Are Tariffs Biased? The Effects of the 2018 US Tariffs on The Gender Wage Gap[1]

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ABSTRACT

In 2018, the United States imposed tariffs on all imported steel and aluminum. Although the U.S. has a long history of using unilateral tariffs, the breadth of and justification for these tariffs renewed global attention on the effects of trade policies. In this paper, we examine how these tariffs changed the gender wage gap in the years leading up to the COVID-19 pandemic. Specifically, pooling waves 1–3 of the 2018 panel of the Survey of Income and Program Participation (SIPP) and using an Ordinary Least Squares (OLS) model, we explore the effects of the 2018 U.S. tariffs on steel and aluminum on industry-specific gender wage gaps. Ex ante, the effects of tariffs on the gender wage gap is ambiguous. Tariffs on steel and aluminum as final goods may lower competition by increasing the prices of foreign goods relative to domestic goods, increase demand for domestic products, and therefore increase employment. Given the higher concentration of male-to-female workers at steel and aluminum industries, the increase in employment is likely concentrated among men, leading to an increase in the male-to-female wage ratio. Alternatively, tariffs on steel and aluminum as intermediate goods may increase the cost of production at downstream domestic industries, and lead to a price hike. This price hike would lower demand and increase employment layoffs in industries producing final goods. Depending on the composition of these downstream industries, more men may be laid off, relative to women, which would lower the gender wage gap.

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[1] This paper is released to inform interested parties of ongoing research and to encourage discussion of work in progress. The views expressed on methodological issues are those of the author(s) and not necessarily those of the U.S. Census Bureau. The U.S. Census Bureau reviewed this data product for unauthorized disclosure of confidential information and approved the disclosure avoidance practices applied to this release. CBDRB-FY22-POP001-0028. The estimates in this paper are based on responses from a sample of the population and may differ from the actual values because of sampling variability and other factors. As a result, apparent differences between the estimates for two or more groups may not be statistically significant. Comparisons are significant at the 90 percent confidence level unless stated otherwise. For information on sampling and nonsampling error refer to: https://www.census.gov/programs-surveys/sipp/methodology/sampling.html. For technical documentation and more information about SIPP data quality, please visit the SIPP website's Technical Documentation page at https://www.census.gov/programs-surveys/sipp/tech-documentation.html.

1 Introduction

The gender wage gap— differential pay by gender to workers with otherwise observationally identical characteristics— has both immediate and generational consequences for the economic and social well-being of individuals, families, and society (Aizer 2010; Angel-Urdinola and Wodon 2006; Bond et al. 2020). Therefore, it is not surprising that there is an ever-growing literature on the determinants of the gender wage gap. In fact, this literature documents competition and industrial employment composition as potential contributing factors to the gender wage gap.[2] Trade shocks, such as those from rising international competition in manufacturing, on average, reduce employment and income of young men (Autor, Dorn, and Hanson 2019). Also, growing trade and increasing competition among countries lead to a reduction in the gender wage gap (Black and Brainerd 2002). Given that tariffs are considered a tool to protect domestic industries against international competition, they too may change employment composition of industries and influence the gender wage gap.

In 2018, the United States implemented some of the most aggressive trade policies since the end of the World War II. It began with 20–50 percent tariffs on washing machines and washers, 30 percent on solar cells and modules, and ultimately led to 25 percent tariffs on imported steel and 10 percent tariffs on imported aluminum. This radical change in the U.S. trade policy presents a unique opportunity for researchers to examine the effects tariffs on the gender wage gap.

[2] See Bertrand (2011) for a review of gender gaps literature. For differential sorting of men and women across firms and industries and their effects on gender wage gap, see Card, Cardoso and Kline (2016) and Sin, Stillman and Fabling (2020), respectively.

Pooling waves 1–3 of the 2018 panel of the Survey of Income and Program Participation (SIPP), we examine the effects of the 2018 U.S. tariffs on steel and aluminum on gender wage gaps. Ex ante, the effects of tariffs on the gender wage gap are ambiguous. Part of the ambiguity stems from the different ways in which tariffs can affect domestic industries. The other part stems from the dual nature of steel and aluminum as both final and intermediate goods.

Tariffs can, and are intended to, lower the competition domestic industries face from foreign industries. Tariffs on steel and aluminum as final goods can achieve lower competition by increasing the prices of foreign goods relative to domestic goods. Given the inverse relationship between demand and price, tariffs may increase the quantity demanded for domestic products, which in turn will increase domestic employment. Given the higher concentration of male-to-female workers in steel and aluminum-intensive industries,[3] the increase in employment is likely concentrated among men, leading to an increase in the male-to-female wage ratio.

Alternatively, tariffs on steel and aluminum as intermediate goods can increase the cost of production at downstream domestic industries. The increased cost of production may result in price hikes, lower demand, and employment layoffs in industries producing final goods. Depending on the composition of industries that use steel and aluminum as intermediate goods, we may expect more men to be laid off, relative to women. This would lead to a reduction in the gender wage gap.

Figure 1 plots the changes in male-to-female ratios for employment (Panel A) and wages (Panel B) in SIPP, before and after the implementation of the 2018 steel and aluminum tariffs by

[3] Data from the Survey of Income and Program Participation (SIPP), 2018–2020 panels show that men account for 61 percent of employment in steel- and aluminum-intensive industries compared to 34 percent in all others. Steel- and aluminum-intensive industries are defined in Section 3.

industry. Points that are highlighted in magenta indicate industries in which there was a reduction in the male-to-female employment ratio or wage ratio after the implementation of the 2018 tariffs. Panel A shows that there was a reduction in the male-to-female employment ratio in Construction, Recreation and Food, Other Services, and Public Administration. This implies that, in these industries, it is either the case that more women were hired or more men were separated from employment from pre- to post-tariffs. Panel B indicates that there was a drop in the male-to-female wage ratio in Construction, Manufacturing, Information, Education and Healthcare, Recreation and Food, Transportation and Utilities, and Public Administration. These plots provide us with a first-hand look at how the tariffs may have affected the gender wage gap, but to determine how the two are related to each other, more precise modelling is necessary.

To identify the relationship between the U.S. tariffs and the gender wage gap, we estimate a pooled Ordinary Least Squares (OLS) regression model. We begin by identifying industries that are more 'steel-intensive' based on the 2017 production and consumption of steel, according to the Bureau of Economic Analysis (BEA). From there, we disaggregate industries based on their propensity to produce steel as an output, consume steel as an input, or both produce and consume steel. This distinction allows us to more easily identify the mechanisms that may result in the tariffs being associated with changes in the gender wage gap.

Our estimates show that when the tariffs on steel and aluminum, and retaliatory tariffs, were passed, women working in more steel-intensive industries experienced wages that were 10.7 percent lower, relative to men in non-steel-intensive industries. These results suggest that industries producing steel as a final good experienced higher demand, resulting in increases in employment. Because the steel industry tends to hire a larger proportion of men, relative to women, this increase in employment resulted in a widening of the gender wage gap. When testing this further by isolating industries that were more likely to consume (steel-intensive input) or more likely to produce (steel-intensive output), we find that many of the results lose their statistical significance.[4] Despite this fact, for industries that produce steel as a final good, after the implementation of tariffs on steel and aluminum and retaliatory tariffs, we find that women in these industries experienced a 10.3 percent reduction in wages, relative to men working in non-steel-intensive output industries. Again, these results suggest that firms producing steel as a final good were more likely to respond to an increase in demand by hiring more workers.

