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On the Effects of U.S. Section 232 Steel and Aluminum Tariff Enactment

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Abstract

As of March 8th, 2018, U.S. President Donald J. Trump made known his decision to enact a respective 25 percent tariff on certain steel articles and a 10 percent tariff on certain aluminum articles. According to President Donald J. Trump: “These tariffs are necessary and appropriate to adjust imports of steel and aluminum articles so that such imports will not threaten to impair the national security […]” (The White House, 2018a, b). The enactment of the section 232 steel and aluminum tariff may have effectuated a reduction in the external import price of sanctioned articles, possibly, in conjunction, effectuating an increase in the producer price index of sanctioned articles and respective U.S. steel and aluminum industry employment. In this study, I ascertain the effect of section 232 steel and aluminum tariff enactment on the external import price of sanctioned steel articles, on the producer price indexes of the respective U.S. steel and aluminum industries, on the producer price index of a selection of steel articles and on employment of the respective U.S. steel and aluminum industries. I do this by applying the methods of multiple regression, fixed effects regression and difference-in-difference regression (in conjunction with the synthetic control method). I find a statistically significant negative effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles. Next, I find section 232 steel and aluminum tariff enactment to have increased the U.S. steel industry's producer price index by 2.9 – 4.8 percent and the producer price index of the U.S. aluminum industry by 13.4 percent. Then, I find section 232 steel tariff enactment to have increased the producer price index of a selection of sanctioned steel articles by 5.2 – 8.8 percent. Finally, I find section 232 steel and aluminum tariff enactment to have increased U.S steel industry employment by 2.9 percent and U.S. aluminum industry employment by 8.8 percent.

Table of contents	Page

I. Introduction

The importation of a certain article can be detrimental to the domestic industry, producing that specific article. Subsequently, the domestic industry can be constitutive of the national security of the nation. In recognition hereof, section 232 of the Trade Expansion Act of 1962 authorizes the President to: “take such action and for such time as he deems necessary to adjust the imports of such article and its derivatives so that such imports will not so threaten to impair the national security.” (U.S. House of Representatives, n.d.).

As of April 19th, 2017, “the Secretary of Commerce initiated an investigation under section 232 of the Trade Expansion Act to determine the effects on national security of U.S. imports of steel” (U.S. Department of Commerce, n.d.). Subsequently, as of April 26th, 2017, the Secretary of Commerce initiated an investigation under section 232 of the Trade Expansion Act to determine the effects on national security of U.S. imports of aluminum (U.S. Department of Commerce, 2018). These two investigations culminated in Presidential proclamation 9704: “on adjusting imports of aluminum into the U.S.” (The White House, 2018a) and Presidential proclamation 9705: “on adjusting imports of steel into the U.S.” (The White House, 2018b). In these two proclamations, import tariffs of respectively 25 and 10 percent on certain steel and aluminum articles were announced. The tariff first became effective as of March 23rd, 2018.

The purpose of this study is to analyze the effects of section 232 steel and aluminum tariff enactment on 1. the external (before tariff) import price of sanctioned articles, on 2. the producer price index (PPI) of sanctioned articles, and on 3. the employment of the respective U.S. steel and aluminum industries. The term “sanctioned articles” refers to articles subject to the section 232 steel and aluminum tariff. The main hypothesis reads: The section 232 steel and aluminum tariff served to reduce the external import price of sanctioned articles, to increase the producer price index of sanctioned articles, and to increase U.S. steel and aluminum industry employment.

Relative to the existing literature, this study has one main contribution: the current study employs different approaches to the estimation of the PPI and employment effects of section 232 steel and aluminum tariff enactment, thereby expanding the breadth of the empirical literature concerning the effects of section 232 steel and aluminum tariff enactment.

Carvalho, (2014) maps the Bureau of Economic Analysis input-output table for the year 2002 and finds the iron and steel mills sector to be the fifth input supplier. An increase in the PPI of certain steel articles concomitant section 232 steel tariff enactment thus has the potential to adversely affect input costs for a broad base of the U.S. economy.

To ascertain the effects of section 232 steel and aluminum tariff enactment on 1. the external import price of sanctioned steel articles, on 2. the PPI's of the respective U.S. steel and aluminum industries, on 3. the PPI of a number of sanctioned steel articles, and on 4. employment of the respective U.S. steel and aluminum industries, I implemented four specifications.

First, I used a specification used by Amiti et al., (2019) to ascertain the effect of the tariffs imposed by the Trump administration in 2018 on the external import price of sanctioned articles, to ascertain the effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles.

