# Disentangling the Effects of the 2018-2019 Tariffs on a Globally Connected U.S. Manufacturing Sector *

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**Abstract**

Since the beginning of 2018, the United States has undertaken unprecedented tariff increases, with one goal of these actions being to boost the manufacturing sector. In this paper, we estimate the relationship between recent tariffs and U.S. manufacturing employment, output, and producer prices. We account for multiple ways that tariffs might affect the manufacturing sector, including protecting domestic industries, raising costs for imported inputs, and harming competitiveness in overseas markets due to retaliatory tariffs. We find that industries more exposed to tariff increases experience relative reductions in employment, as a small positive effect from import protection is offset by larger negative effects from rising input costs and, to a lesser extent, retaliatory tariffs. Higher tariffs are also associated with relative increases in producer prices via exposure to rising input costs. Lastly, we find evidence for broader impacts of these tariffs outside manufacturing, as counties more exposed to rising input costs and retaliatory tariffs exhibit relative increases in unemployment rates.

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# 1 Introduction

The unprecedented increase in tariffs imposed by the United States against its major trading partners since early 2018 has brought renewed attention to the economic effects of tariffs. While vast theoretical and empirical literatures document the effects of changes in trade policy, it is not clear how prior estimates apply when there are virtually no modern episodes of a large, advanced economy raising tariffs in a way comparable to the U.S. in 2018-2019. Further complicating estimation of the effects of tariffs is the rapid expansion of globally interconnected supply chains, in which tariffs can have impacts through channels beyond their traditional effect of limiting import competition.

Another important feature of these tariffs is that they were imposed, in part, to boost the U.S. manufacturing sector by protecting against what were deemed to be the unfair trade practices of trading partners, principally China. Thus, while existing research has mostly documented negative consequences of the tariff increases on the broad economy—including higher prices, lower consumption, reduced business investment, and drops in the valuations of affected firms—some might view these effects as an acceptable cost for achieving the policy aim of ensuring more robust manufacturing activity in the United States.

This paper provides the first comprehensive estimates of the effect of recent tariffs on the U.S. manufacturing sector, while also considering spillovers to the broader labor market. A key feature of this analysis is accounting for the different channels through which tariffs could affect manufacturers in the presence of global trade and supply chain linkages. On the one hand, U.S. import tariffs may protect some U.S.-based manufacturers from import competition in the domestic market, allowing them to gain market share at the expense of foreign competitors. On the other hand, U.S. tariffs have also been imposed on intermediate inputs, and the associated increase in costs may hurt U.S. firms' competitiveness in producing for both the export and domestic markets. Moreover, U.S. trade partners have imposed retaliatory tariffs on U.S. exports of certain goods, which could again put U.S. firms at a disadvantage in those markets, relative to their foreign competitors. Disentangling the effects of these three channels and determining which effect dominates is an empirical question of critical importance.

Toward this end, we construct straightforward industry-level measures of exposure to each of these three channels. We measure the import protection channel as the share of domestic absorption covered by newly imposed tariffs. We account for possible increases in production costs associated with tariffs on imported inputs as the share of industry costs subject to new tariffs. Finally, we measure an industry's exposure to retaliatory tariffs by U.S. trading partners as the share of industry-level shipments subject to new retaliatory tariffs. We construct these measures using detailed data on each industry's input-output structure, country-specific trade flows, and shipments, as well as information on the set of products covered by both U.S. and foreign retaliatory tariffs. We then relate the measures for these three channels of tariff exposure to monthly data on manufacturing employment, output, and producer prices.

We employ a difference in differences approach that compares outcomes in industries that are more subject to each of the three tariff channels to those that are less affected. We begin by regressing the industry-month-level outcomes on interactions of measures of the three channels with a set of month dummies, which allows us to observe the precise timing of any effects of tariffs. We adopt two approaches to control for pre-existing industry-level trends, including using detrended measures of the dependent variables and differencing out the effect of pre-trends as in Finkelstein (2007). Industry and month fixed effects in the regressions control for time-invariant characteristics of industries and aggregate shocks. In addition, we control for industries' overall import share of domestic absorption and export share of shipments to allow for the possibility, for example, that more internationally exposed industries may perform differently at different stages of the business cycle.

We find that tariff increases enacted since early 2018 are associated with relative reductions in U.S. manufacturing employment and relative increases in producer prices. In terms of manufacturing employment, rising input costs and, to a lesser extent, retaliatory tariffs contribute to the negative relationship, and the contribution from these channels more than offsets an imprecisely estimated positive effect from import protection. For producer prices, the relative increases associated with tariffs are due solely to the rising input cost channel. We find little evidence for a relationship between industrial production and any of the three tariff channels considered, and provide evidence that this lack of a response is due to the historically high orders backlog that manufacturers built up in the two years prior to imposition of the tariffs.

In terms of economic significance, we find that shifting an industry from the 25th percentile to the 75th percentile in terms of exposure to each of these channels of tariffs is associated with a relative reduction in manufacturing employment of 1.8 percent, with the positive contribution from the import protection effects of tariffs (0.4 percent) more than offset by the negative effects associated with rising input costs (-1.3 percent) and retaliatory tariffs (-0.9 percent). For producer prices, we find that an interquartile shift in exposure to tariffs is associated with a 2.9 percent relative increase in factory-gate prices, which is more than entirely due to the rising input cost channel. We note that these estimates provide information about the responses of more-exposed relative to less-exposed industries, but do not reflect general equilibrium effects of the tariff increases.

Next, we conduct two exercises to consider the possibility of broader effects of the tariffs outside the manufacturing sector. First, we estimate the impact of manufacturing tariff increases on employment in downstream non-manufacturing industries. Based on this approach, we find only limited evidence of a negative relationship between exposure to rising input costs and overall nonmanufacturing employment. However, we find clear evidence for broader labor market effects of the manufacturing tariffs in our second approach, which estimates the relationship between county-level unemployment rates and geographic measures of exposure to the three tariff channels that are based on industry composition. Specifically, we find that counties with higher exposure to either rising input costs or foreign retaliation experience relative increases in unemployment rates that manifest after tariffs are imposed and are highly statistically significant. This pattern for unemployment rates mirrors that found for industry-level manufacturing employment and suggests that manufacturing workers who were displaced by tariffs were not readily absorbed into employment in other industries.

The results in this paper point to the importance of increased costs from tariffs on inputs as a mechanism through which tariffs affect the manufacturing sector and the broader labor market, with highly statistically significant relationships between this channel and manufacturing employment and producer prices, as well as county-level unemployment rates. The importance of this channel in our estimates is consistent with the purposeful targeting of intermediate inputs for early rounds of U.S. tariffs in order to avoid tariffs on consumer goods, as discussed in section 2, and points to the relevance of global supply chains when evaluating the effects of tariffs. While uncertainty about future trade policy may also have effects on economic outcomes, we show that our results are robust to inclusion of the industry-level measure of trade policy uncertainty calculated by Caldara et al. (2019).

All results in this paper necessarily represent short-term effects of tariffs, and the longer-term implications of trade tensions may differ from those estimated here. For example, some adjustment to the imposition of tariffs may take time as firms complete previously agreed-upon contracts with customers and suppliers, and as these linkages break and re-form. To a large extent, the longer-term effects of the tariffs will depend on whether firms view them as transitory or more permanent. While a Phase One trade agreement between the U.S. and China temporarily halted the imposition of new tariffs, all of the tariffs examined in this paper remain in effect, approximately two years after their initiation. With heightened tensions between the U.S. and China over the response to Covid-19 and developments in Hong Kong making tariff reductions unlikely—and additional tariffs possible—understanding the economic effects of these tariffs becomes even more important.

This paper contributes to the evolving literature examining the effects of recent global trade tensions on the U.S. economy. Early work in this literature includes Amiti, Redding and Weinstein (2019) and Fajgelbaum et al. (2020) who find near-complete pass-through of U.S. tariff increases to domestic prices, implying welfare losses, though of a relatively small magnitude. Cavallo et al. (2019) show that product composition appears to be a key determinant in the differences in tariff pass-through between U.S. imports and U.S. exports during the 2018-2019 tariff escalation, while also showing that the majority of U.S. tariff increases are being absorbed by U.S. retailers. Flaaen, Hortaçsu and Tintelnot (2020) examine the case of U.S. tariffs imposed on washing machines, showing that tariffs on individual countries can lead to the relocation of production across borders, while tariffs on broader sets of countries lead to substantial retail price increases for both targeted products and complementary goods. Handley, Kamal and Monarch (2020) find that U.S. import tariffs lead to reduced exports for firms in affected industries, and Bown et al. (2020) find that tariffs imposed since the 1980s have lowered sales and employment while increasing prices in downstream industries. Results in each of those papers are consistent with our finding of the importance of the rising input cost channel of tariffs and highlight the importance of considering the implications of global value chains and networks when evaluating the effects of tariffs (Antras and Chor (2018), Alfaro et al. (2019), Bernard and Moxnes (2018)).

Focusing on geographic exposure to tariffs, Waugh (2019) finds that counties specializing in industries subject to Chinese retaliatory tariffs experience reductions in new auto sales, Goswami (2020) finds that commuting zones subject to higher retaliatory tariffs experience lower employment growth, with no effect from import protection, and Blanchard, Bown and Chor (2019) show that retaliatory tariffs can explain a shift in voting away from Republican House candidates in the 2018 election. In terms of financial impacts, Huang et al. (2019) and Amiti, Kong and Weinstein (2020) find that the effects of tariffs carry through to firms' financial performance, with firms more engaged in trade with China experiencing lower stock returns and, in turn, higher default risk and lower investment, respectively, after the announcement of new rounds of tariffs targeting China. Lastly, in research focusing on uncertainty regarding tariff rates, Caldara et al. (2019) find that increases in measured trade policy uncertainty reduce investment in firm-level and aggregate data, and Reyes-Heroles, Traiberman and Van Leemput (2019) note that the effects of tariff actions by major trading countries can also have implications for the trade patterns of emerging market economies.

Although we highlight the recent and rapidly expanding literature on the 2018-2019 tariffs, the ideas of accounting for retaliatory tariffs and supply chain effects of tariffs go back decades. Early examinations of optimal tariffs given the potential for retaliation can be found in Kaldor (1940) and Johnson (1953). The counteracting effect of tariffs on intermediate inputs used in further domestic production—the rising input cost channel described above—was highlighted in Balassa (1965) and Corden (1966), and is present in a wide range of more recent empirical research such as Amiti and Konings (2007) and Topalova and Khandelwal (2011), among others. The scale of the 2018-2019 tariffs, the increased availability of data, and the immensely expanded network of global supply chains permits a quantitative examination of these channels that was not possible before.

Our paper makes several contributions to the existing literatures. First, we explicitly measure and estimate the effects of several channels through which tariffs could affect manufacturing industries, which we find to be important given that tariffs can simultaneously protect an industry's output, while raising prices for its inputs and subjecting it to retaliation in its export markets. Second, we focus specifically on the manufacturing sector, the sector whose output and employment were targeted to be boosted by tariffs, and find that the trade war has been a drag on employment and has failed to increase output, providing context for decision-makers evaluating the efficacy of the tariffs. Third, we provide the first simultaneous examination of the output, employment, and price effects of the 2018-2019 tariffs in a particular sector, and highlight that the tariffs have been associated with price increases, even as they have failed to boost activity in the sector. And finally, we consider the possibility of spillover effects from the manufacturing sector to the broader economy and find that manufacturing workers displaced by the tariffs have not been quickly absorbed into employment in other sectors, as indicated by increases in unemployment rates in more affected counties.

The remainder of the paper proceeds as follows. Section 2 describes the timing of recent trade actions by the U.S. and its trading partners, lists the data sources used in the analysis, and details the calculation of the three measures of exposure to tariffs. Section 3 presents our baseline empirical strategy, results, and robustness checks, and Section 4 examines potential spillovers from the manufacturing sector to the broader economy. Section 5 concludes.

## 2 Background, Data, and Industry-Level Measurement

We begin by providing some brief background on recent trends in manufacturing activity in the period leading up to and during the imposition of tariffs. Toward that end, Figure 1 displays manufacturing employment and production from January 2017 to September 2019, with each data series converted to an index that equals 100 in January 2018, just before the imposition of the first round of new tariffs. As indicated in the Figure, manufacturing employment and output increased at a steady pace in 2017 and, indeed, through much of 2018. Toward the end of 2018, however, manufacturing output declined noticeably and manufacturing employment growth stalled. Given this inflection point, which came after the imposition of substantial tariffs by the U.S. and its trading partners, it seems reasonable to ask whether the tariffs implemented or planned in 2018 played some role in this manufacturing slowdown. Given the patterns evident in Figure 1, it is now helpful to provide additional detail on the timing of the implemented tariffs we study.

## 2.1 Timing and Features of U.S. and Retaliatory Tariffs

To evaluate the effects of recent tariffs, it is first important to understand their timing, their scope, and the characteristics of products targeted by tariffs. The tariffs imposed by the U.S. and its trading partners since 2018 can be classified under three separate actions, with the largest round of U.S. tariffs occurring in late September 2018. As described in detail below, Figures 2 and 3 display the scope and timing of these three trade actions, and Figure 4 shows that U.S. tariffs were focused overwhelmingly on the intermediate and capital goods used by U.S. manufacturers in their production processes.

### 2.1.1 U.S. Import Tariffs

The first tariff action was initiated by the administration and enacted by the U.S. in early February 2018 against large residential washing machines and solar panels/modules based on the rarely used Section 201 of the Trade Act of 1974 (U.S. Code: Title 19, Code 2252). These safeguard tariffs apply to all countries and are scheduled to last for three years before automatically expiring. The value of 2017 U.S. imports affected by these tariffs is shown by the green area in Figure 2.

The second major tariff action affected steel and aluminum imports beginning in March 2018. In only the third instance of its use by the United States, the U.S. administration self-initiated an investigation under Section 232 of the Trade Expansion Act of 1962, which determines whether an imported product is being imported "in certain quantities or under such circumstances as to impair or threaten to impair U.S. national security" (U.S. Code: Title 19, Code 1862). The announced tariff rates were applied at 25 percent on steel and certain steel products and 10 percent on aluminum. The administration initially exempted the imports of several countries, including Canada, Mexico, Korea, and the countries comprising the European Union; however, in June 2018 these exemptions were removed.[1] The value of imports affected by these tariffs is shown by the red area in Figure 2.

The third and most significant tariff action imposed tariffs on U.S. imports from China based on Section 301 of the Trade Act of 1974. This provision provides enforcement mechanisms against a wide range of trade practices deemed to be unjustifiable, unreasonable, discriminatory, or that violate trade agreements. The initial Section 301 investigation against Chinese trade practices focused on intellectual property and technology transfer, and the results of the investigation were released in March of 2018. New tariffs were announced and applied in several phases as both the United States and China retaliated against import tariffs imposed on one another. Phase 1 of U.S. tariffs on imports from China occurred in July 2018, targeting $34 billion of Chinese imports, with additional Phase 2 tariffs on $16 billion following in August. Each of these initial phases were set at a rate of 25 percent. The largest set of tariffs, which covered nearly $200 billion of Chinese imports, went into effect in late September 2018 at a rate of 10 percent, and were later raised to 25 percent in May 2019. These phases of the section 301 tariffs can be seen as the blue areas of Figure 2.[2]

[1] The Republic of Korea secured a permanent exemption after agreeing to stringent import quotas for the U.S. market.

[2] A notable feature of the Section 301 tariffs against China was the potential for U.S. firms to file requests for tariff exemption to the Office of the U.S. Trade Representative (USTR). Although such granted requests could alter the effective tariffs imposed against U.S. firms, in reality these exemptions are unlikely to ma-

### 2.1.2 Retaliatory Tariffs

The retaliatory tariffs imposed in response to these U.S. actions are summarized in Figure 3. In response to the Section 232 tariffs on steel and aluminum, China announced retaliatory tariffs on U.S. exports in April of 2018, while the European Union, Canada, and Mexico imposed their own retaliatory tariffs in June and July of 2018. These tariffs focused on aluminum waste, scrap, pork and various agricultural products for the case of China, and steel, aluminum and other agricultural goods for the cases of the E.U., Canada, and Mexico. The value of 2017 U.S. exports subject to these retaliatory tariffs is shown by the red portion of Figure 3.

In response to the Section 301 tariffs against U.S. imports from China, China imposed retaliatory tariffs on U.S. exports associated with each of the three phases of U.S. tariffs. Retaliation on Phases 1 and 2 covered dollar values of U.S. exports that were equivalent to the dollar values covered by U.S. tariffs on imports from China, and at identical rates. China's Phase 3 retaliation covered $60 billion of U.S. exports, initially at rates ranging from 5-10 percent, which were then increased in 2019 in response to the U.S. raising its Phase 3 tariff rates. These values of U.S. exports subject to Chinese retaliatory tariffs are shown in the blue areas of Figure 3. The equal scale of the axes in Figures 3 and 2 makes clear that the value of U.S. exports subject to retaliatory tariffs has been substantially smaller than the value of U.S. imports subject to U.S. tariffs.

terially affect our results due to the timing of the exemption process. The number of industries affected by tariffs, combined with the extensive detail required for these petitions, led to long delays in decision notices by the USTR. For Phase 1 of the Section 301 tariffs, these decisions were announced on a rolling basis between December 2018 and October 2019; decisions on Phase 2 and Phase 3 didn't begin until July 2019 and August 2019, respectively, at the very end of our sample period. Hence, the vast majority of tariffs were not affected by exemptions during the period we study in this paper.