Our work advances the gender wage gap and trade liberalization literature in several ways. First, unlike previous work (Flaaen and Pierce, 2019) that examines the effects of tariffs on only the manufacturing sector, we examine how the effects of tariffs vary across industries. Second, in another deviation from previous work (Asquith et al., 2019) that primarily focuses on the effects of trade shocks on employment, we focus on the resultant changes in wages. Third, by using individual-level data (SIPP) we can account for individual's selection into different industries. Lastly, by using the SIPP, we can examine changes to wages at the monthly level. This fine-level microdata allows us to examine what is happening in direct response to changes in tariffs in the United States. While the relationship between trade and the gender wage gap has been studied (Menon and Van Der Meulen Rodgers, 2009; Artecona and Cunningham, 2002; Wolszczak-Derlacz, 2013), the topic remains fairly understudied within the United States (Autor et al., 2019; Black and Brainerd, 2002; Kamal et al., 2020). In using detailed micro-data,

[4] We discuss how steel-intensive input and steel-intensive output are defined in Section 3.

we contribute to this literature with a better picture of the impacts that trade has on individual outcomes.

In this paper, Section 2 provides a background on tariffs and the current literature on the impacts of tariffs. Section 3 discusses the data, while Section 4 explains our research methodology and model specification. Section 5 provides results for aggregated and dis-aggregated industries. Section 6 concludes.

2 Tariffs Background and Trade Literature

We begin by providing a brief background of U.S. trade history and its 2018 trade policy. We then provide an overview of the economic literature on trade, and then more specifically on the 2018 tariffs.

2.1 Tariffs Background

A tariff is a tax levied on imported goods with the goal of restricting the volume of imports, protecting domestic industries from foreign competition and consequently domestic levels of employment, and increasing revenue of national governments. The Tariff Act of 1789 was the first tariff levied by the United States, to finance expenses incurred during the Revolutionary War. In fact, because prior to 1913 and ratification of the 16th amendment to the U.S. constitution there was no income tax, tariffs were an important source of tax revenue for the federal government. Until then, tariffs accounted for 50 to 90 percent of the U.S. government's income.

Following the World War I, one of the strategies President Wilson outlined in his Fourteen Points speech before Congress for achieving long-lasting peace was removing trade barriers. The U.S.'s rejection of President Wilson's vision in the years that followed led to the passage of the Tariff Act of 1930, also known as the Smoot-Hawley Tariff, which levied the highest tariff rates ever imposed by the U.S. Authors have asserted Smoot-Hawley tariffs worsened the Great Depression (Bernanke 2013). As part of his efforts to pull the U.S. out of the Great Depression, President Roosevelt signed the Reciprocal Trade Agreements Act of 1934. The Reciprocal Trade Agreements Act permitted the president to lower U.S. trade barriers in return for similar concessions from other countries. By the end of World War II, the U.S. had reached trade agreements with more than 25 countries (Dobson 1976).

As the role of tariffs in generating revenue for the government declined, tariffs became intertwined with foreign policy and protecting national security. Lower tariffs would open markets to foreign goods and promote economic stability and peace, while higher tariffs would close market access to rivals and pressure them to adopt U.S. values. In fact, Krugman (1993) argues that the North American Free Trade Agreement (NAFTA) between the U.S., Canada, and Mexico was motivated by foreign policy: fostering strong and democratic neighbors. Similarly, in 2013, when the U.S. and the European Union launched negotiations on a Transatlantic Trade and Investment Partnership (T-TIP) agreement to lower tariff barriers to zero, it was viewed as a foreign policy instrument aimed at curbing the rise of China and other emerging economies in the global market.

However, in 2018, in a reversal of general trend toward lowering tariffs and other trade barriers, the U.S. rolled out several tariffs. On January 22, 2018, the U.S. imposed tariffs of 20 percent on the first 1.2 million washing machines and 50 percent of all subsequent imported washing machines with the rate set to decline over three years. A 30 percent tariff was also imposed on solar panel components with the rate set to decline over four years. Tariffs on imported steel were increased to 25 percent on March 8, 2018 and were followed by an increase in tariffs on aluminum imports to 10 percent on March 23, 2018. Countries responded negatively to the tariff announcement by the U.S. and enacted retaliatory tariffs on U.S. imports. The retaliatory tariffs were imposed by China in April 2018, while the European Union, Canada, and Mexico enacted their own retaliatory tariffs in June and July of 2018. In April 2018, the U.S. specifically imposed tariffs on imported goods from China in multiple phases, each of which was then met by retaliatory tariffs from China. The trade war with China escalated through 2019 and is ongoing. Currently, negotiations to loosen tariffs with China are underway (Ruwitch 2021).

2.2 Tariffs Literature

David Ricardo developed the first economic theory of trade in *Principles of Political Economy and Taxation* in 1817. This model presented the first explanations of comparative advantages between two countries. John Stuart Mill (1821) further developed the Ricardian model so that trading partners' "reciprocal demand" would determine the price. Alfred Marshall (1879) then advanced the role of demand by constructing "offer curves" and nations' willingness to import and export at different prices based on a country's production possibility frontier, indifference curves, and relative price ratios.

If countries adopt the same level of technology, the Ricardian model can no longer explain why they trade. Therefore, Heckscher (1919) and Ohlin (1924) developed a new trade model to explain benefits of international trade even when countries have identical technologies. The model assumes two countries, say Japan and India, with varying endowments of production factors, labor and capital, and goods that require different proportions of labor and capital for production. Suppose India has an abundance of labor compared to Japan, while Japan has abundance of capital relative to India. Further suppose that shoe production is more labor intensive than computer production. Since India is relatively well endowed in labor compared with Japan, labor and consequently shoe production are cheaper in India. Whereas in Japan, because of a higher relative endowment of capital, capital and computer production are cheaper. Thus, India has a comparative advantage in producing shoes and Japan has a comparative advantage in producing computers.

However, in an endowment-based trade model, free trade can change prices. Stolper and Samuelson (1941) set forth a theorem within the Heckscher-Ohlin framework about the consequences of free trade in terms of relative prices of traded goods and the relative prices of their factors of production. The theorem states that free trade will benefit a country's abundant resource and harm that country's scarce resource. Per the preceding example, by exporting shoes and importing computers, India faces an increase in demand for shoes relative to computers. Consequently, demand for labor relative to capital and the price of labor (wages) relative to the price of capital (rent) increase in India. Free trade reduces the relative scarcity of capital in India, which would push down rental rates. Meanwhile, by exporting computers and importing shoes, relative demand for computers and the rental rate of capital relative to wages increase in Japan. At the same time, the relative scarcity of labor is reduced in Japan and labor prices fall.