Second, I used two types of difference-in-difference regression specifications, respectively, concerning the effect of section 232 steel and aluminum tariff enactment on the producer price indexes of the respective U.S. steel and aluminum industries (specification 2) and the effect of section 232 steel and aluminum tariff enactment on the employment of the respective U.S. steel and aluminum industries (specification 3). Before implementation of the appurtenant difference-in-difference regression specifications, the synthetic control method was implemented to select a control group of which the pretreatment values of the dependent variable tracked the pretreatment values of the dependent variable of the treatment group well. The synthetic control method was enacted to ensure conformity with the parallel trend assumption.

Third, I implemented an amended version of Liebman, (2006) his method for determining the effect of the 2002 section 201 safeguards on certain steel articles on the price of a selection sanctioned steel articles, to determine the effect of section 232 steel tariff enactment on the PPI of a selection of sanctioned steel articles.

The remainder of this study is organized as follows: first, in the theoretical framework section, three sub-hypotheses based on the main hypothesis will be established, and certain definitions will be provided for. The three sub-hypotheses will also be theoretically substantiated, factors affecting the magnitudes of the hypothesized effects will be provided, and magnitudes for the hypothesized effects found in previous empirical literature will be provided. Second, In the empirical specification section, the specifications implemented to empirically test the three sub-hypotheses will be provided and discussed. Third, in the data section, the data underlying the specifications implemented will be discussed. Fourth, In the results section, the results of the empirical testing of the three sub-hypotheses will be provided. Fifth, In the conclusion section, conclusions regarding the verity of the three sub-hypotheses (and therefore, the main hypothesis) will be drawn based on the results. Finally, the limitations of the current methodologies and future avenues for research suggested by the current study will be discussed.

II. Theoretical Framework

II.I Establishment of Hypotheses

The hypotheses ascertained in this study entail:

1. The enactment of the section 232 steel and aluminum tariff effectuated a reduction in the before tariff import price of sanctioned articles.
2. The enactment of the section 232 steel and aluminum tariff effectuated an increase in the producer price index of sanctioned articles.
3. The enactment of the section 232 steel and aluminum tariff effectuated an increase in U.S. steel and aluminum industry employment.

II.II Definitions

The U.S. steel industry is defined as North American Industry Classification System (NAICS) sector 331110: Iron and Steel Mills and Ferroalloy Manufacturing. The U.S. aluminum industry is defined as NAICS sector 331313: Alumina Refining and Primary Aluminum Production. Definitions for these two NAICS sectors are listed in table 0.a. (appendix).

The term “section 232 steel and aluminum tariff” refers to the tariffs announced in Presidential proclamations 9704 and 9705 and subsequent (procedural) amendments thereof.

The term “external import price” refers to the import price before the application of applicable duties.

II.III. Literature review

Ad valorem tariff enactment, external price, internal price, and employment.

The enactment of an ad valorem tariff on a certain article is expected to reduce the external import price of such an article while increasing the internal price of such article (Greenville and MacAulay, (2005)_. Greenville and MacAulay, (2005) further note regarding the production of the particular article subject to the ad valorem tariff: “The tariff induces a change in the relative price with an increase in domestic production at the cost of production in the exporting nation.”

Grossman, (1984) models the demand for labor by the (U.S.) steel industry as a function of the wage rate prevailing in the steel sector, the price of steel, and the production of steel. The enactment of an ad valorem tariff by the U.S. on a steel article is thus expected to increase U.S. employment in the production of that particular article.

Factors affecting the magnitude of the external price, internal price and employment effects of ad valorem tariff enactment.

Let us now look at factors affecting the rate of tariff pass-through and, thereby, the effect of ad valorem tariff enactment on the external import price and producer price of a sanctioned article. Menon, (1996), looking at Australian imports of manufactures, finds that quantitative restrictions, foreign control, concentration, product differentiation, and the import share of the domestic market are negatively related to the rate of exchange rate pass-through, while substitutability between imported and domestically produced goods is positively related to the rate of exchange rate pass-through. Here I assume, consistent with Amiti et al. (2019), tariff and exchange rate pass-through to be related. The factors affecting exchange rate pass-through, therefore possibly affecting tariff pass-through.

Let us now look at the factors affecting supply elasticity and thereby the effect of ad valorem tariff enactment on production and on employment in the sanctioned article's production. Gardner, (1979) “draws out the implications of equilibrium in a two-product, two-factor model for the elasticity of product supply, which is found to depend upon input supply elasticities, alternative product demand elasticity, the elasticity of substitution between production inputs, relative factor intensity of the product, and relative importance of the product in its use of resources. These factors interact in a complex manner to determine supply elasticity”.