### 2.1.3 Characteristics of Products and Industries Subject to U.S. Tariffs

The effect of U.S. tariffs on the domestic manufacturing sector depends, at least in part, on the products that are affected and how those products fit into global trade linkages and supply chains. U.S. manufacturers competing with Chinese imports in the U.S. market, for example, would likely fare differently than manufacturers that rely on Chinese inputs for their U.S. production. As a rough guide of how these tariffs are split along these dimensions, we apply the United Nations Broad Economic Categories (BEC) classification to these tariffs (see also Bown, Jung and Lu (2019*b*) for a similar breakdown).[3] As shown in Figure 4, the early U.S. tariffs predominantly covered intermediate goods, represented by the blue areas of the section 232 and initial section 301 phases of U.S. tariffs, as well as capital goods, shown in red. Media reports suggested that this focus on intermediate goods over consumer goods was a purposeful effort on the part of the United States to shield U.S. consumers from some of the most salient effects of tariffs on prices (Lawder and Schneider (2018)). Recalling the prominence of imported inputs among the set of goods subject to tariffs will be helpful when considering the effects of the three channels of tariffs in Section 3.

Lastly, we note two features of the "Phase One" trade deal adopted by the U.S. and China in January 2020 that are relevant to our study, and particularly our sample period, which extends from January 2017 to September 2019. First, the Phase One trade deal left all of the tariffs examined in this paper in place, underscoring their continued importance. Second, while the Phase One trade deal did decrease tariff rates on a fourth round of U.S. tariffs imposed in September 2019, we are unable to examine that additional round of tariffs given the short amount of time between the imposition of tariffs and the massive disruption of international trade—particularly trade with China—that began with the outbreak of Covid-19 in China in December 2019.

[3] Of course, the BEC classification does not substitute for analysis using input-output tables, as one U.S. industry's final good output can be another industry's intermediate input.

## 2.2 Data and Measurement

This section describes the data sources and measurement for the empirical analysis presented in Section 3. We use publicly available data on the lists of products covered by U.S. import tariffs and foreign retaliatory tariffs. For U.S. tariffs, product lists are from the United States Trade Representative and the U.S. Federal Register. For retaliatory tariffs by U.S. trade partners, data are drawn from the relevant government agencies including the Canadian Department of Finance, the European Commission, as well as the World Trade Organization. These lists of affected products have been helpfully collected by other researchers who have made them available for public use.[4] Table A1 provides links to all lists of affected products.

We map the Harmonized System (HS) codes covered by tariffs described above to the North American Industry Classification System (NAICS) using the concordance developed by Pierce and Schott (2012). For U.S. import tariffs, this requires a simple application of the concordance. For tariffs imposed by U.S. trade partners, this process is complicated by the fact that the import product codes published by foreign governments cannot be matched to the Schedule B system used for U.S. exports below the six-digit HS level. Therefore, for foreign retaliatory tariffs, we treat an entire six-digit HS code as being covered by tariffs if any product with that six-digit HS prefix is covered by a tariff, following Blanchard, Bown and Chor (2019), Waugh (2019) and Bown, Jung and Lu (2019*a*). We find that this assumption is justified because the value of U.S. exports that we classify as being covered by retaliatory tariffs lines up well with those calculated by other researchers as well as those announced by U.S. trade partners, as reported in Table A2.

Our measures of exposure to the various rounds of tariffs imposed by the U.S. and its trading partners also require industry-level data on the value of overall imports, exports and shipments. We collect data on the dollar value of U.S. imports and exports from the USITC.

[4] See, for example, Bown and Kolb (2019) and the website maintained by the Crowell-Moring International Trade law firm.

For annual levels of industry shipments, we use the most recent year of the Annual Survey of Manufactures (ASM), 2016. Data on the input usage of each industry are drawn from the BEA's detailed input-output tables for 2012, the most recent vintage available.

Lastly, we draw monthly values of the dependent variables for our analysis—industry output, employment, and producer prices—from three sources. Our measures of monthly industry output come from the Federal Reserve's G.17 Release on Industrial Production and Capacity Utilization. For monthly estimates of employment at the industry-level, we utilize data from the Current Employment Statistics (CES) program of the Bureau of Labor Statistics. Finally, we use the producer price index, also from the Bureau of Labor Statistics, to measure monthly changes in prices across industries. As mentioned above, our sample extends from January 2017 to September 2019.

## 2.3 Level of Aggregation

We conduct the analysis largely at the four-digit NAICS industry level, which is the most detailed level at which comprehensive data for industrial production, producer prices, employment, and input-output relationships are typically available at a consistent level of aggregation. There are minor differences in availability of data at the four-digit industry level across the different outcome variables—the BLS employment data sometimes combine small four-digit industries—and data are only available at the three-digit NAICS level for Apparel Manufacturing (NAICS 315) and Leather and Allied Product Manufacturing (NAICS 316).[5] Ultimately, our baseline samples contain 76 industries for employment, 84 industries for industrial production, and 82 industries for producer prices.[6]

[5]Results are qualitatively identical if NAICS 315 and 316 are excluded from the sample, given their small size.

[6]Industrial production has the largest number of industries because detail is available to separate aluminum manufacturing (NAICS 3313) into three sub-industries that are relevant given the set of tariffs we study: Primary aluminum production (NAICS 331313), secondary smelting and alloying of aluminum (NAICS 331314), and aluminum product (sheet, plate, foil, etc.) production. This split takes into account that while all three of these groups stand to benefit from tariffs on their output, the latter two are also

## 2.4 Industry-Level Measures of Trade Policy Impact

This section describes the measures we construct to quantify the industry-level effects of the trade policies enacted by the U.S. and its trading partners since 2018. Our focus in constructing these measures is capturing the effect of realized changes in tariffs on forces likely to affect outcomes in the manufacturing sector, including the amount of import competition in the U.S. market, the competitiveness of U.S. exports in foreign markets, and input costs. In particular, we construct three industry-level measures capturing each of these channels of potential trade policy impact.[7] As shown in Figure B2, the three measures of exposure to tariffs we construct vary substantially across industries, driven by variation in the share of imports of each product sourced from or exported to China, variation in the share of products within an industry subject to US or retaliatory tariffs and, in the case of the rising input cost channel, variation in the intensity with which each input is used in the production process.

**New Tariff Import Share of Domestic Absorption**

One of the most salient ways that tariffs could affect an industry's economic activity is by restricting foreign competition. To measure the extent of this potential protection, we relate the value of imports of an industry's output affected by new tariffs to the level of domestic absorption (domestic production + imports - exports). Formally, let $\Omega^I$ be the list of U.S. imported product-country pairs ($pc$) subject to new tariffs. The variables $imp_i$ and $exp_i$ identify total industry $i$ imports and exports, and $Q_i$ equals domestic production. Then, the

subject to tariffs on their inputs, implying different overall effects of tariffs. We note, however, that use of this additional detail does not have substantive effects on our estimates—we find little relationship between tariffs and industrial production whether the additional detail is used or not.

[7] Uncertainty regarding trade policy may have led to additional effects (Caldara et al. (2019)), and we explore robustness of our estimates to inclusion of measures of trade policy uncertainty later in section 3.

new tariff import share of domestic absorption is given by:

$$\text{Import Protection}_i = \frac{\sum_{pc \in \Omega^I} imp_{ipc}}{Q_i + imp_i - exp_i}. \tag{1}$$

Throughout the remainder of the paper, we typically refer to this measure as an industry's degree of "import protection" from tariffs. Note that this measure is based on country-product-level trade flows identifying the value of trade subject to tariffs, but does not reflect the ad valorem tariff rate assessed. This is because the ad valorem rates set across products were largely uniform: In the case of U.S. tariffs, 91 percent of the value of imports subject to new tariffs was covered by a 25 percent ad valorem rate by May 2019. We use this approach for all three tariff channel measures. In addition, in our baseline results, we calculate equation (1) for the cumulative set of products covered by all tariff actions described in Section 2.1.[8]

Table 1 lists the top ten industries for this measure of new import protection. Despite the focus on China-specific tariffs in media coverage of recent trade actions, the global tariffs—Section 232 tariffs on steel and aluminum and the Section 201 tariffs on washing machines and solar panels—play a prominent role in this list of protected industries.[9] Other industries such as electric lighting equipment (NAICS 3351), household and institutional furniture and kitchen cabinets (NAICS 3371), and other electrical equipment and component (NAICS 3359) are primarily affected by the U.S. tariffs on Chinese imports.

#### New Tariff Export Share of Output

While U.S. tariffs may reduce competition for some industries in the domestic market, U.S. trading partners responded to these tariffs by imposing retaliatory tariffs. These retaliatory

[8]Measures of export retaliation and rising input costs are also based on the cumulative set of tariffs. In Appendix B.4 we describe additional results in which we calculate separate measures of import protection for each individual wave of tariffs.

[9]The presence of NAICS 3344 (semiconductor and other electronic components) in the table reflects the tariffs on solar panels and modules, which are classified under that NAICS industry.

tariffs may harm U.S. manufacturers by decreasing their competitiveness in foreign markets.

We measure this potential effect as the share of U.S. output subject to new retaliatory tariffs. Defining $\Omega^E$ to be the list of U.S. exported product-country pairs ($pc$) subject to retaliatory tariffs, we calculate the new tariff export share of output—which we refer to as an industry's exposure to "foreign retaliation"—as the following:

$$\text{Foreign Retaliation}_i = \frac{\sum_{pc \in \Omega^E} exp_{ipc}}{Q_i}. \tag{2}$$

The ten industries most affected by new foreign retaliatory tariffs are shown in Table 2. As is clear from the table, even the most affected industries experience increases in tariffs on less than 10 percent of their overall shipments.[10]

#### New Tariff Share of Costs

The final channel we study traces the impact of U.S. tariffs on input costs via supply chain linkages with foreign countries. The principal data on an industry's sources of inputs used in U.S. production come from the "use" table of the Bureau of Economic Analysis's (BEA) input-output tables. This table consists of a matrix with elements $use_{ij}$—the dollar value of commodity $j$ used in industry $i$ production. With information on industry $i$'s use of total intermediate inputs $M_i$ and compensation of employees $Comp_i$, it is straightforward to construct a matrix $SC_{ij}$ with the share of input costs of commodity $j$ in industry $i$:

$$S_{ij} = \frac{use_{ij}}{M_i + Comp_i}, \tag{3}$$

[10] This measure of retaliatory tariffs includes retaliatory tariffs by China on U.S. exports of motor vehicles (NAICS 3361), which were imposed in July of 2018, but then suspended in January of 2019.

Then, we define $IS_j$ as the import share of domestic absorption of commodity $j$:

$$IS_j = \frac{imp_j}{Q_j + imp_j - exp_j}, \tag{4}$$

where here the variables $imp_j$, $Q_j$, and $exp_j$ are imports, output, and exports of commodity $j$, respectively. By multiplying the terms from equations (3) and (4) we arrive at the (implied) import share of costs in industry $i$ from commodity $j$.[11] Summing across commodities $j$ yields the total import share of costs for industry $i$. This implied import share of costs is given by:

$$\begin{aligned} ISC_i &= \sum_j ISC_{ij} \\ &= \sum_j \underbrace{\frac{use_{ij}}{M_i + Comp_i}}_{\substack{\text{product share} \\ \text{of costs}}} \underbrace{\frac{imp_j}{Q_j + imp_j - exp_j}}_{\substack{\text{product import} \\ \text{share}}} . \end{aligned} \tag{5}$$

As mentioned above, we use data from the "use" table in the BEA's benchmark 2012 input-output tables, the most recent year available, updated with 2016 information on values of imports and shipments to calculate the import shares in equation 4.[12]

Finally, we construct our measure of an industry's share of costs subject to new tariffs to be the share of equation (5) that is covered by new U.S. import tariffs. We refer to this measure below as the degree of exposure to "rising input costs" for a given industry, and

[11] Without additional detail on the sources of inputs across industries, here we must use the "proportionality assumption," i.e. that the distribution of the uses of imported commodities in an industry is proportional to overall commodity usage.

[12] We are only able to update the shares in equation (4) for manufactured goods, as annual output measures for non-manufacturing commodities are unavailable. For non-manufacturing commodities, we use the 2012 shares from the input-output tables.

calculate it as follows:

$$\text{Rising Input Costs}_i = \sum_j \frac{use_{ij}}{M_i + Comp_i} \frac{\sum_{pc \in \Omega^I} imp_{jpc}}{Q_j + imp_j - exp_j}, \tag{6}$$

where as before the term $\Omega^I$ denotes the list of U.S. imported product-country pairs ($pc$) subject to new tariffs.

Table 3 lists the top U.S. industries affected by increased costs from recent import tariffs, again based on the cumulative effects from all new tariffs in our sample period. As is apparent in the table, all of these industries are heavily dependent on various metals for domestic production. In some cases, such as the most affected industry, aluminum sheet/plate/foil (NAICS 33131B), our measures indicate that some of the industries that received protection were also subject to substantial tariffs on inputs.

# 3 Short-Run Impacts of Tariffs on Manufacturing

This section discusses the difference-in-differences empirical strategy we use to estimate the relationship between recent tariffs and outcomes in the manufacturing sector and presents our baseline results.

## 3.1 Empirical Strategy

As indicated in Tables 1, 2, and 3, some industries are both highly protected with respect to their output, while also being highly subject to tariffs on their inputs or exports, underscoring the need for a systematic approach to decompose the impacts of tariffs on the manufacturing sector. Any bivariate relationship between an outcome measure and one of the channels identified above could end up conflating multiple, potentially offsetting effects on an industry. Therefore, we will control for all channels of exposure to tariffs in our baseline specification, allowing us to calculate estimates of the effect of each channel holding the others constant, and determining which tariff channel dominates.

In addition, rather than designating a set period of time over which to analyze the effects of tariffs on the outcome variables, we adopt a flexible setup that allows the effects of each of the channels to vary over time. In particular, we interact the industry-level measures for each of the tariff channels with a full set of month dummies. This allows us to determine the exact timing of any estimated tariff effects in high-frequency data, while also controlling for the presence of any differential pre-existing trends in outcome variables across industries.

Finally, recognizing that industries with varying exposure to international trade may respond differently to shocks even in the absence of changes in trade policy, we include additional controls that account for a baseline level of export and import exposure for each industry.[13] These controls account for general exposure to international conditions such as changes in the value of the dollar and foreign GDP growth, as well as allowing for the possibility that industries with different levels of exposure to trade behave differently at different points in the business cycle.

Our estimating equation is given by:

$$
\begin{aligned}
y_{it} = \quad & \alpha + \sum_t \gamma_t \mathbf{1}(M_t = t)(\text{Import Protection}_i) + \sum_t \theta_t \mathbf{1}(M_t = t)(\text{Input Cost}_i) \text{ ...} \\
& + \sum_t \lambda_t \mathbf{1}(M_t = t)(\text{Foreign Retaliation}_i) + \sum_t \omega_t \mathbf{1}(M_t = t)(\text{Import Share}_i) \text{ ...} \\
& + \sum_t \varphi_t \mathbf{1}(M_t = t)(\text{Export Share}_i) + \delta_i + \delta_t + \varepsilon_{it}
\end{aligned} \tag{7}
$$

where the outcome of interest, $y_{it}$, is either log employment, log output, or the log of the producer price index of industry $i$ in time $t$. The $\mathbf{1}(M_t = t)$ terms indicate a set of month

[13] Our export exposure measure is the export share of output, and the import exposure measure is the import share of domestic absorption, each of which are calculated using data from 2016, the most recent year of data available for industry-level shipments.

dummies (spanning February 2017 to September 2019). Import Protection$_i$, Input Cost$_i$, and Foreign Retaliation$_i$ are the three tariff channel measures described above, and Import Share$_i$ and Export Share$_i$ are the industry-level measures of general exposure to international conditions. The $\delta_i$ and $\delta_t$ terms are industry and month fixed effects, respectively.