Of course, economists have since expanded these early models to multi-commodity, multi-country, and multi-factor. New economic trade theories have even relaxed some of the assumptions in the older models and incorporated economies of scale, firm sizes, market structures, and intra-industry trade in their models, which partially if not completely affected the predictive power of older models. However, even though the old theories and the newer variants stated the benefits of trade by comparing static equilibrium states, not many examined growth and development consequences of free trade until the 1950s (refer to Sen 2010 for an overview of some of these models and a more extensive discussion of the literature). Even then, the consensus was that exports led to growth. Supporting examples for this consensus are Japan and Germany post World War II, the East Asian Tigers (South Korea, Taiwan, Hong Kong, and Singapore) between 1970-1985, Mexico in 1994 through NAFTA, and China in the early 2000s through admission to the WTO (Palley 2011).

Despite the consensus on trade liberalization, some countries from time to time adopt protectionist trade policies not for economic reasons but rather for political reasons. In fact, the Stolper-Samuelson theorem on the effect of free trade on price changes within the Heckscher-Ohlin model provides insight into the political economy of trade. Labor in a capital-abundant country that experiences downward pressure on wages has an incentive to oppose free trade through interest groups and voting. Higher geographic concentration, more voters, or stronger interest groups of affected industries increases the likelihood of receiving trade protection. There may also be persistence in the level of trade protections from policymakers' reluctance to pay for adjustment costs from tariff reduction. Policymakers may also have an incentive to reduce income inequality by keeping high tariffs for industries that employ lower-skilled workers with lower income. Bargaining ability of countries, their rate of investments in one another, and their ability to restrict the flow of earnings back to the investing country may shape foreign policy and policymakers' willingness to lower tariffs (Gawande and Krishna 2003).

Examples of such "endogenous" trade policies in the U.S. are the 10 percent tariffs imposed by President Richard Nixon, shoe quotas imposed by President Jimmy Carter, Japan's "voluntary" quotas on automobile exports under President Ronald Reagan, steel tariffs by

President George W. Bush, and 35 percent tariffs on Chinese tires by President Barack Obama, all in their first terms. President Donald Trump joined the trend in 2018. However, the extent of the 2018 tariffs was unprecedented in modern U.S. history. President Trump announced tariffs on imported washing machines and solar panels under Section 201 of the Trade Act of 1974, which allows for trade protection if an import causes or threatens to cause substantial injury to an industry. President Trump also levied tariffs on imported steel and aluminum under Section 232 of the Trade Expansion Act of 1962, which allows for protection if imports imperil national security. The president imposed further tariffs on China by invoking Section 301 of the Trade Act of 1974, which allows for tariffs if a trading partner is in violation of terms of trade. However, by the end of 2018, the tariffs costed U.S. consumers and firms importing foreign goods $3.2 billion per month in additional tax costs and another $1.4 billion per month in lost welfare (Amiti, Redding and Weinstein 2019). The short-run aggregate net real income loss as a result of the 2018 tariffs was $7.2 billion, or 0.04 percent of GDP (Fajgelbaum, et al. 2020). Additionally, rising input costs from tariffs lowered employment in the U.S. manufacturing sector (Flaaen and Pierce 2019).

3 Data

The Survey of Income and Program Participation (SIPP) is a longitudinal household survey that collects information on individuals' employment characteristics, social program participation, demographic characteristics, to name a few, over multiple years. A group of households selected for repeated interviews over multiple years makes-up a SIPP panel. The 2018 panel was administered as a standalone panel, while the 2019 and the 2020 panels were conducted concurrently with previous panels as an overlapping design. Within each panel, a full year of interviews is referred to as a wave. In the 2018-2020 SIPP panels that we use in this paper, selected households are intended to be interviewed for four years (Waves) about the preceding calendar years.[5] We focus on waves 1–3 of the 2018 panel, which have reference years of 2017, 2018, and 2019, respectively.

Compositional differences in our sample before and after the tariffs could indicate a correlation between individual decisions to leave the survey across waves (attrit) with the implementation of the tariffs. Such correlation could pose identification challenges to estimating the effects of the steel and aluminum tariffs on gender wage gap. Table 1 characterizes the sample of workers before and after implementation of the steel and aluminum tariffs. Columns 1 and 2 show sample averages. Column 3 shows *t*-statistics for a test of equality of means between the two samples. The post-tariff period has lower shares of respondents that are women (0.5 percent), respondents that are white (0.7 percent), respondents with a high school diploma (1.1 percent), divorced respondents (0.5 percent), respondents working in construction (0.4 percent), and Finance and Real Estate (0.4 percent). Also, the post-tariff period has higher rates of respondents from other races (0.8 percent), Hispanics (1.1 percent), respondents with at least a bachelor's degree (1.4 percent), and respondents working in other services industry, except for Public Administration (0.3 percent). These differences are small and are not alarming.

While respondents take the survey annually, information about employment is measured at the monthly level. Respondents can report up to seven jobs and two instances of a change in

[5] The 2018 panel only includes wave 1 respondents, while the 2019 panel includes 2018 Wave 2 respondents as well as 2019 Wave 1 respondents. The 2020 panel would then include 2018 Wave 3, 2019 Wave 2, and 2020 Wave 1. However, for data quality concerns, the SIPP survey administrators decided not to interview the 2019 Wave 1 respondents for another year. As such, the 2020 panel only includes 2018 Wave 3 and 2020 Wave 1 respondents.

earnings or employment status for each of the seven jobs. To account for multiple jobs, we define the respondent's primary job as the one accounting for the largest proportion of total annual earnings. Since the variation in the tariff implementation is at the monthly level, and there is monthly variation in earnings and hours worked, we can estimate the effects of tariffs using monthly data. However, given that other job characteristics such as industry[6] are constant for all months in which the primary job was held, we also use total annual earnings and annual hours earnings (i.e., total annual earnings / total annual hours) to estimate the effects of tariffs on gender wage gap. In the latter, all of 2018 and 2019 are considered post-tariff period.

To identify industries targeted by the steel and aluminum tariffs, we classify industries as whether they are steel-intensive or not. we aggregate industry codes from 2017 Census Industry classification into their two-digit NAICS sector codes. From there, we identify sectors that are more likely to use steel as an input or an output based on the Input-Output Accounts Data from the Bureau of Economic Analysis (BEA).[7] The industries that we identify as more steel-intensive are Mining, Construction, Manufacturing, Transportation and Utilities, Professional Services, Recreation and Food, Public Administration, and Military.

[6] Within a job, the occupation code can change if the respondent reports a change in their job, but the industry code will remain the same.

[7] We use the numbers from 2017 for our calculations. The tables were accessed on the 30th of September 2020. The most recent version of these tables can be found on the BEA's website at: https://apps.bea.gov/iTable/iTable.cfm?reqid=150&step=3&isuri=1&table_list=6010&categories=io and https://apps.bea.gov/iTable/iTable.cfm?reqid=150&step=3&isuri=1&table_list=6007&categories=io
We identify the top five industries that have the highest use of steel as steel-intensive input industries. Top five industries with the highest steel production are steel-intensive output industries.

4 Research Methods

We now describe our empirical framework to identify changes in employment of women relative to men in response to tariff increases on steel and aluminum, and to examine resultant changes in the gender wage gap as a function of changes in relative employment of women and men in industries exposed to tariffs. The ideal experiment to identify gender wage gap impacts would require random assignment of tariffs across men and women, industries, and time. Although the timing of the imposition of the tariffs is plausibly random, there is a well-documented sorting across industries by gender. Further, the choice of steel and aluminum for invoking tariffs is probably not exogenous. Therefore, even if tariffs on steel and aluminum were random, selection on unobservables into different industries would make causal estimation of the gender wage and employment gaps challenging because of omitted variables bias. The endogenous choice of steel and aluminum for tariffs adds an additional identification challenge.