Empirical estimates of the pass-through rate.

Cavallo et. al., (2019) plot the steel import price indices for three groups of countries: respectively, Australia, Argentina, Brazil and South Korea; Canada, the EU and Mexico; and all other countries. With Argentina, Australia, Brazil, and South Korea (the first group): “satisfactory alternative means to address the threatened impairment to national security posed by steel articles imports from these countries were reached” (The White House, (2018c)). For Canada, the EU, and Mexico, the section 232 steel tariff became effective June

1st, 2018. For all other countries, the section 232 steel tariff became effective March 23rd, 2018. “Steel import price indices from all three groups tracked each other relatively closely until the steel tariffs were introduced. After that point, prices on imports from all countries rose, but the import price indexes from the affected countries jumped to roughly 20 percent above those from unaffected countries” Cavallo et al., (2019). The section 232 steel tariff is 25 percent, implying a pass-through rate of at least 80 percent.

Amiti et al., (2019), find that: “tariffs on steel inputs have an initial pass-through rate of close to 100 percent to steel buyers, which falls to around 50 percent a year after the tariff was applied.” Amiti et al. (2020) note that: “Indeed, the fact that foreign steel producers have lowered their prices in response to U.S. tariffs may help explain why U.S. steel production only rose by 2 percent per year between the third quarter of 2017 and the third quarter of 2019 despite 25 percent steel tariffs”. Steel production being related to steel industry employment. Amiti et al. (2020) implement an event study specification controlling for numerous possible sources of endogeneity through the use of (country-time, time, and country-product) fixed effects.

Empirical estimates of the internal price effect.

Hufbauer and Jung, (2019), in a policy brief by the Peterson Institute of International Economics, note that: “US steel prices (i.e., the PPI of the U.S. steel industry) will be 8.9 percent higher in 2018 than in 2017 thanks to tariffs and quotas”. Hufbauer and Jung, (2019) infer this estimate from the increase in discrepancy between the U.S. steel industry PPI and the U.S. steel import price index.

Empirical estimates of the employment effect(s).

Baughman and Francois, (2018), in a policy brief for the Trade Partnership, project, using a computable general equilibrium (CGE) model, the enactment of the section 232 steel and aluminum tariff to increase employment in the (U.S.) iron and steel and non-ferrous metals (i.e., aluminum) industries by 33,000 jobs.

Hufbauer and Jung, (2019), in a policy brief by the Peterson Institute of International Economics, project the enactment of the section 232 steel tariff to increase (U.S.) steel industry employment by about 8,700 jobs. Hufbauer and Jung, first implement a multiple regression to determine the relationship between the PPI of the U.S. steel industry and crude steel production. Subsequently, Hufbauer and Jung, use their estimated 8.9 percent increase in the PPI of the U.S. steel industry due to section 232 steel tariff enactment in conjunction with the estimated relationship to determine the effect of section 232 steel tariff enactment on crude steel production. Finally, Hufbauer and Jung divide their estimated effect of section 232 steel tariff enactment on crude steel production by the steel output per worker to arrive at their employment estimate.

Relative to the existing literature, this study has one main contribution: the current study employs different approaches to the estimation of the PPI and employment effects of section 232 steel and aluminum tariff enactment compared to Hufbauer and Jung, (2018) and Baughman and Francois, (2018), expanding the breadth of the empirical literature concerning the effects of section 232 steel and aluminum tariff enactment.

III. Empirical Specification

III.I. Specification 1. The effect of section 232 steel tariff enactment on the external import price of a of sanctioned steel articles.

To identify the effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles, I use a specification analogous to one used by Amiti et al. (2019). Amiti et al. (2019), using the specification to ascertain the effect of the tariffs imposed by the Trump administration in 2018 on the prices received by foreign exporters of sanctioned articles. The effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles is estimated with the following empirical specification:

(1) $\Delta \ln\left(P_{i,\ j,\ t}\right) = \alpha_0 + \alpha_1 \Delta \ln\left(1 + Tariff_{i,\ j,\ t}\right) + \alpha_2\, Product_i + \alpha_3\, (\text{Country} * Time)_{j,\ t} + \varepsilon_{i,\ j,\ t}$

Where the dependent variable $(P_{i,\ j,\ t})$ is the twelve-month change in the logarithm of the average unit price of steel article i from country j at time t. The independent variable $(1 + Tariff_{i,\ j,\ t})$ is the twelve-month change in the logarithm of one plus the tariff rate of steel article i from country j at time t. The $Product_i$ and $Country * Time_{j,\ t}$ terms are product and country-time fixed effects and $\varepsilon_{i,\ j,\ t}$ is an error term. The focus is on the first term on the right-hand side of the regression and on the sign and significance of α_1, with a negative sign suggesting that enactment of the section 232 steel tariff reduced the external import price of sanctioned steel articles, vice versa for a positive sign. Robust clustered standard errors are used.