One concern with this approach is the potential for tariffs to have been assigned to specific industries based on trends in the dependent variables we examine, i.e., employment, production, or prices. Several aspects of how the 2018-2019 tariffs were determined, however, make detailed targeting of industries based on these outcomes unlikely, and our treatment of tariffs in equation 7 is consistent with their treatment in the existing literature (i.e. Fajgelbaum et al. (2020) and Cavallo et al. (2019)). First, the bulk of the 2018-2019 tariffs resulted from investigations initiated by the U.S. government for the purpose of addressing longstanding complaints against U.S. trading partners, especially treatment of intellectual property in China. This process stands in contrast to that associated with temporary tariffs like antidumping duties, where industries experiencing negative shocks apply for assistance from the government. Second, the tariffs imposed were largely uniform—91 percent of the value of targeted imports were subject to a 25 percent ad valorem duty rate—and covered broad groups of industries, with nearly all imports from China ultimately subject to tariffs. Third, tariff lists were assembled quickly, with the timing of tariffs imposed and magnitude of trade covered largely determined by the tit-for-tat responses of U.S. trading partners, particularly China. In sum, while products subject to tariffs were clearly not chosen randomly, there is substantial evidence that they were chosen primarily based on strategic considerations of the trade war, rather than on short-run industry-specific trends in employment, output, or prices.[14]

[14] In addition, Fajgelbaum et al. (2020) examine the relationship between industry-level protection and 2016 campaign contributions, and actually find a somewhat negative relationship, implying that tariffs were not directed toward politically connected industries.

Another feature of difference-in-differences analysis is the need to address differing trends across industries prior to the implementation of new tariffs. We utilize two approaches to explicitly account for pre-trends. First, we replace the outcome variable $y_{it}$ with the equivalent measure after removing an industry-specific linear trend for the period from January 2017 to January 2018 (denoted $\widetilde{y}_{it}$), the last full year before the implementation of new tariffs.[15] In a second approach, we estimate equation (7) and then follow Finkelstein (2007) by differencing out the pre-trend path for each coefficient, thereby arriving at a point estimate of the relationship between each tariff channel and the outcome variable. Specifically, for a given set of coefficients (say, the $\gamma_t$ coefficients above) we calculate the following:

$$\Delta y_{it}^{\gamma} = \quad (\overline{\gamma}_{\text{Jul-Sep19}} - \overline{\gamma}_{\text{Dec17-Feb18}}) - \kappa(\overline{\gamma}_{\text{Dec17-Feb18}} - \overline{\gamma}_{\text{Feb17-Apr17}}) \tag{8}$$

This calculation compares changes in average coefficients over two periods: A post-tariff period spanning just before tariffs were put in place (December 2017 - February 2018) to the final three months of our sample (July-September 2019); and a pre-tariff period from the start of the sample (February - April 2017) to just before tariffs were put in place (December 2017 - February 2018). The $\kappa$ term adjusts for the differing lengths of the post-tariff and pre-tariff periods.

## 3.2 Results

Figure 5 provides a visual representation of the results of estimating equation (7) when using the industry-detrended ($\widetilde{y}_{it}$) outcomes of interest.[16] Specifically, the three panels of the figure display coefficient estimates and 90 percent confidence intervals for the interactions of the tariff channel measures with the month dummies. The dashed vertical lines indicate the

[15] See Boehm, Flaaen and Pandalai-Nayar (2019) for a similar approach using firm-level data.

[16] Results for the non-detrended outcome variables are provided in Figure B3 of the appendix.

timing of the first (February) and last (September) trade actions imposed by the U.S. and its trading partners in 2018.

Panel (a) displays estimated effects for detrended employment. The left column of panel (a) shows a negative and statistically significant relationship between the rising input cost channel of tariffs and manufacturing employment. An interesting feature of this relationship is that it materializes with a lag following the application of tariffs affecting U.S. imported intermediates, which could reflect delays in effects being passed through supply chains or suppliers temporarily continuing to provide inputs under previously agreed-upon contracts. This result, therefore, provides additional context for the aggregate trends shown in Figure 1, in which manufacturing activity did not slow noticeably until the end of 2018. The middle column of panel (a) indicates a modest, but imprecisely estimated, positive effect on employment associated with import protection. Finally, the right column of panel (a) shows a negative and marginally significant effect of foreign retaliatory tariffs on U.S. manufacturing employment that is apparent immediately after retaliatory tariffs begin to be imposed. For all three sets of estimates shown in panel (a) of Figure 5, coefficient estimates during the period prior to the implementation of tariffs are reasonably flat, with the zero line almost always falling within the 90 percent confidence interval.

The first column of Table 4 provides alternative estimates of the relationship between the tariff channels and employment based on the de-trending approach from Finkelstein (2007) described above. Results largely mirror those shown in panel (a) of Figure 5. There is a negative and highly statistically significant relationship between manufacturing employment and rising input costs. There is also a negative association between employment and the foreign retaliation channel that falls just outside common thresholds of statistical significance (p-value = 0.11). The relationship between employment and import protection is positive, as in Figure 5, but imprecisely estimated.

Beyond providing an additional way of accounting for prior industry trends, this approach also provides a straightforward way of characterizing the economic significance of each channel. We find that shifting an industry from the 25th percentile to the 75th percentile in terms of exposure to rising input costs is associated with a relative reduction in manufacturing employment of 1.7 percent. Including the two less precisely estimated channels increases this effect to a 2.1 percent relative reduction in manufacturing employment, as a positive contribution from the import protection effect (0.4 percent) is more than offset by a negative contribution from retaliatory tariffs (-0.9 percent).[17]

Panel (b) of Figure 5 presents the coefficient estimates pertaining to the relationship between tariffs and industrial production. Here, we see little evidence of significant impacts from the 2018 tariffs, on net. There is a brief period of a negative relationship with the input cost channel in mid-2018 and a noticeable shift down in estimates toward the end of our sample. The estimates pertaining to the other channels—import protection and foreign retaliation—do not exhibit statistically significant patterns. Point estimates in column 2 of Table 4 similarly show a lack of statistically significant relationships between industrial production and exposure to the three tariff channels.

Finally, panel (c) of Figure 5 indicates that new tariffs are associated with a statistically significant relative increase in producer prices due to exposure to rising input costs (the left column). Coefficient estimates for the import protection channel, on the other hand, shift down toward the end of our sample, though this movement is quite subtle (the middle column). We find no relationship between exposure to foreign retaliatory tariffs and producer prices (the right column). In terms of economic significance, the estimates in column 3 of

[17] Another way of calculating the economic significance of these estimates is to consider the effect of shifting to an alternative scenario with zero tariff exposure. In this scenario, the reduction in exposure to rising input costs is associated with a 1.5 percent relative increase in employment (or around 185,000 jobs); adding in the other two channels would increase this estimated effect to 2.1 percent (or around 250,000 jobs). We caution, however, that these estimates do not account for additional general equilibrium effects that might be associated with the recent tariffs.

Table 4 indicate that an interquartile shift in exposure to rising input costs is associated with a 3.8 percent relative increase in factory-gate prices. Including the other channels results in a 3.1 percent relative increase in factory-gate prices. These results are consistent with Amiti, Redding and Weinstein (2019), who find a role for input tariffs, in addition to tariffs on output, in increasing U.S. prices.

## 3.3 Examining Differing Responses for Employment and Industrial Production

At first glance, it may seem surprising that manufacturing employment exhibits a stronger relationship with exposure to tariffs than industrial production, given costs associated with firing and hiring employees. We find evidence, however, that this difference arises from a need by manufacturers to fulfill a large order backlog, even as they slowed hiring. As shown by the dashed red line in Figure 6, strong demand for manufactured goods in 2017 and the early part of 2018 had led to historically high levels of unfilled orders, as measured by the Institute for Supply Management (ISM) manufacturing survey.[18] While this high level of demand might typically lead to increased hiring at manufacturers, as rounds of tariffs were put into place in 2018, the diffusion index for new orders of manufactured goods plunged (black line in Figure 6). As a result, it is plausible that firms would continue to produce at prior levels, in order to fulfill customers' orders, while forgoing hiring that would have otherwise taken place given declining future demand, leading to the relative declines in employment found above.

[18] The ISM Manufacturing Orders Backlog Index reached its highest level in 14 years in the first half of 2018.

## 3.4 Trade Policy Uncertainty

Much of the discussion of the effects of the 2018-2019 tariffs has focused on the role of uncertainty about trade policy (Caldara et al. (2019)), and a recent literature has documented substantial effects on economic activity of trade policy uncertainty and its resolution (Crowley and Exton (2018), Pierce and Schott (2016), Handley and Limao (2017)). Given that tariffs were actually imposed on the inputs or outputs of nearly every U.S. goods-producing industry, separating the effects of uncertainty from the realized changes in tariff rates is difficult. Here, we explore the effects of augmenting equation (7) with a commonly-cited measure of trade policy uncertainty related to the 2018-2019 tariffs from Caldara et al. (2019).

Caldara et al. (2019)'s measure of trade policy uncertainty is based on a textual analysis of the quarterly earnings calls of publicly traded U.S. firms. After classifying firms according to their Fama-French 12 industry definition, Caldara et al. (2019) measure the frequency of references to trade policy and uncertainty-related terms by industry, for each quarter. We explore the robustness of our results to the inclusion of this measure of trade policy uncertainty. Because Caldara et al. (2019)'s measure of trade policy uncertainty is only defined through the second quarter of 2019, our analysis in this robustness check ends in June 2019, versus September 2019 in our baseline results. Results are presented visually in Figure 7, and to conserve space, we report only the results of regressions using detrended manufacturing employment as the dependent variable.

As indicated in the figure, relationships between realized tariff changes and employment remain very close to those reported in Figure 5, and the coefficient on the measure of trade policy uncertainty is not statistically significant at conventional levels. While we caution that the Caldara et al. (2019) measure of trade policy uncertainty is defined at a more aggregate industry level (Fama-French 12) and time frequency (quarterly) than our dependent variable, these results provide support for the idea that actual changes in tariffs are associated with changes in economic activity that are distinct from effects of trade policy uncertainty.

### 3.5 The Impact of Business Cycle Shocks

An alternative explanation of the slowdown in manufacturing activity observed after the start of the 2018-2019 tariffs is that it reflects a slowing in general economic activity, which also happens to manifest in the manufacturing sector. However, conditions outside the manufacturing sector at this time, along with features of our empirical strategy, make this explanation unlikely. First, private nonmanufacturing employment continued to increase throughout our sample period, even as manufacturing employment stagnated, suggesting that the manufacturing slowdown was not broad-based. In addition, our empirical strategy controls for the role of business cycle shocks in two ways. To the extent that a negative aggregate shock affects all manufacturing industries identically, it will be captured by the month fixed effects in equation 7. Moreover, even if business cycle shocks have differential effects on industries with varying levels of international exposure—such as the highly cyclical and also highly tradable durable goods industries—this heterogeneity would be captured by the interactions of month dummies with the two measures of general trade exposure. Our finding of statistically significant relationships between the tariff channel measures and industry-level outcomes, even after including controls that would capture business cycle shocks, is strong evidence of a role for tariffs in the manufacturing slowdown.

### 3.6 Discussion

This analysis is necessarily short-run in nature, and the longer-term effects of the 2018-2019 tariffs may differ from those that we find here. On the one hand, there may be more substantial expansion of U.S. manufacturing activity in the longer-term as firms fully adjust their supply chains to avoid U.S. import tariffs. That said, there is suggestive evidence that the United States is not typically the immediate destination for production relocation from China due to increased tariffs. In the washing machine case studied in Flaaen, Hortaçsu and Tintelnot (2020), firms first moved production to other East Asian countries (Thailand and Vietnam) following China-specific antidumping duties imposed in mid-2017. After the later Section 201 tariffs against *worldwide* imports of washing machines (discussed above), these same firms did indeed shift some sizable production to the United States, though this occurred with substantial costs to consumers via rising prices.

The longer-run effects of the tariffs will also depend on the extent to which firms view them as being transitory or more permanent. Notably, the "Phase One" trade deal signed by the U.S. and China in January 2020 left all of the tariffs examined in this paper in place and unchanged, meaning that the initial rounds of tariffs we examine have now been in place for over two years.[19] Moreover, the increased tensions between the U.S. and China over the response to Covid-19 and the status of Hong Kong makes the swift removal of these tariffs unlikely, and in fact, increase the probability of additional tariffs.

# 4 Examining Broader Effects of Tariffs on Manufacturing

Given the relationship between tariffs and activity in the manufacturing sector described above, we next examine whether this relationship has broader implications outside the sector. We do this by conducting two exercises, each with a differing focus. First, we examine whether tariffs on the manufacturing sector have spillover effects to downstream nonmanufacturing industries via input-output linkages. Second, we consider whether the negative

[19] In terms of U.S. actions, the Phase 1 trade agreement lowered the ad valorem rates applied on a fourth round of tariffs imposed by the U.S. in September 2019, while indefinitely suspending a fifth round scheduled to be imposed in December 2019.

relationship between tariffs and manufacturing employment is sufficiently large to have implications for county-level unemployment rates. This second exercise also provides information on the difficulty with which manufacturing workers displaced by tariffs were re-employed in other industries.

## 4.1 Examining Potential Spillovers to Downstream Nonmanufacturing Industries

In the same way that manufacturing firms are affected by tariffs on imported intermediate inputs, nonmanufacturing industries that use manufactured goods as inputs may face similar effects. In this section, we estimate the relationship between exposure to rising input costs and employment in nonmanufacturing industries. We focus on employment as the outcome variable because detailed data on producer prices and monthly output are unavailable for nonmanufacturing industries. We focus on exposure to rising input costs because services industries are neither protected by U.S. tariffs nor subject to retaliatory tariffs by U.S. trading partners.[20] We address the case of retaliatory tariffs on non-manufacturing goods-producing industries—particularly agriculture—in further detail below.

Our empirical approach is highly similar to that used to examine the manufacturing sector, and involves estimation of the following equation:

$$\widetilde{y}_{it} = \alpha + \sum_t \theta_t \mathbf{1}(M_t = t)(\text{Input Cost}_i) + \delta_i + \delta_t + \varepsilon_{it} \tag{9}$$

where $\widetilde{y}_{it}$ is industry-month-level detrended employment and $\text{Input Cost}_i$ is industry-level exposure to the rising input cost channel. As with the manufacturing employment results,

[20] There were some instances of non-tariff retaliation by U.S. trading partners, such as China's brief effective banning of imports of U.S. crude oil, that could have also affected nonmanufacturing industries. Because these non-tariff barriers were small relative to the size of tariff increases, and because they are often exceedingly difficult to detect and measure, they are not explicitly included in this analysis.

we report estimates with a graphical presentation of the coefficient estimates from equation (9) and also using the approach from Finkelstein (2007).

The upper left panel of Figure 8 displays results based on all nonmanufacturing industries. For these industries, we see little evidence for a negative relationship between the input cost channel of tariffs and employment in the nonmanufacturing sector, although coefficient estimates do move down in 2019—after the largest round of US tariffs went into effect—unwinding a pre-tariff increase. Likewise, the Finkelstein (2007) test statistic takes a value of -0.73, indicating a negative relationship between input tariffs and nonmanufacturing employment, but the standard error of 0.54 indicates a lack of statistical significance at conventional levels (p-value of 0.17).[21]

There are a number of reasons why one might expect the input cost measure of tariff exposure to be less salient for non-manufacturing industries than for manufacturing industries. One reason relates to differences in production processes. Manufactured goods make up a far lower share of input costs for nonmanufacturing industries than for manufacturing industries. The average manufacturing industry has an exposure to input tariffs that is nearly an order of magnitude higher than that for the average nonmanufacturing industry (0.026 percent of costs vs. 0.0029 percent of costs, respectively), and the top 43 industries in terms of exposure to tariffs via input costs are all manufacturing industries. Another reason relates to timing. Research from Cavallo et al. (2019), suggests that, at least in the short-run period examined in that paper, U.S. retailers responded to higher tariffs by simply absorbing the higher costs, rather than passing them on to consumers. Our lack of a response by nonmanufacturing industries in the short-term is consistent with the wait-and-see approach taken

[21]The negative relationship between input tariffs and nonmanufacturing employment aligns with Bown et al. (2020) and Barattieri and Cacciatore (2020), who find that downstream nonmanufacturing industries experience notable effects on employment related to antidumping duties on manufacturing industries. The comparative strength and precision of these other findings may be due in part to the large magnitude of the duty rates applied in antidumping investigations, which can exceed 100 percent, as well as to the sample period spanning multiple decades.

by these firms that was documented in Cavallo et al. (2019). We note, however, that effects could ultimately materialize if inputs tariffs are sustained for a prolonged period of time.[22]

Lastly, we examine whether the relationship between exposure to rising input costs and employment that is present for manufacturing industries persists in broader groupings of sectors, especially including those nonmanufacturing sectors that use manufactured goods more intensively in their production processes. As shown in the figure, a negative relationship between exposure to rising inputs and employment remains apparent when the manufacturing sample is augmented with construction (upper right panel) and, to a lesser extent, with mining (lower left panel) or with all goods-producing industries (lower right panel).[23] The Finkelstein (2007) approach indicates that this relationship is negative and statistically significant for manufacturing plus construction and negative and marginally insignificant for manufacturing plus mining (p-value -0.13) and all goods producing industries (p-value -0.20). In sum, the results indicate that while the relationship between tariffs and non-manufacturing employment is weak, the relationship between tariffs and manufacturing employment is strong enough to show through when broader groups of sectors are considered.