We identify targeted industries based on the steel intensiveness of their inputs or outputs using broad (two-digit) NAICS industry classifications. Broad sector definitions may not perfectly separate industries that only use steel and aluminum as inputs from industries that only produce steel and aluminum as final goods; that is, within two-digit NAICS industries, some detailed industries are more steel-intensive input industries, some are more steel-intensive output industries, and some do not use steel intensively. However, this strategy does address the endogenous sorting into industry by gender. If men and women differentially enter different industries, by aggregating these industries into various segments of economy (two-digit NAICS codes), then we may be able to smooth over the selection on unobservables.

In fact, we assess whether there is any sorting across two-digit NAICS codes by gender in Figure 2. Panel A shows monthly trends in employment ratio of men to women across broad industry classifications from January 2017 to December 2019. The vertical line in March 2018 denotes the steel and aluminum tariff implementation. It shows very similar male-to-female employment ratio patterns across industries, which not only alleviates concerns about gender sorting across industries, but also reduces concerns about possible correlations between the choice of steel and aluminum for tariffs with employment trends in such industries in the pre-tariff period. Panel B shows monthly trends in male-to-female wage ratio across two-digit industries and further removes concerns about the endogenous choice of tariffs on steel and aluminum.

To identify the causal effects of the U.S. tariff increases on the gender wage gap, we estimate pooled Ordinary Least Squares (OLS) regression models of the following form, where the treatment variable ($\delta_j * \tau_t * w_i$) is an interaction term between an indicator for whether an industry is steel intensive (input or output) (δ_j),[8] an indicator variable for the passage of tariffs (τ_t), and an indicator variable for being a woman (w_i).

The treatment variable captures how an industry classification of a firm affects log wages (Y_{ijt}) of men, versus women, differently before and after the passage of the 2018 steel and aluminum tariffs. The identifying variation comes from comparing men and women before and after the tariffs across industries that are steel-intensive. In the model,

[8] Recall from Section 3 that steel-intensive industries are determined from data provided by the BEA. Industries that had either the greatest domestic supply or the greatest consumption of steel-related commodities were identified as more steel-intensive.

$$\log(Y_{ijt}) = \alpha + \delta_j + T_t + \beta_1\tau_t + \beta_2 w_i + \beta_3(\delta_j * \tau_t) + \beta_4(\delta_i * w_i) + \beta_5(\tau_t * w_i) + \beta_6(\delta_j * \tau_t * w_i) + \alpha_1 X_{ijt} + \epsilon_{ijt}, \quad (1)$$

$Log(Y_{ijt})$ is the wages of person *i*, working in industry *j*, and in month-year *t* in some specification and year *t* in others. In the monthly specification, wage is defined as monthly earnings or monthly hourly wages for t = 1, …, 36, whereas in the annual specification, wage is defined as total annual earnings or total hourly wages (i.e., total annual earnings / total hours) for t = 2017, 2018, and 2019. T_t removes changes that have the same effect on all industries.

β_3 captures the differences across steel-intensive industries before and after tariff imposition. That is, β_3 would estimate: $\left(Y^{after\ tariffs}_{steel-intensive\ industry} - Y^{before\ tariffs}_{steel-intensive\ industry}\right) - \left(Y^{after\ tariffs}_{non-steel-intensive\ industry} - Y^{before\ tariffs}_{non-steel-intensive\ industry}\right)$. β_4 captures differences across industries for women versus men. That is, $\beta_4$would estimate: $\left(Y^{women}_{steel-intensive\ industry} - Y^{men}_{steel-intensive\ industry}\right) - \left(Y^{women}_{non-steel-intensive\ industry} - Y^{men}_{non-steel-intensive\ industry}\right)$. β_5 captures differences in the effects of tariff imposition by sex, i.e., $\left(Y^{women}_{after\ tariffs} - Y^{men}_{after\ tariffs}\right) - \left(Y^{women}_{before\ tariffs} - Y^{men}_{before\ tariffs}\right)$.

Finally, β_6 captures how the gender wage gap evolves differentially by whether an industry is steel-intensive after the imposition of tariffs. Therefore, at first glance, β_6 may appear similar to a triple difference-in-differences estimator. However, a distinguishing feature of our setting is the lack of control groups – all industries and both sexes are "treated" by the tariffs, albeit to different extents.

X_{ijt} includes control variables for individual characteristics that might be correlated with wages by gender, such as dummy variables for race and ethnicity, education, marital status, an indicator variable for whether an individual worked for an employer or had other work arrangements versus being self-employed, average age, and age squared. ϵ_{ijt} is the error term.

5 Results

In this section, we present the results of our empirical models. We begin by presenting pooled OLS estimates, at the annual and monthly level, for industries that either use steel and aluminum as inputs or produce them. To explore whether the results are sensitive to earnings and wage outliers, we also present results excluding the earnings measures above the 99th percentile. To tease out whether the estimated effects of tariffs are driven by industries that are defined as either a steel-intensive input industry or steel-intensive output industry, we regress the log of the wage ratio on separate indicators.

5.1 Effects in Steel-Intensive Industries

Table 2 gives the regression results for steel-intensive industries (input or output) relative to non-steel-intensive industries. Because the 2018 tariffs targeted steel and aluminum, we would expect industries that use or produce a lot of steel to be affected to a greater degree than other industries. Steel-intensive industries are determined from the Input-Output Accounts Data generated by the BEA. Industries that had either the greatest domestic supply or the greatest use of commodities that were steel related were identified as more ‘steel-intensive’ industries. These industries were Mining, Construction, Manufacturing, Transportation and Utilities, Professional Services, Recreation and Food, Public Administration, and Military.

In this table, and all subsequent results tables, Column 1 gives the estimates for log annual earning when tariffs are measured at the annual level, Column 2 gives the estimates for log annual hourly earnings when tariffs are measured at the annual level, Column 3 shows estimates for log monthly earnings when tariffs are measured at the monthly level, and Column 4 shows estimates for log monthly hourly earnings when tariffs are measured at the monthly level. Panel A presents results for the full sample and Panel B presents results when observations are restricted to below the 99th percentile of each respective earnings category. All estimates are calculated using pooled OLS and standard errors are clustered at the household level. Columns 1 and 2 have annual weights included while Columns 3 and 4 have monthly weights included.

According to the third column of Table 2, Panel A, when the 2018 tariffs on steel and aluminum were passed, women working in steel-intensive industries experienced monthly wages that were 10.7 percent lower, relative to men in non-steel-intensive industries. These results may suggest industries that use steel as a final good experienced a greater quantity demanded for domestic products which increased employment. Because steel-intensive industries are more likely to have a higher concentration of male-to-female workers, the gap in earnings grew as a higher proportion of men were hired into these jobs. In Column 4 Panel A, we observe a similar outcome where, after the passage of the steel and aluminum tariffs, women in steel-intensive industries experienced a 9.8 percent reduction in monthly hourly wages, relative to men in non-steel-intensive industries. The coefficients of interest in Columns 1 and 2 show a similar story at the annual level but these results are statistically insignificant.