The time period covered runs from January 2018 through December 2018. The data frequency is monthly. The period was chosen, incorporating into the decision Amiti et al., (2019)'s use of this specific time period. As a robustness check, I additionally estimate the specification using data for the time period January 2018 through December 2019.

III.II. Specification 2. The effect of section 232 steel and aluminum tariff enactment on the producer price indexes of the respective U.S. steel and aluminum industries.

To identify the effect of section 232 steel and aluminum tariff enactment on the producer price indexes of the respective U.S. steel and aluminum industries, I implement a combination of the synthetic control method (for more information see: Abadie et al., (2010); Abadie, (2014)) and a difference-in-difference regression specification dually: once for the U.S. steel industry and once for the U.S. aluminum industry. The difference-in-difference regression specification is standard and analogous to the one used by e.g., Lloyd and Solomou, (2019).

Regarding the synthetic control method. A priori, I gather producer price index data for a large number of entities not directly affected by section 232 steel and aluminum tariff enactment. Subsequently, I gather producer price index data for the respective U.S. steel and aluminum industries. I then dually implement the synthetic control method: once for the U.S. steel and once for the U.S. aluminum industry. The dependent variable of the synthetic control specification is constituted by the producer price index. The independent variables of the synthetic control specification are constituted by pretreatment time periods producer price indexes. The synthetic control method ascertains for respectively the U.S. steel and aluminum industry the control group minimizing the mean squared prediction error between the pretreatment periods producer price indexes of the particular industry and those of the synthetic control group. The synthetic control method, subsequently, provides for the respective U.S. steel and aluminum industry the producer price index of the industry and of the synthetic control group.

One risk associated with implementation of the synthetic control method is that the producer price index of the selected control group might follow the producer price index of the U.S. steel or aluminum industry purely by coincidence and not due to both entities' subjection to similar outside influences id est economic forces. To control for this risk, and thus to ensure that the producer price index of the synthetic control group tracks the producer price index of the U.S. steel or aluminum industry closely due to both entities subjection to the similar outside influences, two measures are implemented.

First, only entities closely related to the U.S. steel and aluminum industries were selected to be possibly included in the synthetic control group.

Second, an out-of-sample forecast was included. The out-of-sample forecast yielding a satisfactory result indicating the synthetic control group and U.S. steel or aluminum industry to be subject to similar outside influences.

Regarding the difference-in-difference regression specification. The difference-in-difference regression specification is displayed below.

(2) $Log\left(PPI_{i,\ t}\right) = \alpha_0 + \alpha_1\ Time_t + \alpha_2\ Treatment\ Group_i + \alpha_3\ Treatment_{i,\ t} + \varepsilon_{i,\ t}$

The difference-in-difference regression specification is implemented dually: once for the U.S. steel industry and once for the U.S. aluminum industry. The difference-in-difference regression specification takes the producer price index of the U.S. steel or aluminum industry and the producer price index of the synthetic control group yielded by the synthetic control method as dependent variable. The independent variable $(Treatment_{i,\ t})$, the group-time indicator variable of the section 232 steel and aluminum tariff, captures the effect of section 232 steel and aluminum tariff enactment on the producer price index of the U.S. steel or aluminum industry. The time fixed effect $(Time_t)$ controls for the average change over time in factors affecting the producer price index. The group fixed effect $(Treatment\ Group_i)$ controls for the initial difference in factors affecting the producer price index between the U.S. steel or aluminum industry and suited synthetic control group. $\varepsilon_{i,\ t}$ is an error term. The difference-in-difference specification will be estimated with robust standard errors given the limited number of entities: two.

As a robustness check for the U.S. steel industry, I also include an indicator dummy variable assuming the value of unity for the period March 2002 through December 2003. For this period, the George W. Bush administration safeguards on certain steel articles were effective. As an additional robustness check, I subsequently also include two indicator dummy variables, respectively, assuming the value of unity for the period March 2001 through November 2001 and December 2007 through June 2009 to control for the 2001 and 2007-2009 economic recessions.