## 4.2 Examining County-Level Unemployment Rates

An alternative way to examine whether the 2018-2019 tariffs have spillover effects beyond the manufacturing sector is to construct measures of geographic exposure to the tariffs and relate those measures to broader labor market outcomes. This is particularly important as the impact of tariffs could be concentrated in specific areas of the United States, leading to more severe employment effects that would not be apparent in the industry-level analysis of

[22] In addition, in section B.5 of the appendix, we conduct two robustness checks to explore the lack of precision in these estimates. Those tests suggest the lack of statistical significance in the relationship for nonmanufacturing industries is due, at least in part, to the more aggregated level at which nonmanufacturing industries are tracked in official statistics and to the non-linear growth in certain non-manufacturing industries before the tariffs were announced.

[23] Goods-producing industries includes industries whose NAICS code begins with 1, 2, or 3. Because agriculture is excluded from the BLS's Current Employment Statistics, NAICS code 1 represents only logging.

non-manufacturing industries described above. Several recent papers have analyzed this geographic dimension of the 2018-2019 tariffs. Fajgelbaum et al. (2020) and Blanchard, Bown and Chor (2019) consider the political economy aspects of the tariffs, with the former finding that import protection favored politically competitive counties and the latter finding that retaliatory tariffs influenced the 2018 Congressional elections.[24] Waugh (2019) calculates a measure of employment-weighted county-level exposure to tariff changes and finds that counties more exposed to retaliatory tariffs exhibit relative declines in consumption expenditures. Goswami (2020) uses Waugh (2019)'s approach of calculating geographic exposure to tariffs and finds that retaliatory tariffs are associated with a decline in commuting zone-level employment growth, while import tariffs had no immediate effect.

Here, we calculate county-level measures of exposure to each of the three tariff channels described above. To do so, we apply the industry-level measures of each tariff channel described in Section 2.2 to each county's industrial structure based on data from the Census Bureau's County Business Patterns.[25] Specifically, for an individual county $k$, we define exposure to each of the three tariff channels as the employment-weighted averages of exposure of the industries present in each county:

$$\text{Channel}_k = \sum_i \left( \frac{m_{ik}}{m_k} \right) \text{Channel}_i, \tag{10}$$

where $m_{ik}$ is employment in industry $i$ in county $k$, and the three channels are once again exposure to rising input costs, import protection, and foreign retaliation.

When constructing these county-level measures, all industries, whether manufacturing or nonmanufacturing, have varying levels of exposure to the rising input cost channel via

[24] While these papers note that tariffs may have been targeted based on *future political considerations*, there is no evidence that tariffs were targeted—either by the U.S. or its trading partners—based on *industry performance*.

[25] The latest available year for these data is 2016. To address the well-known issues of data suppression due to confidentiality requirements, we use the CBP version with imputations created by Eckert et al. (2020).

their input-output structures, as discussed in Section 4.1. Manufacturing industries are also exposed to the import protection and export retaliation channels via U.S. tariffs on their output, and retaliatory tariffs on their exports. Services industries, by contrast, have zero exposure to these channels, by definition, as their output is not subject to tariffs. While non-manufacturing goods-producing industries—i.e. logging, mining, and agriculture—received very modest import protection and were subject to export retaliation, we are unable to include their exposure to these channels because there is not a readily comparable analogue of the Annual Survey of Manufactures to measure industry-level shipments for these industries.[26] While new U.S. import protection on these industries was inconsequential (less than 1 percent of the value of trade covered by new tariffs, based on 2017 value) this is more relevant for retaliatory tariffs, as a large component of these tariffs targeted agricultural products (roughly 15 percent of the value of new retaliatory tariffs on exports by 2017 value). Therefore, while our county-level analysis accounts well for spillovers of manufacturing tariffs to other sectors, it will not reflect the direct effects of the retaliatory tariffs on agriculture and mining that have been found to be important in Waugh (2019). In this sense, our estimates of the impact of foreign retaliation may be conservative.

The county-level distributions of the three tariff channels are summarized in Figure 9. The maps highlight once again the importance of simultaneously considering the multiple effects of tariffs. For example, as shown in panel (a), clusters of counties in the industrial Midwest and Southeast are apparent as being the most highly protected by import protection, which might benefit industries in those areas. However, as shown in panels (b) and (c), these areas are also among those that are most subject to exposure to both foreign retaliation and rising input costs. More precisely, the correlations between the import protection channel and the

[26] Waugh (2019) and Goswami (2020) use an alternative approach to measure exposure to tariffs, based on employment-weighted average changes in tariffs for the industries in each county. That measure does not account for the value of imports or exports covered by tariffs and is not normalized by the value of shipments or apparent consumption.

rising input cost and export retaliation channels are 0.80 and 0.68, respectively.

We use these county-level measures of each channel to examine the relationship between exposure to tariff changes and a broader measure of labor market outcomes, the unemployment rate. Unemployment rate data are from the BLS's Local Area Unemployment Statistics (LAUS), which collects information on labor market outcomes at the county-level.[27] Our approach mirrors that used to estimate equation (7) in Section 3, but using county-month-level data in place of industry-month-level data:

$$
\begin{aligned}
\widetilde{y}_{kt} = \quad & \alpha + \sum_t \gamma_t \mathbf{1}(M_t = t)(\text{Import Protection}_k) + \sum_t \theta_t \mathbf{1}(M_t = t)(\text{Input Cost}_k) \ ... \\
& + \sum_t \lambda_t \mathbf{1}(M_t = t)(\text{Foreign Retaliation}_k) + \sum_t \omega_t \mathbf{1}(M_t = t)(\text{Import Share}_k) \ ... \\
& + \sum_t \varphi_t \mathbf{1}(M_t = t)(\text{Export Share}_k) + \delta_k + \delta_t + \varepsilon_{kt}
\end{aligned}
\tag{11}
$$

The dependent variable ($\widetilde{y}_{kt}$) is the county-month-level detrended value of the unemployment rate, and the independent variables are interactions of month dummies with the county-level measures of each of the three tariff channels, as well as the two measures of international exposure described above. Equation 11 also includes county and month fixed effects.

Results are reported in Figure 10. As shown in the figure, the individual relationships with each channel closely mirror the industry-level relationships found for manufacturing employment, though the signs are reversed given that the dependent variable is now the unemployment rate, as opposed to employment. Coefficient estimates for the rising input costs channel, displayed in the left panel, show that counties more exposed to rising input

[27]The BLS derives the county-level data in the LAUS from several sources, including the Current Employment Statistics, the Quarterly Census on Employment and Wages, the Current Population Survey, the American Community Survey, and local unemployment insurance agencies. We seasonally adjust these data using the standard Census Bureau X-13 seasonal adjustment program available at https://www.census.gov/srd/www/x13as/.

costs via tariffs experience relative increases in the unemployment rate shortly after the imposition of the initial rounds of tariffs, with the magnitude of the relationship increasing over time and becoming highly statistically significant. Similarly, coefficient estimates for the foreign retaliation channel take two distinct steps up following the March 2018 and September 2018 rounds of tariffs, and end the sample period as highly statistically significant, indicating that higher foreign retaliation is also associated with relative increases in county-level unemployment. For import protection, shown in the middle panel, there is a modest step down in coefficient estimates as tariffs protecting US industries are put in place, but the coefficient estimates never reach statistical significance.

Test statistics arising from using the Finkelstein (2007) approach on non-detrended unemployment rates provide similar results (see Table 5), indicating positive and very precisely estimated relationships between the county-level unemployment rate and exposure to both rising input costs and foreign retaliation. In terms of economic significance, these estimates imply that a county in the 75th percentile of the distribution for each tariff channel experiences a 0.16 percentage point increase in the county-level unemployment rate, relative to a county in the 25th percentile. While this increase is modest in size, its precise estimation suggests that manufacturing workers displaced by the imposition of tariffs were not readily employed in other industries. This result, therefore, provides further evidence of the presence of substantial adjustment costs for workers attempting to move between industries or geographic areas (Ebenstein et al. (2014), Artuc, Chaudhuri and McLaren (2010), Caliendo and Parro (2014), and Acemoglu et al. (2016)).

# 5 Conclusion

This paper examines the effect of the tariff increases imposed by the United States and its trading partners since 2018 on outcomes in the U.S. manufacturing sector. We calculate measures of each industry's exposure to tariff changes via three channels: the import protection that comes when an industry's output is subject to U.S. tariffs, the increase in production costs resulting from tariffs on imported inputs, and the reduction in foreign competitiveness due to retaliatory tariffs in U.S. export markets. We then estimate the relationship between these measures of exposure to tariffs and manufacturing employment, output, and producer prices.

We find that the recent tariffs are associated with relative reductions in manufacturing employment and relative increases in producer prices. For manufacturing employment, a small and imprecisely estimated boost from the import protection effect of tariffs is more than offset by larger drags from the effects of retaliatory tariffs and, especially, exposure to rising input costs. Exposure to rising input costs is also associated with relative increases in producer prices.

We consider the possibility of spillover effects of tariffs from the manufacturing sector to the broader economy. While we find little evidence of effects of the tariffs on downstream nonmanufacturing industries, we find a clear positive relationship with county-level unemployment rates. This relationship mirrors that found for manufacturing employment, as counties more exposed to either rising input costs or retaliatory tariffs experience relative increases in unemployment rates.

These results have implications for evaluating the effects of recent U.S. trade policy. While one may view the negative welfare effects of tariffs found by other researchers to be an acceptable cost for a more robust manufacturing sector, our results suggest that the tariffs have not boosted manufacturing employment or output, even as they increased producer prices. While the longer-term effects of the tariffs may differ from those that we estimate here, the results indicate that the tariffs, thus far, have not led to increased activity in the U.S. manufacturing sector.

Finally, our results suggest that the traditional use of trade policy as a tool for the protection and promotion of domestic manufacturing is complicated by the presence of globally interconnnected supply chains and the actions of trade partners. While the potential for both tit-for-tat retaliation on import protection and input-output effects on the domestic economy have long been recognized by trade economists, empirical evidence documenting these channels in the context of an advanced economy has been limited. We find the impact from the traditional import protection channel is completely offset in the short-run by reduced competitiveness from retaliation and higher costs in downstream industries.

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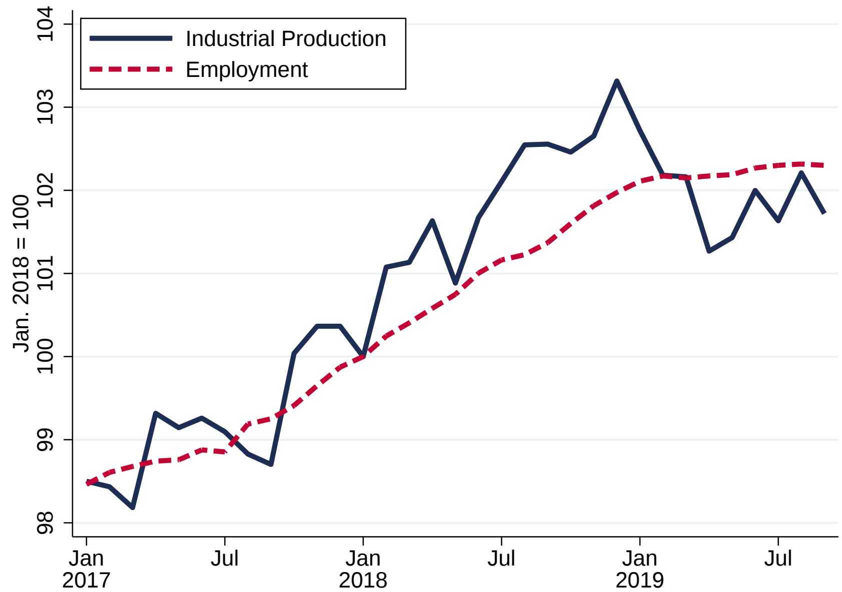
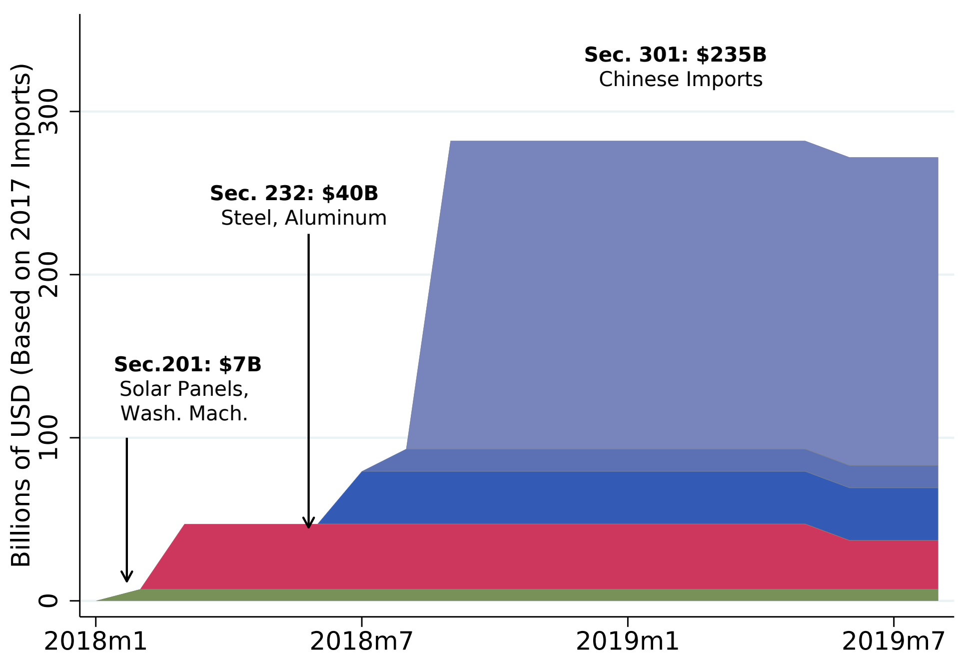
**Figure 1:** Measures of Manufacturing Activity: Jan. 2017 to Sep. 2019



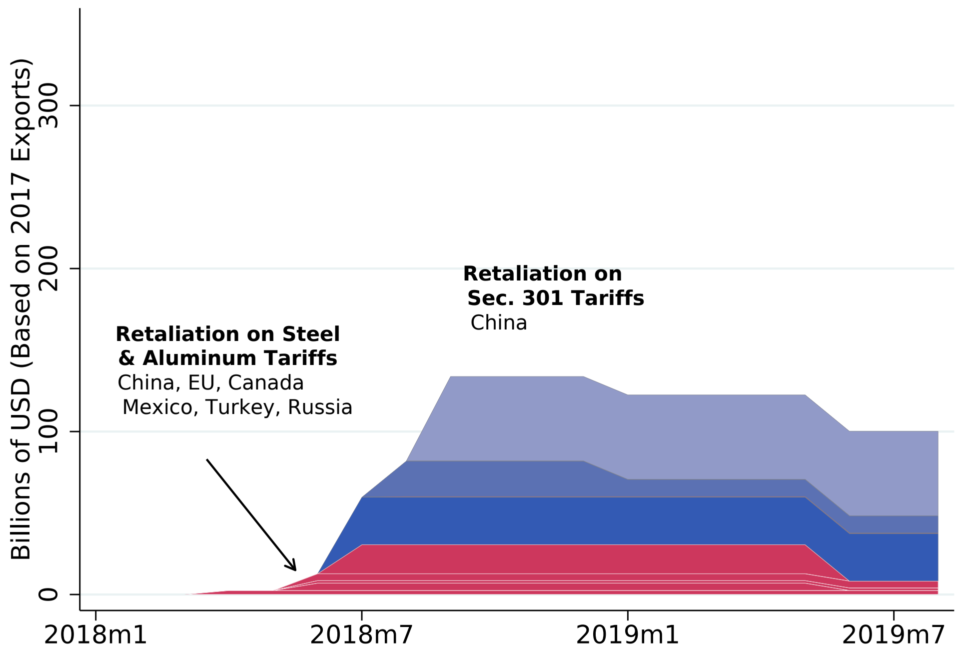

*Sources:* Federal Reserve Board (FRB) for industrial production; U.S. Department of Labor, Bureau of Labor Statistics for employment.