Panel B of Table 2 gives the results for observations with earnings below the 99th percentile. In Column 3 (and 4) when estimates are calculated at the monthly level, women in steel-intensive industries experienced a 9.5 reduction in monthly earnings (7.5 reduction in monthly hourly wages) relative to men in non-steel-intensive industries. As with Panel A, these estimates are not statistically significant at the annual level.

To determine how this relationship changes when industries use steel and aluminum as inputs instead of producing them, we next disaggregate the industry type based on the use of steel and aluminum as inputs versus using steel and aluminum as outputs.

5.2 Steel-Intensive Industries by Inputs and Outputs

Tables 3 and 4 show results in the same format as Table 2, but with indicators for steel-intensive input industries (Table 3) and steel-intensive output industries (Table 4). These distinctions are made using the Inputs-Outputs Data produced by the BEA. Industries that were identified as more likely to use steel as an input were Construction as well as Transportation and Utilities. Industries that were identified as more likely to generate steel as an output were Professional Services as well as Recreation and Food.

Table 3 shows that there is no significant relationship between the passage of the steel and aluminum tariffs in 2018 and wages in steel-intensive input industries. Table 4, columns 3 and 4 show that monthly earnings and monthly hourly earnings for women in steel-intensive output industries were reduced by 10.3 percent and 7.5 percent, respectively, after the tariffs on steel and aluminum were implemented, relative to men in non-steel-intensive industries before the tariffs were implemented. The effect goes away when aggregating to the annual level. According to panel B, the annual estimates continue to be noisy, but we observe a similar magnitude of reduction in monthly estimates (9.2 percent and 5.3 percent reduction in monthly earnings and monthly hourly earnings, respectively) when the sample is restricted to under the 99th percentile of earnings.

Table 5 shows results of log income regressed on the triple interaction with industries that are both steel-intensive output and input industries. These industries are Mining, Manufacturing, Public Administration, and Military. According to columns 3 and 4, panel A, after the implementation of both steel and retaliatory tariffs, monthly earnings and monthly hourly earnings for women decreased by 7.0 percent and 6.6 percent, respectively, relative to men in non-steel-intensive industries pre-tariffs. These results remain when aggregated to the annual level in both panels A and B, but do not remain for the monthly results in panel B.

Tables 3 and 4 provide further support for the hypothesis that this relationship is present for steel-intensive output industries, as opposed to steel-intensive input industries. This indicates that firms experiencing a higher demand for domestically produced steel increased employment and, in turn, widened the gender wage gap for individuals working in more steel-intensive industries. Because this relationship was not present among steel-intensive input industries, we can see that it was not the case the firms responded to higher input prices from the tariffs.

6 Conclusion

This paper studies how the 2018 tariffs on steel and aluminum affected the gender wage gap. Using longitudinal data and fixed effects estimations, we show that women's wages decreased relative to men and, therefore, the gender wage gap widened. We argue that the impact of steel and aluminum tariffs operates chiefly through increases in the demand of the domestic supply of steel among industries that produce steel and aluminum as outputs, rather than industries that use steel and aluminum as inputs.

Our findings extend the growing body of evidence concerning the effects of the 2018 tariffs on prices, employment, and welfare. Whereas previous work exclusively focused on aggregate income loss or outcomes of specific sectors such as manufacturing, we show how the same forces identified in the literature differentially affect men and women. In doing so, our paper fills the gap between the recent work on the tariffs and the vast literature on labor market condition shocks and demographic outcomes such as marriage and fertility.

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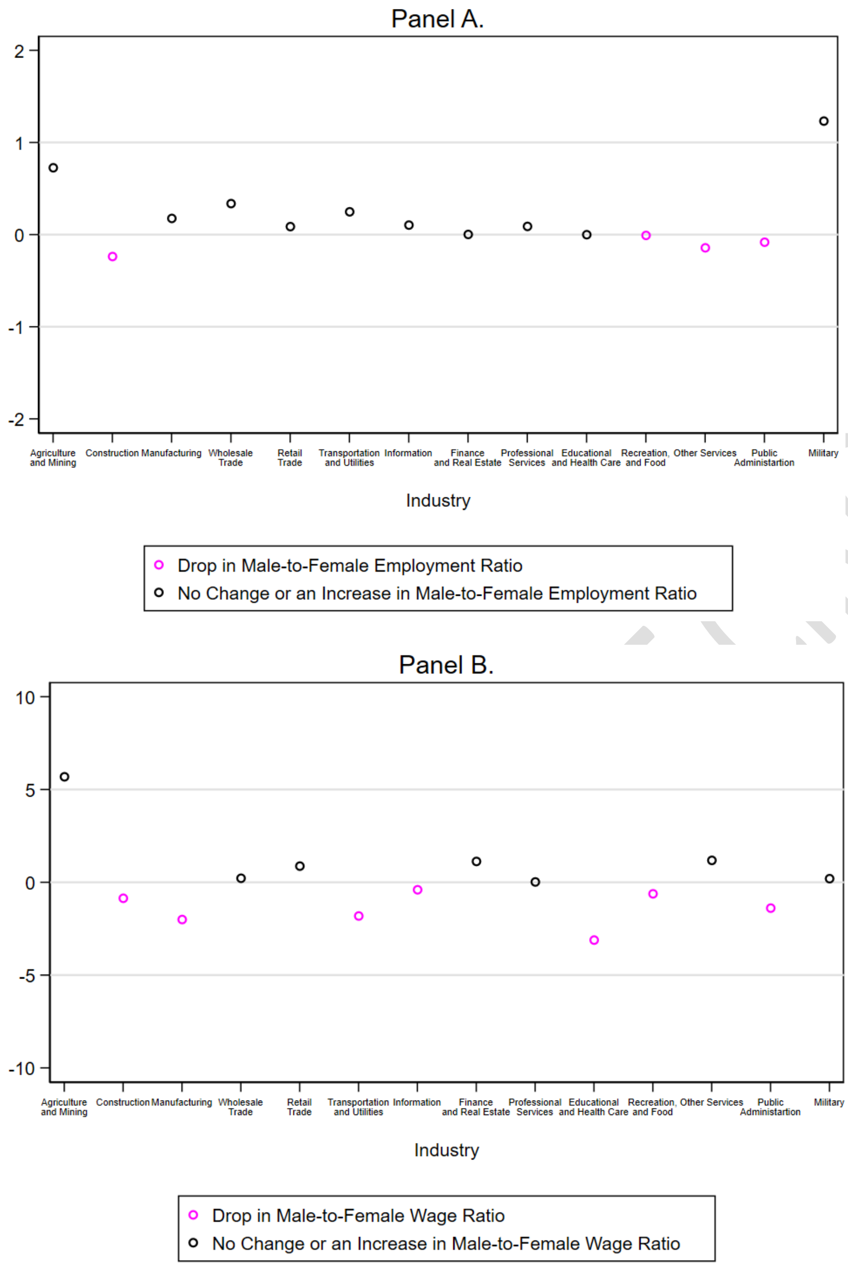
Figures