The time period covered runs from January 2001 through December 2019. The data frequency is monthly. The time period was chosen, incorporating in the decision the consideration as to what time period would yield the largest number of observations given limitations in data availability and the incidence of the Coronavirus global health pandemic.

III.III. Specification 3. The effect of section 232 steel and aluminum tariff enactment on employment of the respective U.S. steel and aluminum industries.

The third specification is identical to the second specification, except for three aspects.

First, while the second specification is there to ascertain the effect of section 232 steel and aluminum tariff enactment on the producer price indexes of the respective U.S. steel and aluminum industries, the third specification is there to ascertain the effect of section 232 steel and aluminum tariff enactment on employment of the respective U.S. steel and aluminum industries. Congruent with the difference in aims, the term producer price index in the second specification is nixed and replaced by the term employment.

Second, the time period covered is amended to January 2004 through December 2019 for the U.S. steel industry and January 2005 through December 2019 for the U.S. aluminum industry.

Third, indicator dummy variables for the 2001 economic recession and the George W. Bush administration safeguards on certain steel articles are nixed given the revised time period covered.

III.IV. Specification 4. The effect of section 232 steel tariff enactment on the producer price index of a selection of sanctioned steel articles.

To identify the effect of section 232 steel tariff enactment on the PPI of a selection of sanctioned steel articles, I use a specification that is analogous to that used by Liebman, (2006). Liebman, (2006), using the specification to ascertain the effect of the 2002 George W. Bush administration's safeguards on certain steel articles on the price of a selection of sanctioned steel articles. The effect of section 232 steel tariff enactment on the PPI of a selection of sanctioned steel articles is estimated with the following empirical specification:

(4) $Log\left(P_{i,\ t}\right) = \beta_0 + \beta_1\, Section\ 232\ Tariff_{i,\ t} + \beta_2\, Antidumping_{i,\ t} + \beta_3\, Safeguards_{i,\ t} + \beta_4\, Log\ (Industrial\ Production_t) + \beta_5\, Log\left(P_{Iron\ Ore,\ t}\right) + \beta_6\ Log\left(P_{Coal,\ t}\right) + \beta_7\, Log\left(P_{Electricity,\ t}\right) + \beta_8\ Log\left(P_{Scrap,\ t}\right) + \beta_9\, Log\ (Wage_t) + \beta_{10}\, Log\ (Capacity_t) + \beta_{11}\, Log\ (Dollar_t) + \beta_{12}\, Log\ (China_t) + \beta_{13}\, t_t + \beta_{14}\, Product_i + \varepsilon_{i,\ t}$

Where the dependent variable $(P_{i,\ t})$ is the logarithm of the PPI of steel article i at time t. The independent variable $(Section\ 232\ Tariff_{i,\ t})$ is an article-time indicator of the section 232 steel tariff. The treatment period is idealized to comprise March 2018 through

December 2019. The first control variable $(Antidumping_{i,\ t})$ is an article-time measure of the antidumping duty. The second control variable $(Safeguards_{i,\ t})$ is an article-time measure of the safeguard duty. The third control variable $(Industrial\ Production_t)$ is the logarithm of the Federal Reserve Board's index of industrial production. The fourth control variable $(P_{Iron\ Ore,\ t})$ is the logarithm of the PPI of iron ore. The fifth control variable $(P_{Coal,\ t})$ is the logarithm of the PPI of coal. The sixth control variable $(P_{Electricity,\ t})$ is the logarithm of the PPI of industrial electricity. The seventh control variable $(P_{Scrap,\ t})$ is the logarithm of the PPI of steel scrap. The eight control variable, $(Wage_t)$ is the logarithm of the average hourly earnings of production and nonsupervisory employees in the primary metal manufacturing industry (refer to table 0.a. appendix). The ninth control variable $(Capacity_t)$ is the logarithm of a steel production capacity index. The tenth control variable $(Dollar_t)$ is the logarithm of a trade-weighted U.S. dollar index. The eleventh control variable $(China_t)$ is the logarithm of the quantity of steel imports by China. The $Product_i$ term is a product (article) fixed effect. The t_t term is a time trend and $\varepsilon_{i,\ t}$ is an error term. All input cost variables, the trade-weighted U.S. dollar index, and the PPI are adjusted for inflation using the total manufacturing industries PPI of the BLS. The industrial production index is not adjusted for inflation, since the index is published in real terms. The focus is on the first term on the right-hand side of the regression and on the sign and significance of β_1, with a positive sign suggesting that section 232 steel tariff enactment effectuated an increase in the PPI of a selection of sanctioned steel articles, vice versa for a negative sign. The specification will be estimated with both robust and robust clustered standard errors.