**Figure 2:** Timeline of New U.S. Import Tariffs: 2018-2019



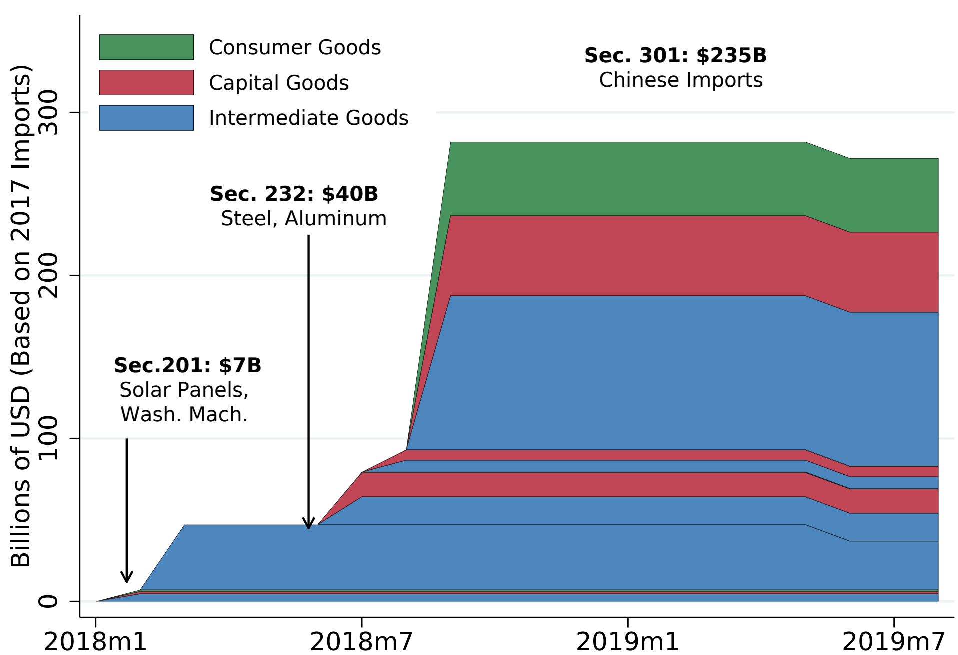

*Sources:* United States International Trade Commission (USITC) for 2017 import values.
*Notes:* See Table A1 for details on the set of relevant products and trade values. The decline in mid-2019 reflects Canada and Mexico being removed from the steel and aluminum tariffs. Some of these tariffs have since been re-instated.

**Figure 3:** Timeline of Retaliatory Tariffs on U.S. Exports: 2018-2019




*Sources:* USITC for 2017 export values.
*Notes:* See Table A2 for details on the set of relevant products and trade values. The scale is set to match that of Figure 2 for purposes of comparison.

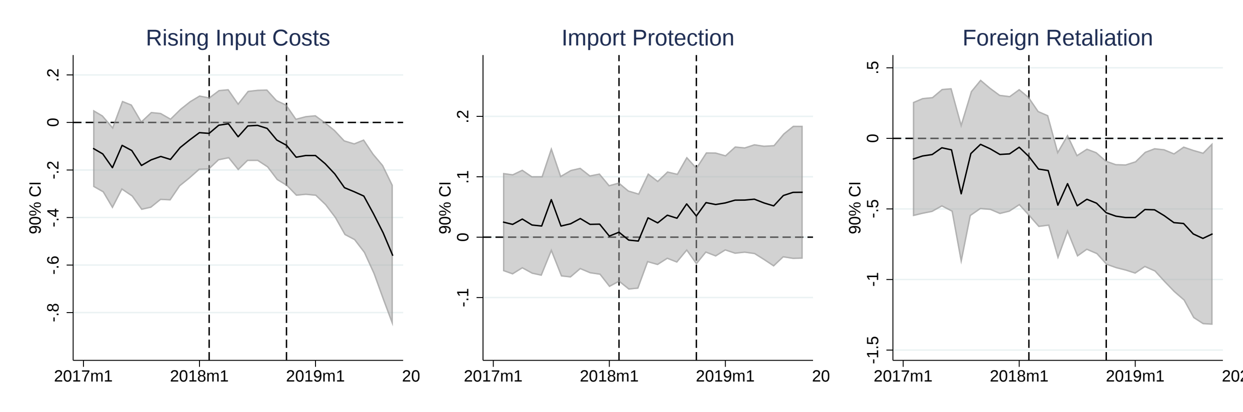
**Figure 4:** Composition of New U.S. Import Tariffs: 2018-2019



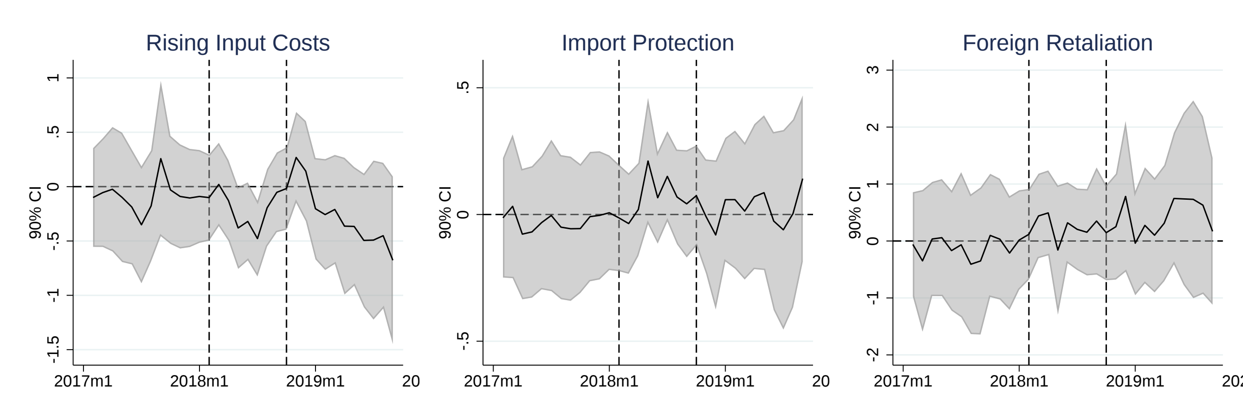

*Source:* USITC for 2017 import values.
*Notes:* See Table A1 for details on the set of relevant products and trade values. Classification comes from the Broad Economic Categories from the United Nations (further details are available here).

**Figure 5:** Effects of Cumulative Tariffs (Detrended)

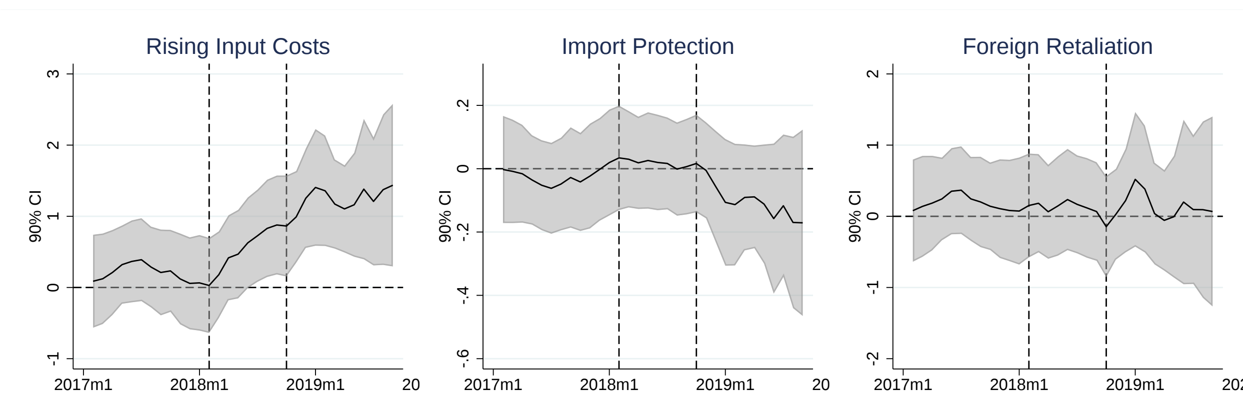
**(a)** Employment




**(b)** Industrial Production (Output)



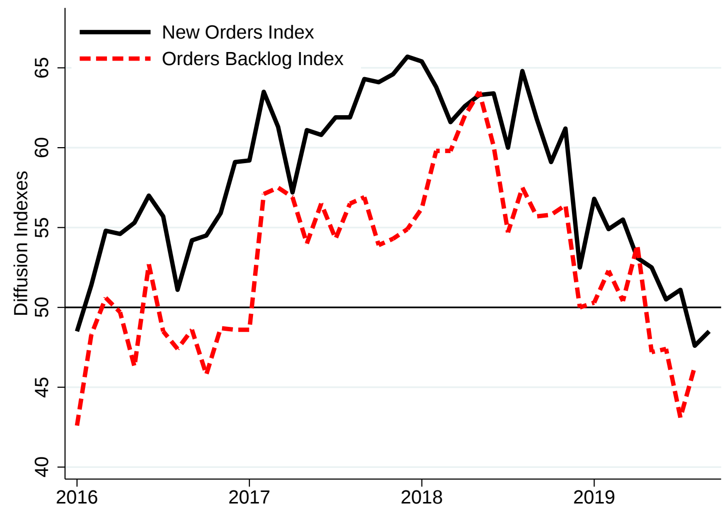

**(c)** Producer Price Index




*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.

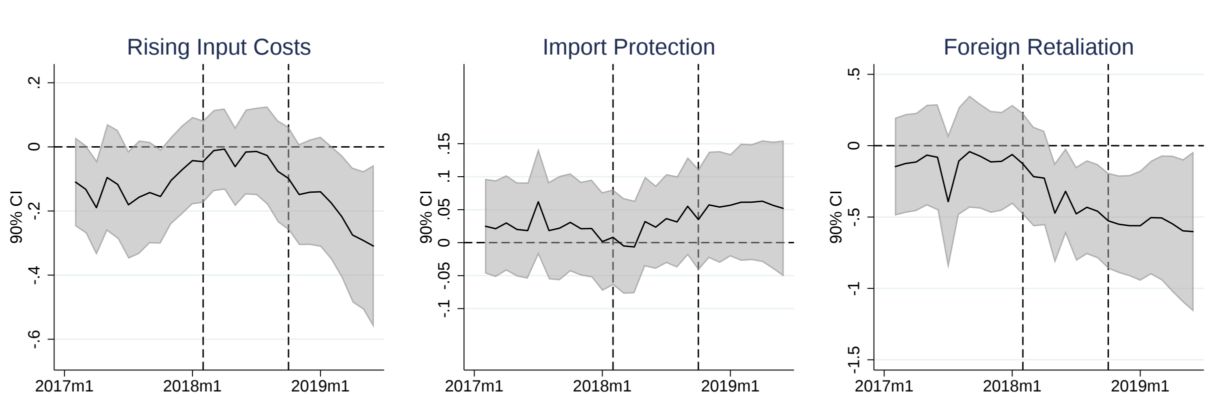
*Notes:* Each panel displays results of a separate regression for the noted detrended dependent variable, with each column corresponding to the three tariff channels in equation (7). Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Figure 6:** Manufacturing Orders Backlog and New Orders Indexes



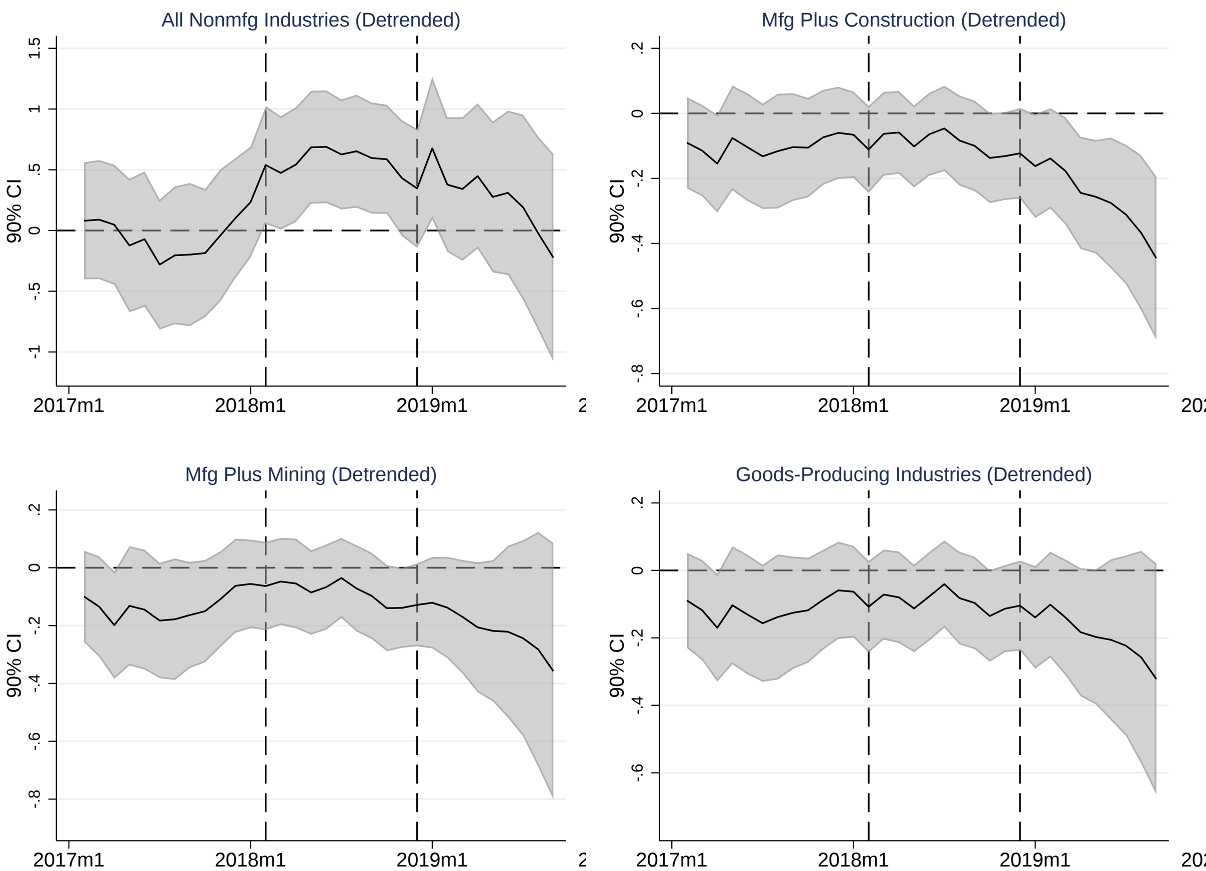

*Source:* Institute for Supply Management.
*Notes:* Figure displays diffusion indexes of Manufacturing Orders Backlog (red dashed line) and Manufacturing New Orders indexes (black line) for the period from January 2016 through September 2019.

**Figure 7:** Effects of Cumulative Tariffs with Trade Policy Uncertainty




*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Figure displays results of an OLS regression of detrended employment on interactions of month dummies and each of the three channels of exposure to the 2018-2019 tariffs, along with the industry-level measure of TPU from Caldara et al. (2019). Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

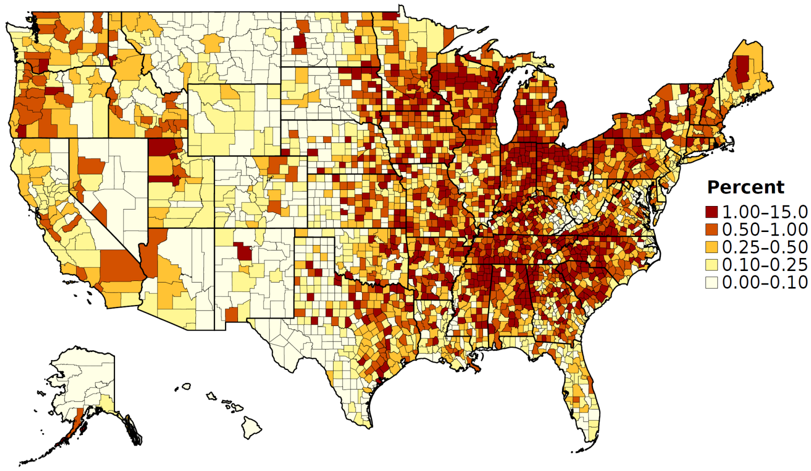
**Figure 8:** Effects of Exposure to Rising Input Costs Via Tariffs on Nonmanufacturing Employment



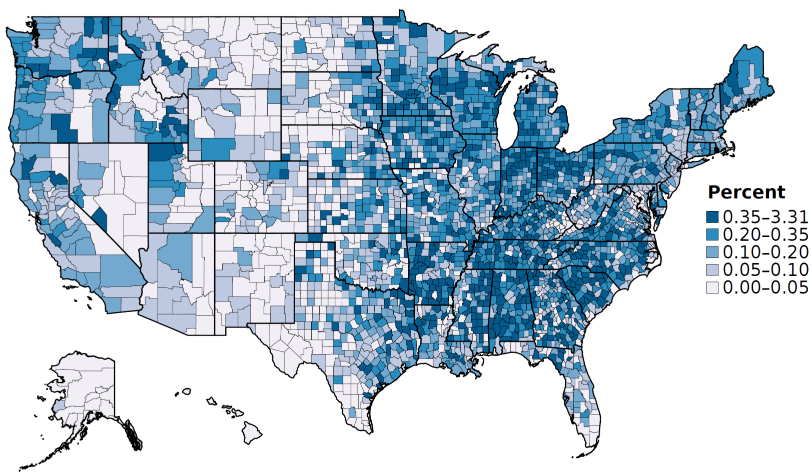

*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Each chart in the figure displays results of a separate regression of nonmanufacturing employment on exposure to rising input costs via tariffs. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Figure 9:** County-Level Distribution of Tariffs