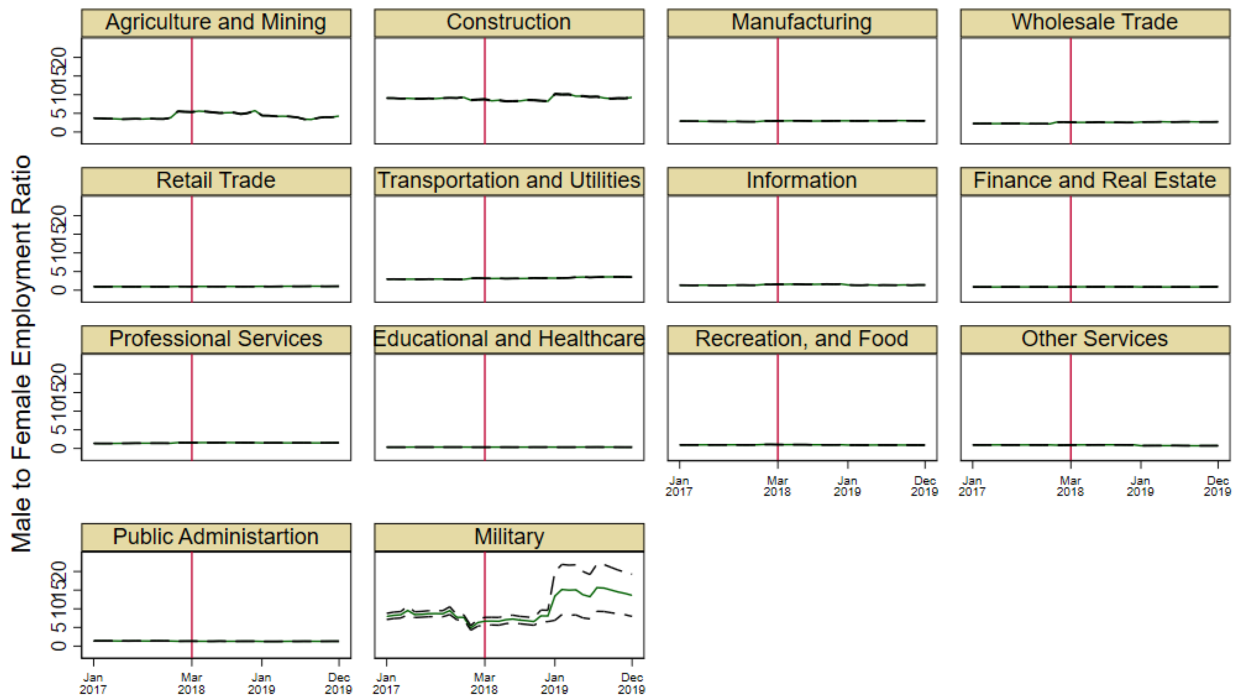
Figure 1: Differences in male-to-female employment and wage ratios before and after the 2018 tariffs



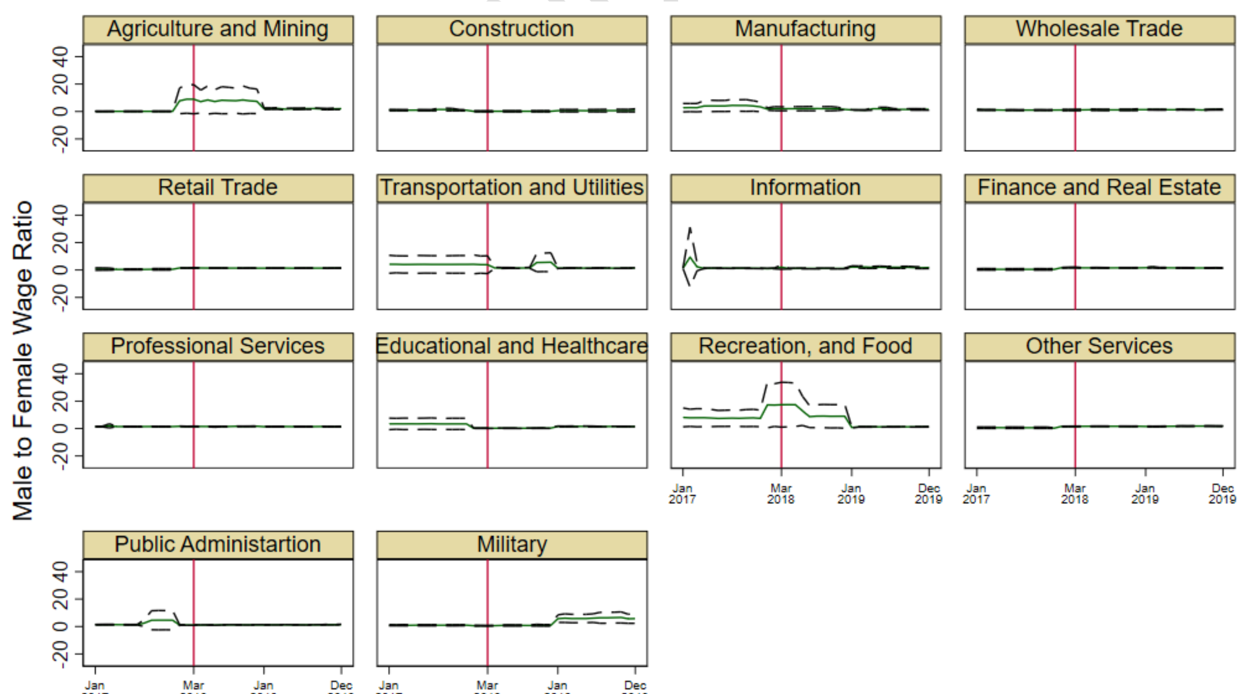
Source: Authors' calculations from the Survey of Income and Program Participation 2017-2019.
Notes: Wage defined as total annual earnings here.

Figure 2: Male-to-Female employment and wage ratios monthly trends until tariff impositions

Panel A.



Panel B.



Source: Authors' calculations from the Survey of Income and Program Participation, 2017-2019.
Notes: Wage defined as monthly earnings. The dashed lines mark the upper and lower confidence intervals for a 95 percent confidence level. The vertical line indicate the timing of steel and aluminum tariff.

