(0.24)
product × time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
cty × time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
cty × sector FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
variety FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
1st-stage F		90.5	86.9	86.9	86.9			0.2	21.2
$\hat{\omega}$ (se[$\hat{\omega}$])								-0.03 (0.05)	
$\hat{\sigma}$ (se[$\hat{\sigma}$])									2.40 (0.24)
r2	0.17	0.01	0.01	0.00	0.00	0.15	0.15	.	.
obs	2,405,233	2,405,233	1,949,262	1,949,262	1,949,262	1,949,262	1,949,262	1,949,262	1,949,262

Notes: Column 1 reports the first stage of the applied tariff, $\Delta\ln(1+\tau_{igt})$, on the statutory tariff, $\Delta\ln(1+\tau^{stat}_{igt})$. Columns 2-5 shows the second-stage results of import values, quantities, unit values, and duty-inclusive unit values regressed on the instrumented applied tariff. Columns 5 and 6 regress unit values and duty-inclusive unit values on the statutory tariff, respectively. Columns 7 is the second-stage IV regression of import quantities on unit values using statutory tariffs as the instrument (the first stage is column 5). Columns 8 is the second-stage IV regression of import quantities on duty-inclusive unit values using statutory tariffs as the instrument (the first stage is column 6). The implied $\hat{\omega}$ and $\hat{\sigma}$ and their standard errors are reported at the bottom of the table in columns 7 and 8. All regressions include variety, product-time, country-time and country-sector fixed effects. Standard errors clustered by country and product. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.3: Product Elasticity η, Trends

	(1) $\Delta \ln(s^m_{gMt})$	(2) $\Delta \ln p^*_{gMt}$	(3) $\Delta \ln(s^m_{gMt})$	(4) $\Delta \ln(s^m_{gMt})$	(5) $\Delta \ln p^*_{gMt}$	(6) $\Delta \ln(s^m_{gMt})$
$\Delta \ln Z_{gMt}$	-0.71***	0.52***				
	(0.09)	(0.08)				
$\Delta \ln p^*_{gMt}$			-1.37***			-1.33
			(0.26)			(0.99)
$\Delta \ln Z^{stat}_{gMt}$				-0.76*	0.53	
				(0.42)	(0.34)	
sector-time FE	yes	yes	yes	yes	yes	yes
product FE	yes	yes	yes	yes	yes	yes
1st-stage F			43.6			2.5
$\hat{\eta}$ (se[$\hat{\eta}$])			2.37 (0.26)			2.33 (0.99)
r2	0.03	0.23	.	0.03	0.24	.
obs	301,420	317,325	301,420	301,420	317,325	301,420

Notes: Columns 1-3 build the price index using the $\hat{\sigma}$ from column 6 of Table 3 and constructs the instrument using applied tariffs. Column 1 reports the reduced form, column 2 reports the first stage, and column 3 reports the second stage. Columns 4-6 repeats the analysis using a price index constructed from $\hat{\sigma}$ from column 9 of Table A.2 and an instrument constructed from the statutory tariffs. The implied $\hat{\eta}$ and its standard error are noted at the bottom of the table in columns 3 and 6. All regressions include product and time fixed effects. Standard errors clustered by product. Significance: * 0.10, ** 0.05, *** 0.01.

Table A.4: Aggregate Impacts, Mobile Labor

	EV^M	ΔR	EV^X	EV
	(1)	(2)	(3)	(4)
	Full War			
Change ($ bil)	-68.8	39.4	24.5	-4.9
Change (% GDP)	-0.37	0.21	0.13	-0.03
Change ($ capita)	-213	122	76	-15
	No Retaliation			
Change ($ bil)	-68.8	39.6	28.1	-1.0
Change (% GDP)	-0.37	0.21	0.15	-0.01
Change ($ capita)	-213	122	87	-3

Notes: Table reports impacts of the war assume imperfectly mobile labor. The aggregate impacts of the trade war are reported in column 4, and the decomposition into EV^M, tariff revenue (R) and EV^X in columns 1-3. The bottom panel reports 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 second row scales by 2016 GDP. The third row scales by 2016 population. These numbers are computed using the model described in Section 5 and sets $\{\hat{\sigma} = 2.47, \hat{\eta} = 1.81, \hat{\kappa} = 2.09, \hat{\omega}^* = 0, \hat{\sigma}^* = .72\}$.