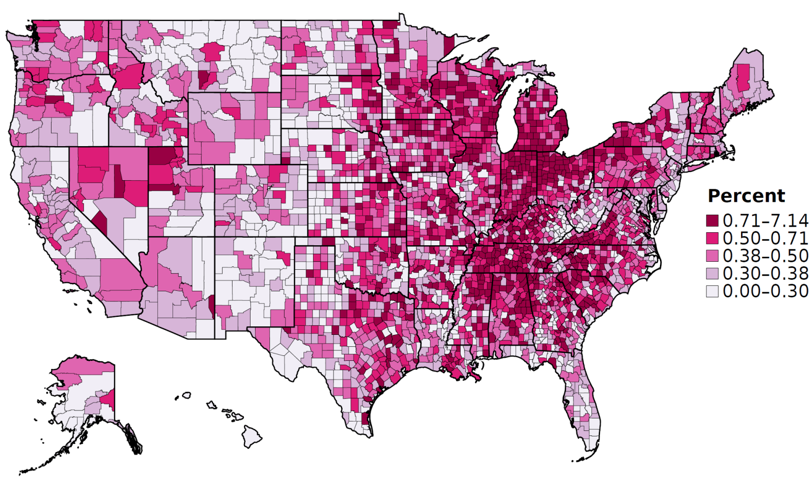
**(a)** Manufacturing Import Protection, by County




**(b)** Foreign Retaliation on Manufacturing, by County

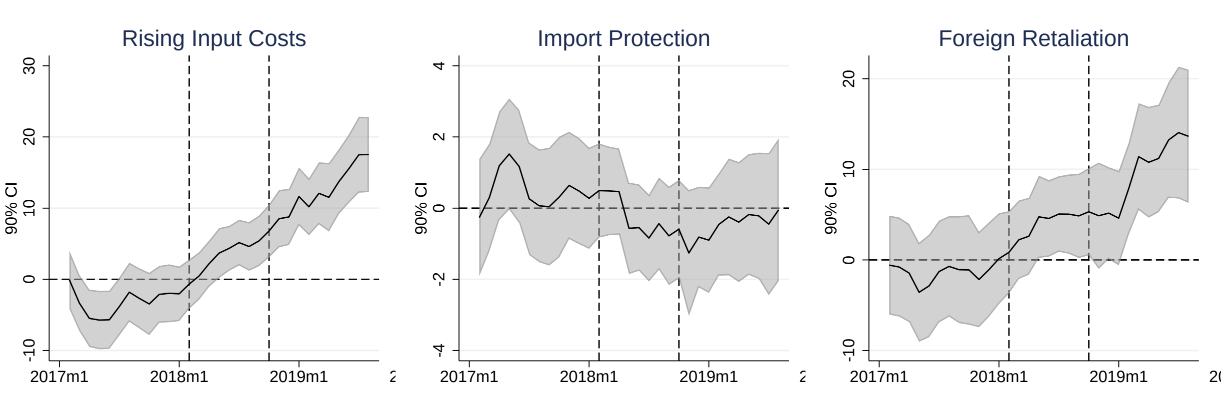



**(c)** Rising Manufacturing Input Costs, by County




*Sources:* Author's calculations using County Business Patterns (U.S. Census Bureau), Eckert et al. (2020) and sources highlighted in Section 2.2.
*Notes:* Maps display county-level measures of exposure to the import protection, export retaliation and rising input cost tariff channels. County-level measures are employment weighted-averages (as shown in equation (10)) of industry-level exposure defined in equations (6), (2), and (1) above.

**Figure 10:** Exposure to Tariffs and County-Level Unemployment




*Sources:* U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Figure displays results of an OLS regression of detrended county-level unemployment rate on interactions of month dummies and each of the three county-level channels of exposure to the 2018-2019 tariffs. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Table 1:** Top Ten Industries by New Import Protection

| **Rank** | **NAICS** | **Industry Description** | **New Tariff Import Share of Absorption** |
|---|---|---|---|
| 1 | 331313 | Primary Aluminum Production | 67% |
| 2 | 3351 | Electric Lighting Equipment | 30% |
| 3 | 3371 | Household and Institutional Furniture and Kitchen Cabinet | 24% |
| 4 | 3344 | Semiconductor and Other Electronic Component | 21% |
| 5 | 3311 | Iron and Steel Mills and Ferroalloy Mfg | 21% |
| 6 | 33131B | Aluminum Sheet/Plate/Foil and Rolling/Drawing/Extruding | 19% |
| 7 | 3352 | Household Appliance Manufacturing | 18% |
| 8 | 3359 | Other Electrical Equipment & Component | 16% |
| 9 | 3160 | Leather and Allied Product | 15% |
| 10 | 3332 | Industrial Machinery | 14% |

*Sources:* Authors' calculations based on equation (1) in the text.
*Notes:* This measure corresponds to the cumulative coverage of all three 2018-2019 tariff actions.

**Table 2:** Top Ten Industries by New Export Retaliation

| Rank | NAICS | Industry Description | New Tariff Export Share of Output |
|---|---|---|---|
| 1 | 3346 | Manufacturing and Reproducing Magnetic & Optical Media | 8.6% |
| 2 | 3160 | Leather and Allied Product | 7.7% |
| 3 | 33131B | Aluminum Sheet/Plate/Foil & Rolling/Drawing/Extruding | 7.7% |
| 4 | 3311 | Iron and Steel Mills and Ferroalloy Mfg | 6.9% |
| 5 | 3361 | Motor Vehicle Manufacturing | 4.9% |
| 6 | 3352 | Household Appliance | 4.7% |
| 7 | 3211 | Sawmills and Wood Preservation | 4.5% |
| 8 | 3343 | Audio and Video Equipment | 4.3% |
| 9 | 3253 | Pesticide, Fertilizer, and Other Agricultural Chemical | 4.1% |
| 10 | 3341 | Computer and Peripheral Equipment | 3.9% |

*Sources:* Authors' calculations based on equation (2) in the text.
*Notes:* This measure corresponds to the cumulative coverage of all three 2018-2019 tariff actions.

**Table 3:** Top Ten Industries by New Tariff Import Share of Costs

| Rank | NAICS | Industry Description | New Tariff Share of Costs |
|---|---|---|---|
| 1 | 33131B | Aluminum Sheet/Plate/Foil & Rolling/Drawing/Extruding | 18.6 |
| 2 | 3324 | Boiler, Tank, and Shipping Container | 9.2 |
| 3 | 3312 | Steel Product Mfg from Purchased Steel | 9.0 |
| 4 | 3321 | Forging and Stamping | 8.0 |
| 5 | 331313 | Primary Aluminum Production | 7.7 |
| 6 | 331314 | Secondary Smelting and Alloying of Aluminum | 7.5 |
| 7 | 3323 | Architectural and Structural Metals | 5.9 |
| 8 | 3369 | Other Transportation Equipment | 5.8 |
| 9 | 3339 | Other General Purpose Machinery | 5.3 |
| 10 | 3332 | Industrial Machinery Manufacturing | 5.3 |

*Sources:* Authors' calculations based on equation (6) in the text.
*Notes:* This measure corresponds to the cumulative coverage of all three 2018-2019 tariff actions.

**Table 4:** Point Estimates of Cumulative Effect by Channel:

| Variable | Employment | Industrial Production | Producer Prices |
|---|---|---|---|
| Import Protection | 0.090 | 0.001 | -0.219* |
| | (0.085) | (0.160) | (0.130) |
| Rising Input Costs | -0.587*** | -0.368 | 1.460*** |
| | (0.200) | (0.362) | (0.437) |
| Foreign Retaliation | -0.641 | 0.348 | 0.044 |
| | (0.419) | (0.590) | (0.472) |
| Industry Fixed Effects | yes | yes | yes |
| Number of Industries | 76 | 84 | 82 |
| Observations | 2,508 | 2,772 | 2,706 |

*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Table displays coefficient estimates and standard errors of the Finkelstein (2007) approach presented in equation (8) in the text. Robust standard errors in parentheses. $* \ p < 0.10$, $** \ p < 0.05$, $* * * \ p < 0.01$.

**Table 5:** Point Estimates of Cumulative Effect by Channel:

| Variable | Unemployment Rate |
|---|---|
| Rising Input Costs | 16.569*** |
| | (3.334) |
| Import Protection | -0.352 |
| | (1.013) |
| Foreign Retaliation | 12.570*** |
| | (3.804) |
| County Fixed Effects | yes |
| Month Fixed Effects | yes |
| Number of Counties | 3,131 |
| Observations | 103,356 |

*Sources:* U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Table displays results of the Finkelstein (2007) test described in equation 8, based on OLS regressions of county-level unemployment rates on county-level measures of exposure to the rising input cost, import protection, and foreign retaliation channels of tariffs. Robust standard errors in parentheses. $* \ p < 0.10$, $** \ p < 0.05$, $* * * \ p < 0.01$.

# Appendix

## A Expanded Detail on Implemented Tariffs

Tables A1 and A2 provide additional information regarding the data on products covered by tariffs. Specifically, the tables report the value of trade–based on 2017 annual data from the U.S. Census Bureau–that we calculate was subject to new tariffs, along with comparisons to values of trade publicly announced by governments and those calculated by other researchers. In addition, we provide links to sources of the lists of HS codes covered by new tariffs.

**Table A1:** New U.S. Import Tariffs by Trade Action and Wave

| **Import Tariff** | **Reference for Affected Products** | **2017 Import Volume** | **Reported by Government** | **Other Estimates** | **Source for Other Estimates** |
|---|---|---|---|---|---|
| | | *Billions of U.S. Dollars* | | | |
| Sec. 201: Solar Panels | | 7 | 8.5 | | |
| Sec. 201: Washing Machines | | 1.85 | 1.8 | | |
| Sec. 232: Steel | Link | 27.7 | 10.2 | 29 | Source |
| Sec. 232: Aluminum | Link | 17.4 | 7.7 | 17 | Source |
| Sec. 301 Part 1 | Link | 32.3 | 34 | | |
| Sec. 301 Part 2 | Link | 13.7 | 16 | | |
| Sec. 301 Part 1+2 | | 46.0 | 50 | 45.7 | Source |
| Section 301 Part 3 | Link | 189 | 200 | 177 | Source |

**Table A2:** New Retaliatory Tariffs on U.S. Exports by Trade Action and Wave

| **Retaliatory Tariff** | **Reference for Affected Products** | **2017 Export Volume** | **Reported by Government** | **Other Estimates** | **Source for Other Estimates** |
|---|---|---|---|---|---|
| | | *Billions of U.S. Dollars* | | | |
| China on US – Apr. 2018 | Link | 2.44 | 2.4 | 2.39 | Source |
| EU on US – Jun. 2018 | Link | 4.23 | 3.2 | 3.24 | Source |
| Canada on US – Jul. 2018 | Link | 17.8 | 12.8 | 12.76 | Source |
| China on US – Jul. 2018 | Link | 29.2 | 34 | | |
| China on US – Aug. 2018 | Link | 21.9 | 16 | | |
| China on US – Jul.+Aug. | | 51.1 | 50 | 49.8 | Source |
| China on US – Sep. 2018 | Link | 52 | 60 | 53.4 | Source |
| Mexico on US – Jun. 2018 | Link | 4.51 | 3.8 | | |
| India on US – Jan. 2019 | Link | 0.89 | 1.3 | 1.3 | Source |
| Turkey on US – Jun. 2018 | Link | 1.56 | 1.8 | | |
| Russia on US – Aug. 2018 | Link | 0.27 | 0.43 | | |
| China on US – Sep. 2019 | Link | | 112 | | |
| China on US – Dec. 2019 | Link | | 160 | | |

# B Additional Results

## B.1 Control Variables

Here, we report coefficient estimates for the control variables used in equation (7). These variables—industry export share of output and industry import share of domestic absorption—are intended to capture any features of industry exposure to things like exchange rate movements or overall foreign growth. These variables may also capture some of the potential impact from increased uncertainty on international markets more generally. Figure B1 reports these results pertaining to employment, industrial production, and PPIs.

For further detail on the distribution of exposure to the three tariff channels considered in this paper, Figure B2 shows density estimates across the 76 manufacturing industries for which manufacturing employment data are available.

## B.2 Alternative Specifications

Figure B3 presents the results from estimating equation (7) without first removing an industry-specific linear trend from each dependent variable. As indicated in the figure, there is evidence that some industries were on different pre-trends in terms of the outcome variables prior to the imposition of tariffs. For example, the estimates for employment, shown in panel (a) of Figure B3 appear to be on upward trends with respect to rising input costs and foreign retaliation and a downward trend for import protection.

As discussed in the main text, we control for these differing pre-trends by either detrending the dependent variable based on its 2017 linear trend or subtracting out the pre-trend following the approach in Finkelstein (2007). We also note that, as shown in Figure B3, these pre-trends often move in different directions for different tariff channels, even though measures of each of the tariff channel exposure variables are positively correlated with one another.

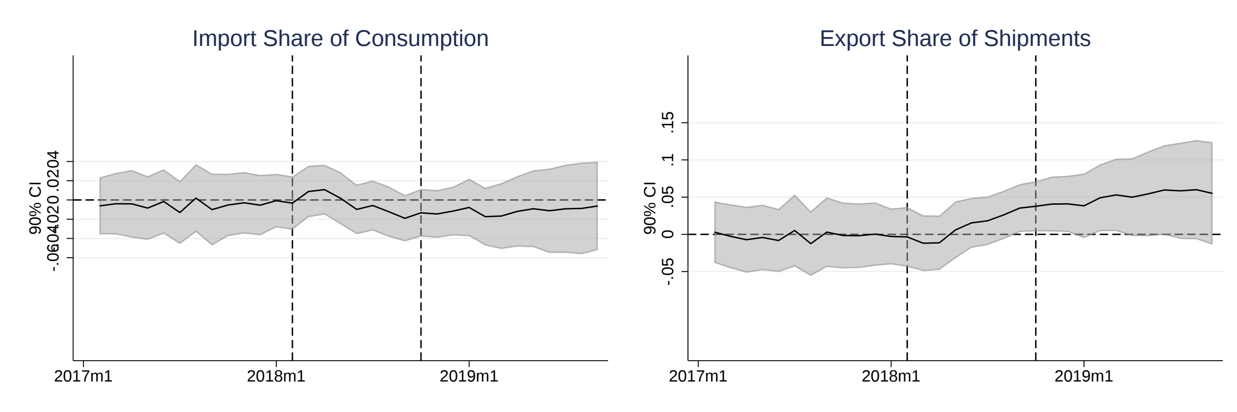
## B.3 Univariate Results

Figure B4 presents results of regressions of the three outcome variables on individual tariff channel measures, one at a time, as opposed to including the three channels together in the same regression. Thus, Figure B4 shows the results of nine separate regressions, rather than three separate regressions as in Figure 5 in the main text.