Tables

Table 1
Characterizing the Samples Before (2017) and After (2018-2019) Tariffs

	(1) Before Tariffs, 2017	(2) After Tariffs, 2018-2019	(3) Difference
Women	0.479	0.474	-0.005*
	(0.500)	(0.499)	(0.003)
White	0.785	0.777	-0.007*
	(0.411)	(0.416)	(0.004)
Black	0.124	0.123	-0.001
	(0.329)	(0.328)	(0.003)
Other Race	0.092	0.100	0.008***
	(0.289)	(0.300)	(0.003)
Hispanic	0.163	0.174	0.011***
	(0.370)	(0.379)	(0.003)
High School Diploma	0.245	0.233	-0.011***
	(0.430)	(0.423)	(0.003)
Some College Education	0.189	0.190	0.001
	(0.392)	(0.392)	(0.003)
Associate Degree	0.100	0.098	-0.002
	(0.300)	(0.297)	(0.002)
Bachelor's Degree and Beyond	0.385	0.400	0.014***
	(0.487)	(0.490)	(0.004)
Married	0.540	0.537	-0.003
	(0.498)	(0.499)	(0.004)
Divorced	0.125	0.120	-0.005**
	(0.330)	(0.325)	(0.002)
Widowed	0.020	0.021	0.001
	(0.140)	(0.144)	(0.001)
Worked for an employer in the ref year	0.940	0.939	-0.001
	(0.237)	(0.239)	(0.002)
Agriculture, and Mining	0.017	0.015	-0.001
	(0.128)	(0.123)	(0.001)
Construction	0.057	0.053	-0.004**
	(0.231)	(0.224)	(0.002)
Manufacturing	0.104	0.106	0.002
	(0.306)	(0.308)	(0.002)
Wholesale Trade	0.023	0.024	0.001
	(0.148)	(0.152)	(0.001)
Retail Trade	0.106	0.107	0.001
	(0.308)	(0.309)	(0.002)
Transportation, and Utilities	0.052	0.053	0.001
	(0.223)	(0.225)	(0.002)
Information	0.019	0.020	0.001
	(0.136)	(0.139)	(0.001)
Finance, and Real Estate	0.065	0.061	-0.004**
	(0.246)	(0.239)	(0.002)
Professional Services	0.118	0.119	0.000
	(0.323)	(0.324)	(0.003)
Educational, and Healthcare Services	0.244	0.243	-0.000
	(0.429)	(0.429)	(0.003)
Recreation, and Food Services	0.097	0.095	-0.001
	(0.296)	(0.294)	(0.002)
Other Services, Except Public Administration	0.042	0.046	0.003**
	(0.201)	(0.209)	(0.002)
Public Administration	0.052	0.053	0.000
	(0.223)	(0.223)	(0.002)
Military	0.004	0.004	0.001
	(0.062)	(0.066)	(0.001)
Observations	27,000	29,000	56,000

Source: Authors' calculations from the Survey of Income and Program Participation, 2017-2019.
Notes: Columns (1)-(2) show standard deviations in parentheses. Column (3) shows standard errors clustered at the household level. All estimates are weighted with annual weights.

Table 2

Estimated Effects of Tariffs and Retaliatory Tariffs on The Gender Wage Gap by Steel-Intensive Industries, SIPP 2018 Waves 1-3

	log (total annual earnings)	log (annual hourly wage)	log (monthly earnings)	log (monthly hourly wage)
	(1)	(2)	(3)	(4)
A. Full Sample				
annual tariff=1 * female=1	0.017	0.018		
	(0.024)	(0.019)		
steel-intensive=1 * female=1	-0.074***	-0.034*	-0.047**	-0.027
	(0.026)	(0.020)	(0.021)	(0.017)
annual tariff=1 * steel-intensive=1 * female=1	-0.048	-0.014		
	(0.036)	(0.027)		
monthly tariff=1 * female=1			0.061***	0.057***
			(0.021)	(0.018)
monthly tariff=1 * steel-intensive=1 * female=1			-0.107***	-0.098***
			(0.030)	(0.027)
F-Statistics	625.5	435.5	578.4	477.8
Observations	56,000	56,000	605,000	602,000
B. Excluding Outliers				
annual tariff=1 * female=1	0.024	0.025		
	(0.023)	(0.017)		
steel-intensive=1 * female=1	-0.078***	-0.029	-0.058***	-0.035**
	(0.025)	(0.018)	(0.020)	(0.016)
annual tariff=1 * steel-intensive=1 * female=1	-0.054	-0.029		
	(0.035)	(0.025)		
monthly tariff=1 * female=1			0.055***	0.046***
			(0.020)	(0.017)
monthly tariff=1 * steel-intensive=1 * female=1			-0.095***	-0.075***
			(0.028)	(0.024)
F-Statistics	638.1	497.3	602.4	517.6
Observations	56,000	56,000	599,000	596,000

Source: Authors' calculations from the Survey of Income and Program Participation 2018, Waves 1-3.

Notes: Dependent variables in columns (1)-(2) are annual: log of total annual earnings, and log of annual hourly wage, respectively. Dependent variables in columns (3)-(4) are monthly: log of monthly earnings, and log of monthly hourly wage, respectively. All measures of earnings are from the primary job, which is defined as the job producing the largest share of earnings for an individual in the reference year. Annual tariff = 1 for the years the steel and aluminum tariffs were implemented and kept in place (2018 and 2019). Monthly tariff = 1 for the months and years the steel and aluminum tariffs were implemented and keep in place (March 2018 - December 2019 inclusive). Steel-intensive = 1 if either a steel-intensive input or a steel-intensive output industry. Using Input-Output Accounts Data by the Bureau of Economic Analysis, we define steel-intensive input industries as industries with the largest domestic consumption of steel and steel-intensive output industries as industries with the largest production of steel. For more details on steel-intensive industries, refer to the paper. All estimates weighted: columns (1)-(2) use annual weights, columns (3)-(4) use monthly weights. Panel B restricted to individual earnings below the 99th percentile of total annual earnings (column 1), annual hourly wage (column 2), monthly earnings (column 3), and monthly hourly wage (column 4) distributions. Standard errors are in parentheses and clustered at the household level. * p<0.10; ** p<0.05; *** p<0.01.

Table 3

Estimated Effects of Tariffs and Retaliatory Tariffs on The Gender Wage Gap by Steel-Intensive Input Industries, SIPP 2018 Waves 1-3

	log (total annual earnings)	log (annual hourly wage)	log (monthly earnings)	log (monthly hourly wage)
	(1)	(2)	(3)	(4)
A. Full Sample				
annual tariff=1 * female=1	-0.003	0.011		
	(0.017)	(0.013)		
steel-intensive input=1 * female=1	0.039	0.016	0.020	0.030
	(0.048)	(0.036)	(0.045)	(0.037)
annual tariff=1 * steel-intensive input=1 * female=1	-0.079	0.005		
	(0.078)	(0.057)		
monthly tariff=1 * female=1			0.009	0.008
			(0.015)	(0.013)
monthly tariff=1 * steel-intensive input=1 * female=1			-0.002	-0.008
			(0.076)	(0.068)
F-Statistics	615.4	424.0	557.9	462.9
Observations	56,000	56,000	605,000	602,000
B. Excluding Outliers				
annual tariff=1 * female=1	0.002	0.012		
	(0.017)	(0.012)		
steel-intensive input=1 * female=1	0.041	0.032	0.007	0.018
	(0.046)	(0.033)	(0.043)	(0.034)
annual tariff=1 * steel-intensive input=1 * female=1	-0.108	-0.022		
	(0.075)	(0.053)		
monthly tariff=1 * female=1			0.012	0.012
			(0.014)	(0.012)
monthly tariff=1 * steel-intensive input=1 * female=1			-0.036	-0.031
			(0.068)	(0.057)
F-Statistics	630.1	488.3	585.6	509.2
Observations	56,000	56,000	599,000	596,000

Source: Authors' calculations from the Survey of Income and Program Participation 2018, Waves 1-3.