Table A.5: Correlates of County-Level Import Protection

	(1) $\Delta(\tau_r)$	(2) $\Delta(\tau_r)$	(3) $\Delta(\tau_r)$	(4) $\Delta(\tau_r)$	(5) $\Delta(\tau_r)$
2016 GOP Pres. Vote Share	0.006***	0.004***	0.003***	0.002	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
2016 GOP Pres. Vote Share Sq.	-0.005***	-0.005***	-0.004***	-0.003*	-0.003*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mfg Employment Share		0.011***	0.011***	0.013***	0.012***
		(0.001)	(0.001)	(0.002)	(0.002)
Mfg Employment Share Sq.				-0.002	0.003
				(0.008)	(0.008)
Ag Employment Share		-0.004***	-0.004**	-0.009***	-0.008***
		(0.001)	(0.001)	(0.003)	(0.003)
Ag Employment Share Sq.				0.025***	0.023***
				(0.007)	(0.007)
Demographic Controls	No	No	Yes	Yes	Yes
Demographic Controls Sq	No	No	No	Yes	Yes
Pre-Trends	No	No	No	No	Yes
R2	0.03	0.26	0.27	0.30	0.33
N	3,111	3,111	3,111	3,111	3,111

Unit of analysis is U.S. counties. Outcome variable is the 2017-18 change in import tariff exposure due to the trade war, defined as the county-specific wage-weighted average of sector-level tariff increases. Employment and demographic variables measured in 2016. Manufacturing industries defined as those with NAICS codes beginning with 31, 32, or 33. Agriculture industries defined as those with NAICS codes beginning with 11. Demographic controls are: share unemployed, share white, share with a college degree, and log mean income. Pre-trend controls included for manufacturing and agriculture employment shares, share unemployed, and log mean income. Regressions weighted by county population. Standard errors clustered by state.

Table A.6: Correlates of County-Level Export Retaliation

	(1) $\Delta(\tau_r^*)$	(2) $\Delta(\tau_r^*)$	(3) $\Delta(\tau_r^*)$	(4) $\Delta(\tau_r^*)$	(5) $\Delta(\tau_r^*)$
2016 GOP Pres. Vote Share	0.003***	-0.001***	-0.002***	-0.002***	0.003**
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
2016 GOP Pres. Vote Share Sq.					-0.006***
					(0.002)
Mfg Employment Share		0.005***	0.005***	0.005***	0.007***
		(0.001)	(0.001)	(0.001)	(0.002)
Mfg Employment Share Sq.					-0.006
					(0.004)
Ag Employment Share		0.033***	0.031***	0.032***	0.043***
		(0.006)	(0.005)	(0.005)	(0.009)
Ag Employment Share Sq.					-0.030
					(0.020)
Demographic Controls	No	No	Yes	Yes	Yes
Demographic Controls Sq	No	No	No	Yes	Yes
Pre-Trends	No	No	No	No	Yes
R2	0.05	0.32	0.35	0.36	0.40
N	3,111	3,111	3,111	3,111	3,111

Unit of analysis is U.S. counties. Outcome variable is the 2017-18 change in export tariff exposure due to the trade war, defined as the county-specific wage-weighted average of sector-level tariff increases. Employment and demographic variables measured in 2016. Manufacturing industries defined as those with NAICS codes beginning with 31, 32, or 33. Agriculture industries defined as those with NAICS codes beginning with 11. Demographic controls are: share unemployed, share white, share with a college degree, and log mean income. Pre-trend controls included for manufacturing and agriculture employment shares, share unemployed, and log mean income. Regressions weighted by county population. Standard errors clustered by state.