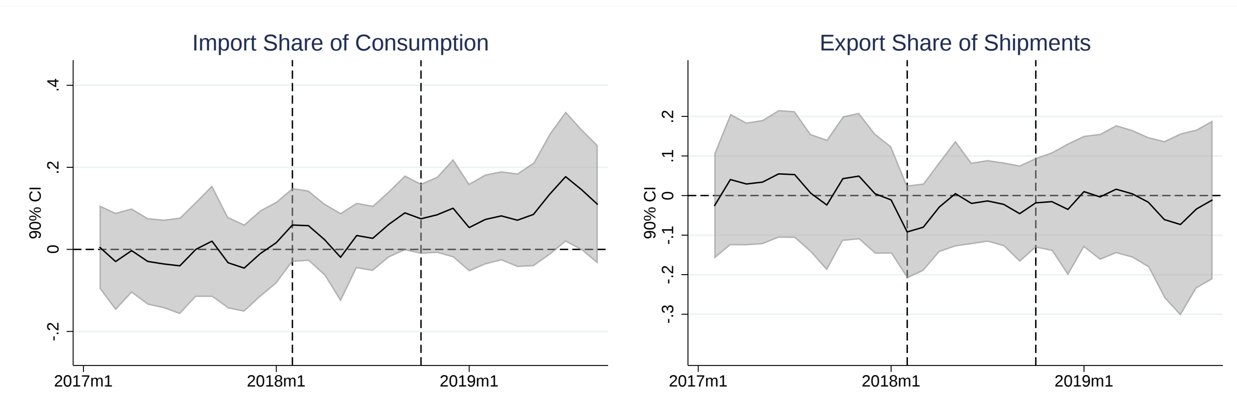
There are some similarities between these "univariate" regression results and the main results shown in Figure 5. Figure B4 still reports negative relationships between employment and both the rising input cost and foreign retaliation channels. There are also important differences, however. While the middle column of Panel C in Figure B4 finds a positive relationship between the effects of import protection and producer prices, the equivalent

**Figure B1:** Coefficient Estimates from General International Conditions

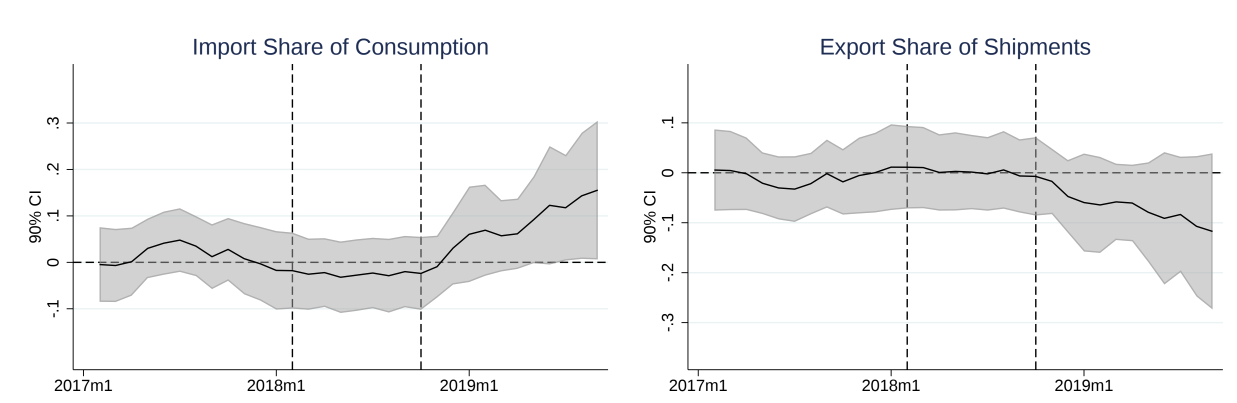
**(a)** Employment




**(b)** Industrial Production (Output)




**(c)** Producer Price Index




*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Each panel displays displays coefficient estimates and standard errors of the interactions of the control variables for import share of consumption (absorption) and export share of shipments with month dummies. Detrended dependent variables for each regression are noted in panel titles. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

panel in Figure 5 reveals that this result is not present once the measure for rising input costs is included in the regression.

## B.4 Results by Tariff Wave

The main results presented in Figure 5 calculate exposure to three tariff channels based on cumulative values of affected trade, covering all tariffs imposed during our sample period. Figures B5, B6, and B7, on the other hand, show the results of regressions that include separate measures for each of the individual waves of tariffs. Therefore, Figures B5, B6, and B7 each show the results of a single regression. The vertical lines in each of the figures represent the time that each individual tariff wave took effect.

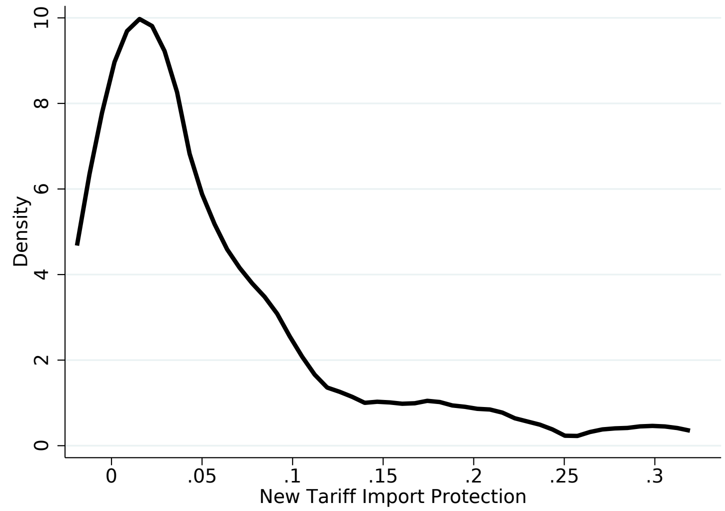
These figures yield several findings on the effects of each individual tariff wave. First, we typically find the most pronounced relationships with outcome variables coming from the March (steel and aluminum) and September (largest China 301 wave) waves of U.S. tariffs. This is apparent, for example, in the relationship between the rising input cost tariff waves and employment (panel (a) of Figure B5) and producer prices (panel (a) of Figure B7). Second, we find that producer prices respond quickly to tariffs. Panel (a) of Figure B7 shows producer prices rising immediately in response to the March and September 2018 rounds of tariffs.

## B.5 Two Robustness Checks for the Nonmanufacturing Industry Sample

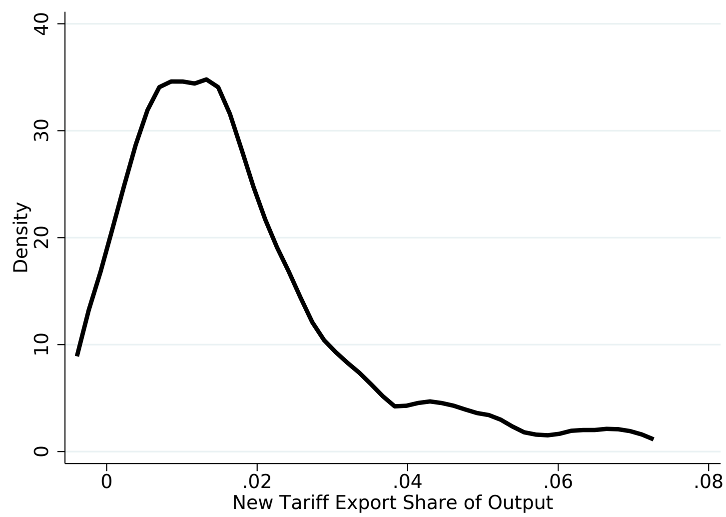
We conduct two robustness checks to examine potential explanations for the weak relationship between exposure to the input cost effects of tariffs and non-manufacturing employment. First, we examine the importance of limitations on the industry detail of data for specific non-manufacturing industries. Data for nonmanufacturing industries are, in general, less detailed than for manufacturing industries, especially in the input-output tables. This lack of disaggregated data is particularly acute for some nonmanufacturing industries that are likely to be affected by tariffs, especially construction, for which all detailed industries in the input-output tables match to a single two-digit NAICS code (NAICS 23). As shown in the middle panel of Figure B8, excluding construction from the analysis of nonmanufacturing industries substantially changes the contour of the coefficients, while still indicating a lack of a statistically significant relationship between tariff exposure and nonmanufacturing employment. Second, we examine the relevance of short-term trends in employment for non-manufacturing industries in the pre-tariff period. The step up in coefficients in 2017 shown in the upper left panel of Figure 8, even after linear detrending, indicates that employment for some of the more-exposed nonmanufacturing industries was increasing at a non-linear rate in the months before tariffs were announced or implemented. In the right panel of Figure B8, we display results of estimating equation 9 after subtracting a quadratic trend from the dependent variable, based on each industry's 2017 data. As shown in the panel, accounting for the more-than-linear employment growth observed in 2017 reveals a substantial slowing that occurs at the time the tariffs begin to be imposed, and which deepens as additional rounds of tariffs take effect. Nonetheless, we caution that the implied assumption that the non-linear growth in employment would continue for any extended period of time is aggressive, and would be likely to reveal under-performance relative to this trend.

**Figure B2:** Density Estimates of Tariff Exposure Channels Across Manufacturing

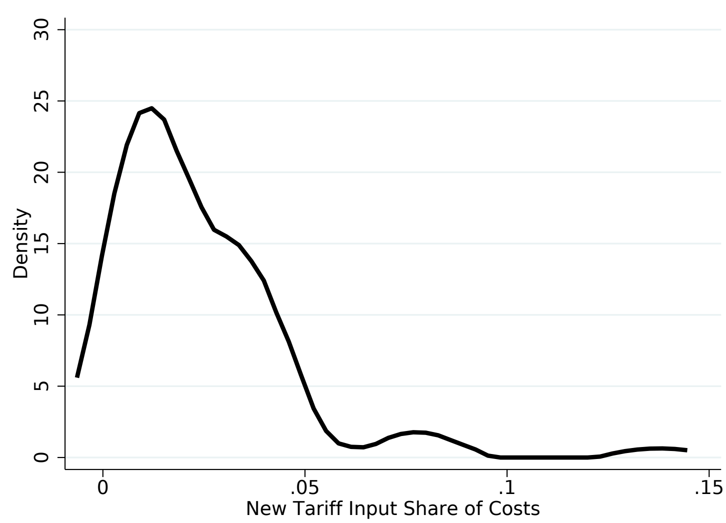
**(a)** Import Protection




**(b)** Foreign Retaliation




**(c)** Rising Input Costs

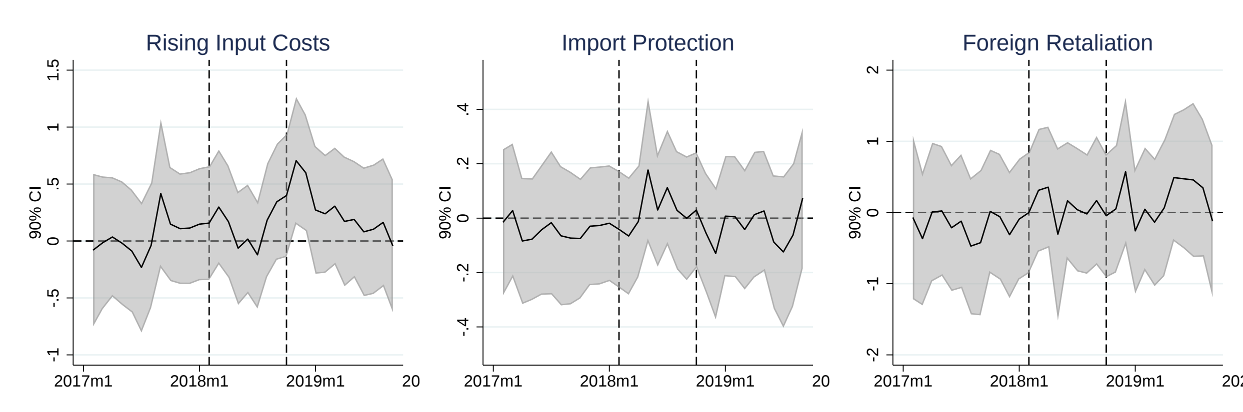



*Sources:* Figures display densities of industry-level measures of exposure to each tariff channel.

**Figure B3:** Effects of Cumulative Tariffs (Non-Detrended)

**(a)** Employment


**(b)** Industrial Production (Output)



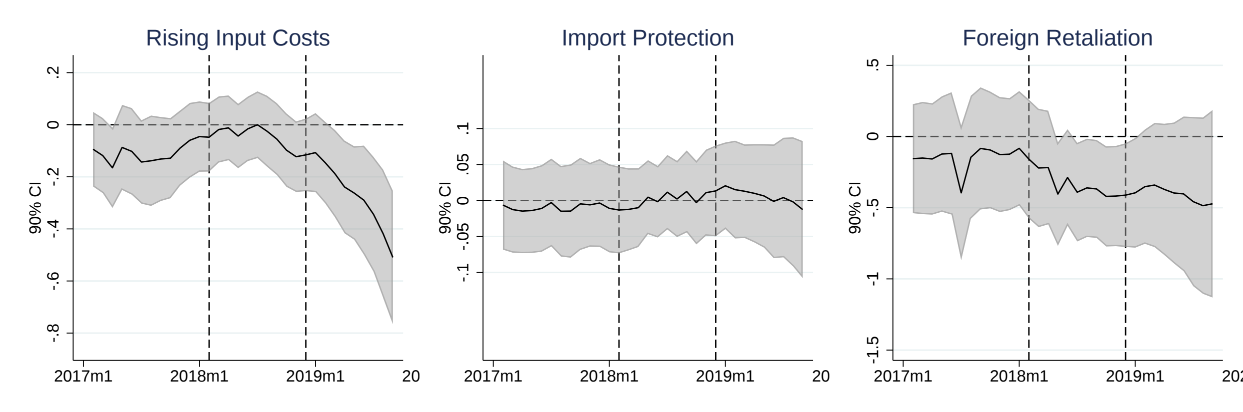

**(c)** Producer Price Index


*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.

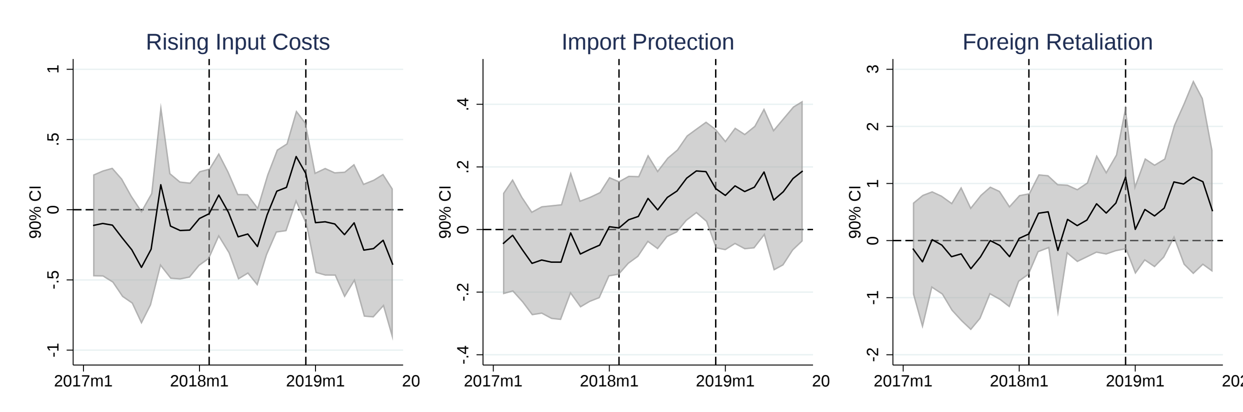
*Notes:* Each panel displays results of a separate regression for the noted non-detrended dependent variable, with each column corresponding to the three tariff channels in equation (7). Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Figure B4:** Univariate Effects of Cumulative Tariffs (Detrended)

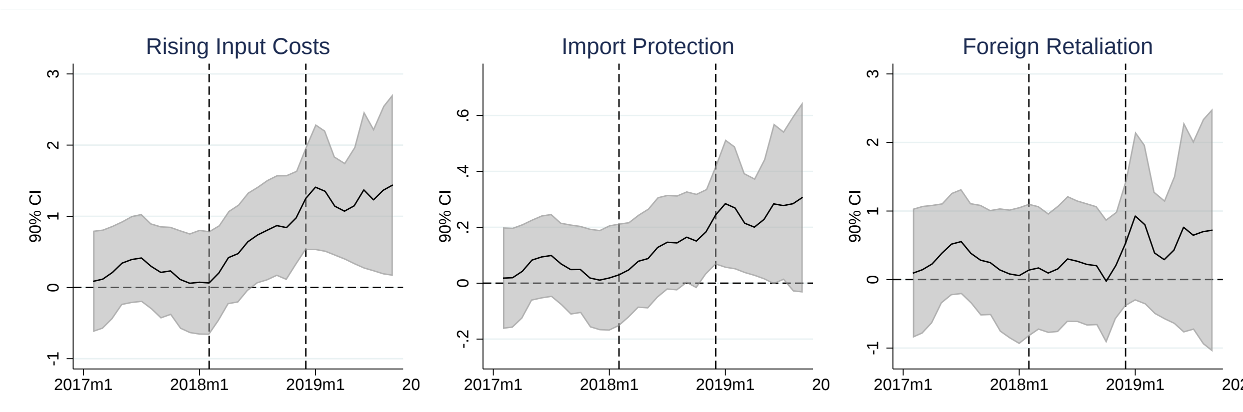
**(a)** Employment




**(b)** Industrial Production (Output)



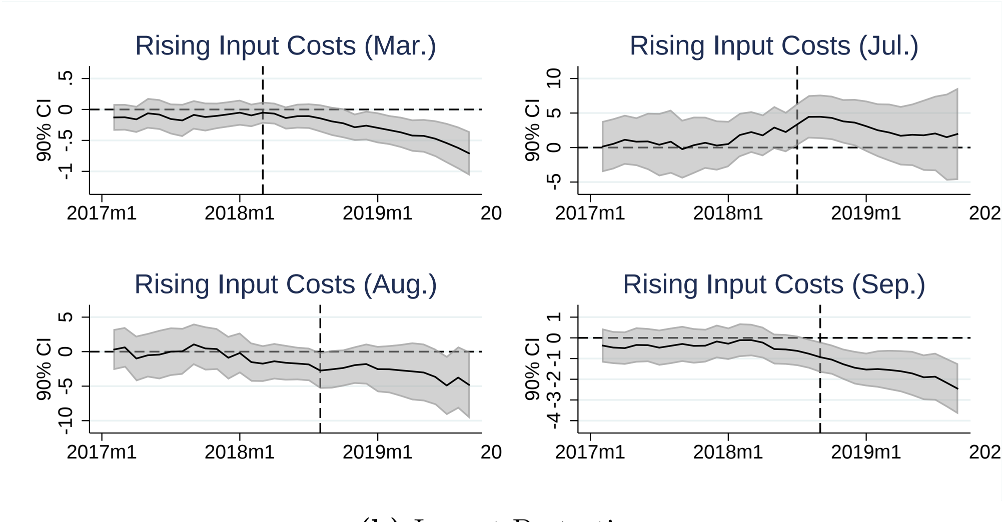

**(c)** Producer Price Index



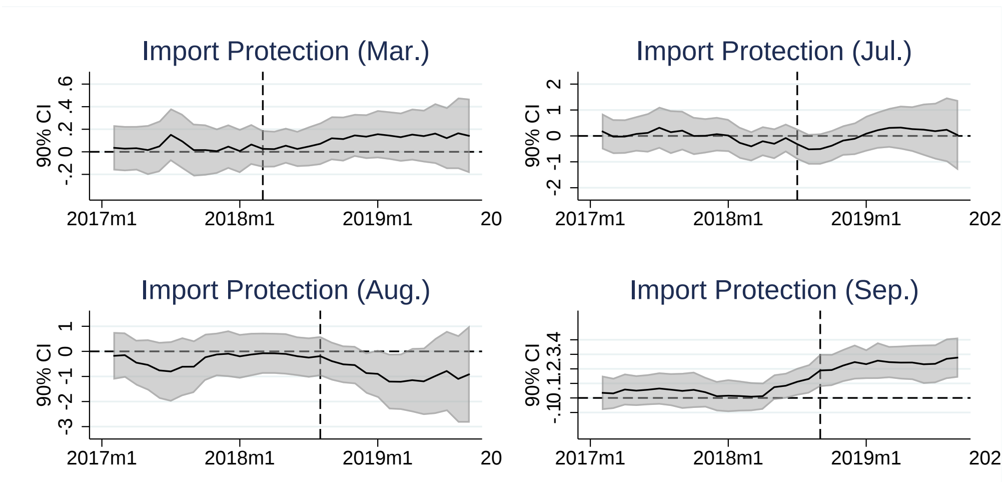

*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Each chart displays results of a univariate regression of the noted detrended dependent variable, on interactions of month dummies with the noted tariff channel. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Figure B5:** Employment Effects by Tariff Wave (Detrended)