Notes: Dependent variables in columns (1)-(2) are annual: log of total annual earnings, and log of annual hourly wage, respectively. Dependent variables in columns (3)-(4) are monthly: log of monthly earnings, and log of monthly hourly wage, respectively. All measures of earnings are from the primary job, which is defined as the job producing the largest share of earnings for an individual in the reference year. Annual tariff = 1 for the years the steel and aluminum tariffs were implemented and kept in place (2018 and 2019). Monthly tariff = 1 for the months and years the steel and aluminum tariffs were implemented and keep in place (March 2018 - December 2019 inclusive). Steel-intensive input = 1 if a steel-intensive input industry. Using Input-Output Accounts Data by the Bureau of Economic Analysis, we define steel-intensive input industries as industries with the largest domestic consumption of steel. For more details on steel-intensive input industries, refer to the paper. All estimates weighted: columns (1)-(2) use annual weights, columns (3)-(4) use monthly weights. Panel B restricted to individual earnings below the 99th percentile of total annual earnings (column 1), annual hourly wage (column 2), monthly earnings (column 3), and monthly hourly wage (column 4) distributions. Standard errors are in parentheses and clustered at the household level. * p<0.10; ** p<0.05; *** p<0.01.

Table 4

Estimated Effects of Tariffs and Retaliatory Tariffs on The Gender Wage Gap by Steel-Intensive Output Industries, SIPP 2018 Waves 1-3

	log (total annual earnings)	log (annual hourly wage)	log (monthly earnings)	log (monthly hourly wage)
	(1)	(2)	(3)	(4)
A. Full Sample				
annual tariff=1 * female=1	-0.004	0.005		
	(0.018)	(0.014)		
steel-intensive output=1 * female=1	0.042	0.033	0.055**	0.036*
	(0.033)	(0.024)	(0.025)	(0.021)
annual tariff=1 * steel-intensive output=1 * female=1	0.018	0.033		
	(0.044)	(0.035)		
monthly tariff=1 * female=1			0.031**	0.022
			(0.016)	(0.014)
monthly tariff=1 * steel-intensive output=1 * female=1			-0.103***	-0.075**
			(0.039)	(0.035)
F-Statistics	614.8	420.7	556.7	458.4
Observations	56,000	56,000	605,000	602,000
B. Excluding Outliers				
annual tariff=1 * female=1	-0.001	0.004		
	(0.018)	(0.013)		
steel-intensive output=1 * female=1	0.039	0.030	0.057**	0.037*
	(0.032)	(0.022)	(0.024)	(0.020)
annual tariff=1 * steel-intensive output=1 * female=1	0.024	0.031		
	(0.043)	(0.031)		
monthly tariff=1 * female=1			0.030**	0.020*
			(0.015)	(0.012)
monthly tariff=1 * steel-intensive output=1 * female=1			-0.092***	-0.053*
			(0.035)	(0.030)
F-Statistics	631.1	484.9	584.3	504.0
Observations	56,000	56,000	599,000	596,000

Source: Authors' calculations from the Survey of Income and Program Participation 2018, Waves 1-3.

Notes: Dependent variables in columns (1)-(2) are annual: log of total annual earnings, and log of annual hourly wage, respectively. Dependent variables in columns (3)-(4) are monthly: log of monthly earnings, and log of monthly hourly wage, respectively. All measures of earnings are from the primary job, which is defined as the job producing the largest share of earnings for an individual in the reference year. Annual tariff = 1 for the years the steel and aluminum tariffs were implemented and kept in place (2018 and 2019). Monthly tariff = 1 for the months and years the steel and aluminum tariffs were implemented and keep in place (March 2018 - December 2019 inclusive). Steel-intensive output = 1 if a steel-intensive output industry. Using Input-Output Accounts Data by the Bureau of Economic Analysis, we define steel-intensive output industries as industries with the largest domestic production of steel. For more details on steel-intensive output industries, refer to the paper. All estimates weighted: columns (1)-(2) use annual weights, columns (3)-(4) use monthly weights. Panel B restricted to individual earnings below the 99th percentile of total annual earnings (column 1), annual hourly wage (column 2), monthly earnings (column 3), and monthly hourly wage (column 4) distributions. Standard errors are in parentheses and clustered at the household level. * p<0.10; ** p<0.05; *** p<0.01.

Table 5

Estimated Effects of Tariffs and Retaliatory Tariffs on The Gender Wage Gap by Both Input and Output Steel-Intensive Industries, SIPP 2018 Waves 1-3

	log (total annual earnings)	log (annual hourly wage)	log (monthly earnings)	log (monthly hourly wage)
	(1)	(2)	(3)	(4)
A. Full Sample				
annual tariff=1 * female=1	0.019	0.025*		
	(0.018)	(0.014)		
steel-intensive=1 * female=1	0.070**	0.025	0.059**	0.017
	(0.032)	(0.024)	(0.024)	(0.021)
annual tariff=1 * steel-intensive input and output=1 * female=1	-0.132***	-0.069**		
	(0.043)	(0.033)		
monthly tariff=1 * female=1			0.022	0.018
			(0.016)	(0.014)
monthly tariff=1 * steel-intensive input and output=1 * female=1			-0.070*	-0.066**
			(0.037)	(0.034)
F-Statistics	642.5	434.1	582.4	470.5
Observations	56,000	56,000	605,000	602,000
B. Excluding Outliers				
annual tariff=1 * female=1	0.024	0.025*		
	(0.018)	(0.013)		
steel-intensive=1 * female=1	0.074**	0.035	0.054**	0.015
	(0.031)	(0.022)	(0.024)	(0.019)
annual tariff=1 * steel-intensive input and output=1 * female=1	-0.140***	-0.083***		
	(0.042)	(0.030)		
monthly tariff=1 * female=1			0.022	0.019
			(0.015)	(0.012)
monthly tariff=1 * steel-intensive input and output=1 * female=1			-0.059	-0.054*
			(0.036)	(0.031)
F-Statistics	659.9	500.0	611.0	516.3
Observations	56,000	56,000	599,000	596,000

Source: Authors' calculations from the Survey of Income and Program Participation 2018, Waves 1-3.

Notes: Dependent variables in columns (1)-(2) are annual: log of total annual earnings, and log of annual hourly wage, respectively. Dependent variables in columns (3)-(4) are monthly: log of monthly earnings, and log of monthly hourly wage, respectively. All measures of earnings are from the primary job, which is defined as the job producing the largest share of earnings for an individual in the reference year. Annual tariff = 1 for the years the steel and aluminum tariffs were implemented and keep in place (2018 and 2019). Monthly tariff = 1 for the months and years the steel and aluminum tariffs were implemented and kept in place (March 2018 - December 2019 inclusive). Steel-intensive input and output = 1 if both an input and an output steel-intensive industry. Using Input-Output Accounts Data by the Bureau of Economic Analysis, we define steel-intensive input industries as industries with the largest domestic consumption of steel and steel-intensive output industries as industries with the largest production of steel. For more details on steel-intensive industries, refer to the paper. All estimates weighted: columns (1)-(2) use annual weights, columns (3)-(4) use monthly weights. Panel B restricted to individual earnings below the 99th percentile of total annual earnings (column 1), annual hourly wage (column 2), monthly earnings (column 3), and monthly hourly wage (column 4) distributions. Standard errors are in parentheses and clustered at the household level. * p<0.10; ** p<0.05; *** p<0.01.