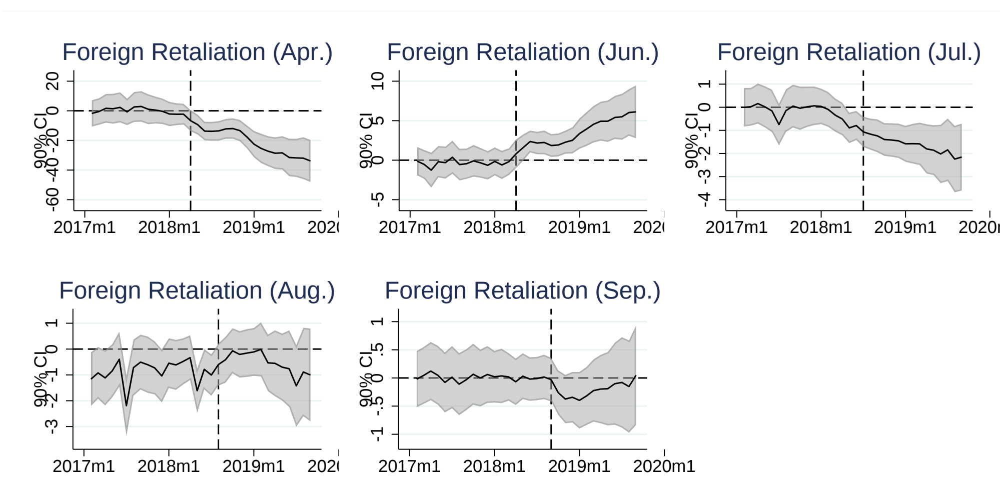
**(a)** Rising Input Costs




**(b)** Import Protection



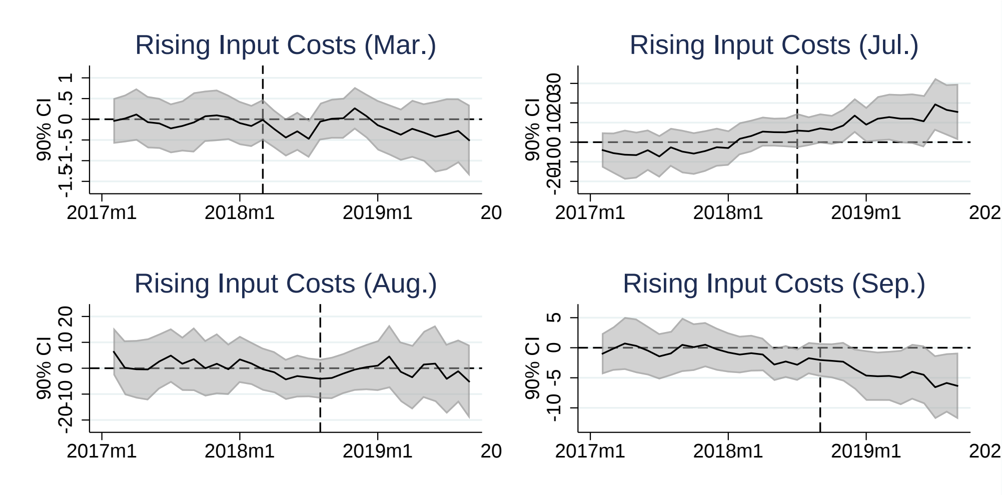

**(c)** Foreign Retaliation



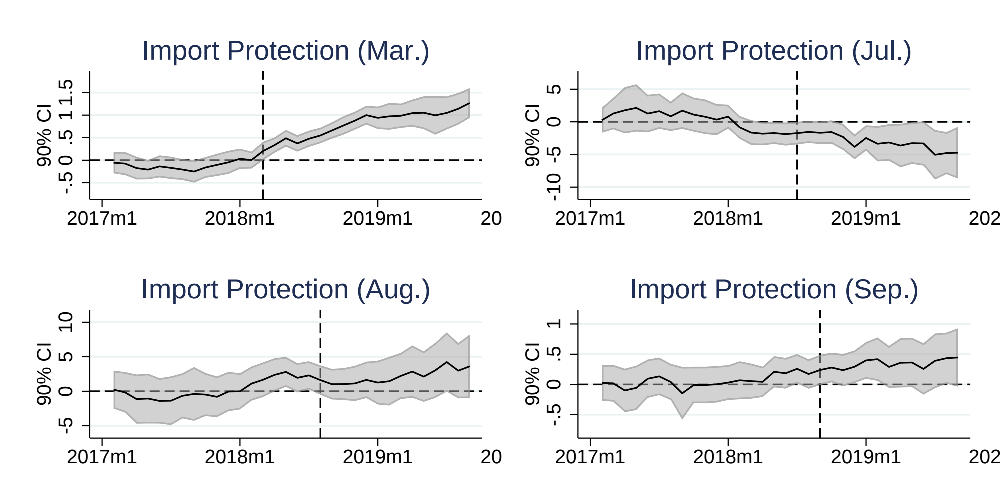

*Sources:* U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.
*Notes:* Figure displays results of a single regression of detrended employment on interactions of month dummies and measures of exposure to each individual tariff wave for each of the three tariff channels. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Figure B6:** I.P. Effects by Tariff Wave (Detrended)

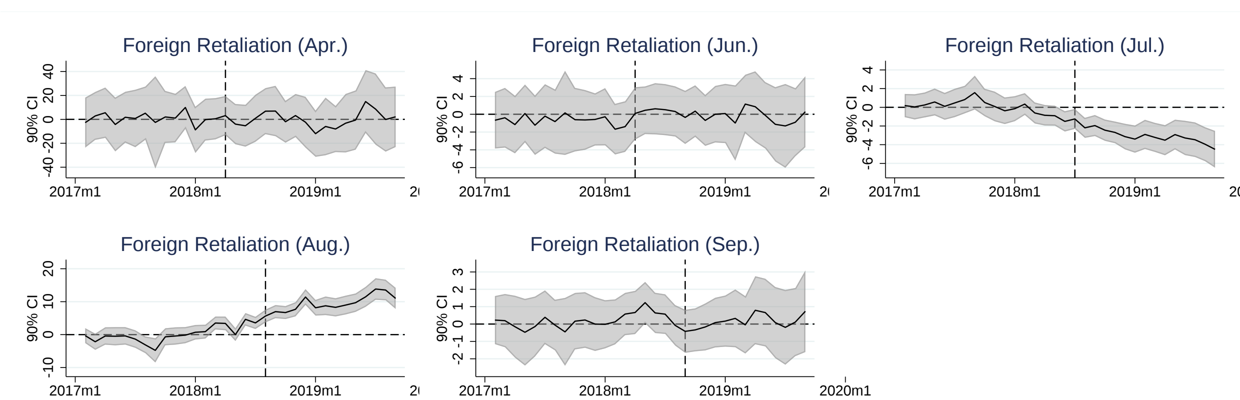
**(a)** Rising Input Costs




**(b)** Import Protection



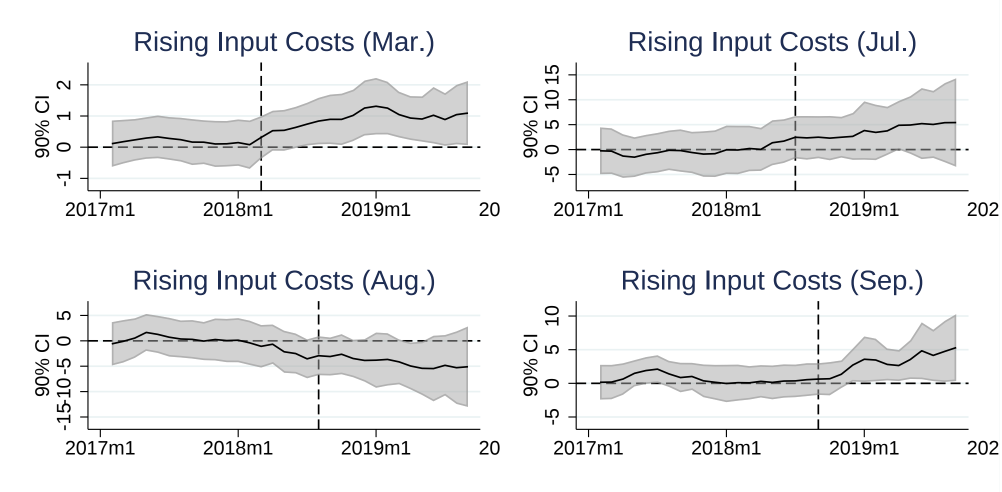

**(c)** Foreign Retaliation



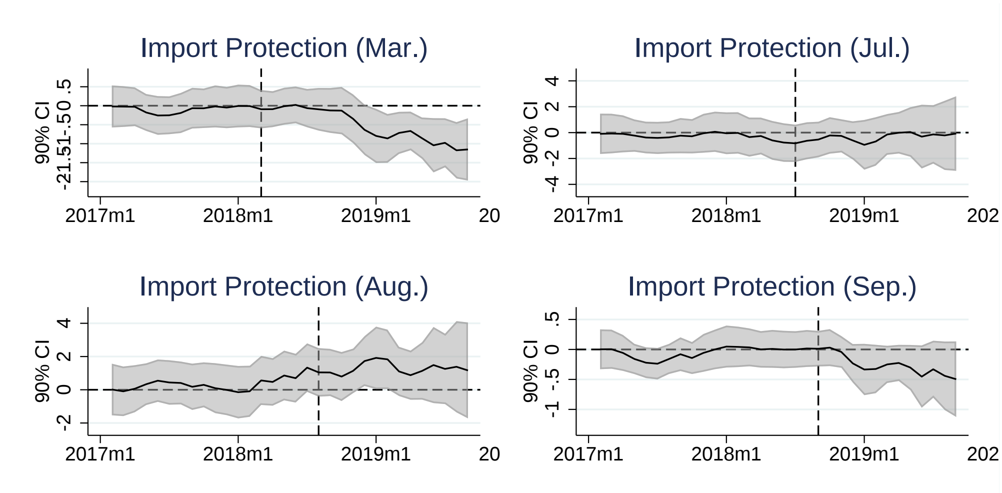

*Sources:* Federal Reserve Board; authors' calculations.
*Notes:* Figure displays results of a single regression of detrended industrial production on interactions of month dummies and measures of exposure to each individual tariff wave for each of the three tariff channels. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Figure B7:** P.P.I. Effects by Tariff Wave (Detrended)

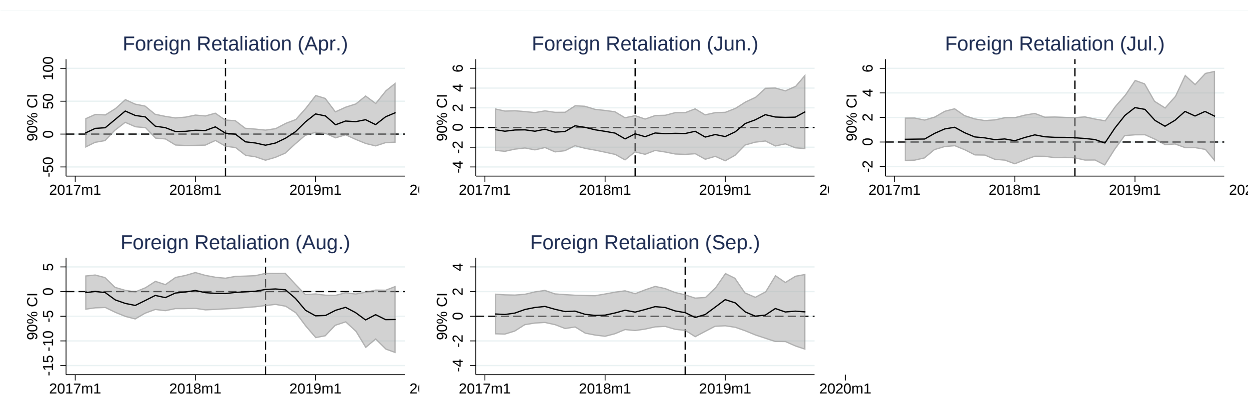
**(a)** Rising Input Costs




**(b)** Import Protection

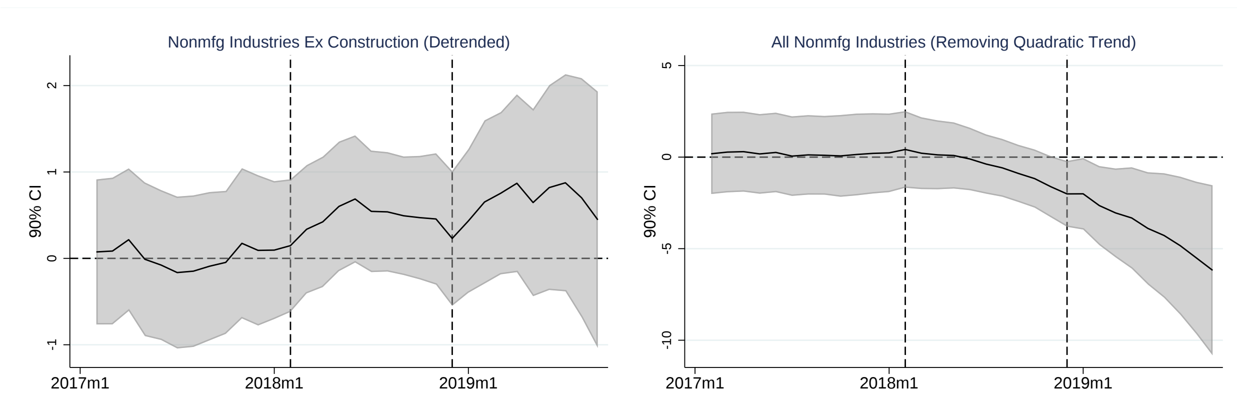



**(c)** Foreign Retaliation




*Sources:* U.S. Department of Labor, Bureau of Labor Statistics ; authors' calculations.
*Notes:* Figure displays results of a single regression of detrended producer price indexes on interactions of month dummies and measures of exposure to each individual tariff wave for each of the three tariff channels. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.

**Figure B8:** Relationship Between Exposure to Rising Input Costs Via Tariffs and Non-manufacturing Employment




*Sources:* Federal Reserve Board (FRB), U.S. Department of Labor, Bureau of Labor Statistics; authors' calculations.

Notes: Each column in the figure represents results of a separate regression of nonmanufacturing employment on exposure to rising input costs via tariffs. The left panel displays results using linearly-detrended non-manufacturing employment, but excludes the construction sector (NAICS 23). The right panel uses non-manufacturing employment de-trended with a quadratic term. Solid lines indicate coefficient estimates and shaded areas represent 90 percent confidence intervals. The two vertical dashed lines are at February 2018 and September 2018, the times of the first and last waves of new 2018 tariffs.