"Since adjustment to a shock from an independent variable may take several periods, it is generally appropriate to incorporate lags when using monthly data" (Liebman, 2006). Therefore consistent with Liebman, (2006) his finding that: "generally adjustment to fluctuations in the price of iron ore, steel scrap, the dollar exchange rate and Chinese steel imports occur more slowly compared with industrial production, coal and electricity prices, production capacity, and the antidumping and safeguard tariff variables," Liebman incorporates six month free lags for the respective PPI's of iron ore and steel scrap, the trade-weighted U.S. dollar index, and the quantity of steel imports by China, and incorporates three month free lags for all other variables at the right-hand side of the regression specification.

I follow Liebman, (2006) and initiate with a six-month lag structure for the respective PPI's of iron ore and steel scrap, the trade-weighted U.S. dollar index, and the quantity of steel imports by China, and a three-month lag structure for all other variables on the right-hand side of the regression specification. As a robustness check, I also adjust the lag structure so as to yield the model with the lowest Akaike Information Criterion (AIC), since the model of Liebman might no longer be optimal given amendments made and the passage of time. Liebman, (2006) includes the steel production capacity index since "plant-closing stemming from bankruptcies and industry consolidation may have helped push up prices starting in 2002". Refer to figure 4.a. (appendix). Figure 4.a. shows the number of establishments in the U.S. steel industry. The data is not indicative of a similar dynamic being present over the 2011-2019 timeframe. I, therefore, additionally estimated specification four without the steel production capacity index.

The time period covered runs from August 2006 through December 2019. The data frequency is monthly. The time period was chosen incorporating in the decision Liebman, (2006), using a time period of around eight years, the availability of "quantity of steel imports by China" data (from August 2006 onward), and the incidence of the Coronavirus global health pandemic. Given the occurrence of an economic recession from December 2007 through June 2009, as a robustness check, I additionally implemented the specification for the period January 2010 through December 2019.

IV. Data

IV.I Specification 1. The effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles.

There are three types of data underlying the first specification. Respectively, data on the external import price, data on the section 232 steel tariff, and data on the most favored nation (MFN) tariff.

Regarding the external import price. I ascertained the "general customs value" of imports under harmonized system (HS) code 72 for all countries, subsequently selecting the 20 countries with the highest general import values. Then, I ascertained the general customs value of imports under HS code 73 for all countries, once more selecting the 20 countries with the highest general import values. There are duplicates in the two respective sets of 20 countries, combining the two respective sets yielding 25 unique countries. For these 25 countries, I ascertained the "general customs unit value" for all 10-digit HS codes under two-digit HS-codes 72 and 73 for the period January 2017 to December 2019. The "general customs unit value" representing the external import price. Subsequently, consistent with Amiti et al. (2019), I removed those entities of which the 12-month external price ratio ever exceeded 3 or was less than 1/3, yielding external import price data for 1,355 10-digit HS code country pairs or steel product category country pairs. Then, I took the logarithm of these external import prices and determined the twelve-month change in the logarithm for the period January 2018 to December 2019 (the dependent variable). All data were retrieved from the "USA trade online" website of the U.S. Census Bureau. Summary statistics on the dependent variable are reported in table 1.a (appendix).

Regarding the section 232 steel tariff. I ascertained the countries and HS-codes subject to the section 232 steel tariff, the effective period of the section 232 steel tariff, and the rate of the section 232 steel tariff with presidential proclamations 9704 and 9705 and subsequent (procedural) amendments thereof (announced in Presidential proclamations 9710, 9711, 9739, 9740, 9758, 9759, 9772, 9776, 9777, 9886, 9893, 9894 and 9980). The presidential proclamations were retrieved from the Federal Register.

Regarding the MFN tariff. I ascertained the MFN tariff for the 10-digit HS-codes for the years 2017, 2018, and 2019 with the Tariff Annual Data of the United States International Trade Commission (USITC).

Using the section 232 steel tariff and MFN tariff data, I determined the monthly tariff rate for the period January 2017 to December 2019 for each of the 1,355 10-digit HS-code country pairs. I subsequently took the logarithm of unity plus the tariff rate and determined the 12-month change in the logarithm for the period January 2018 to December 2019 (the independent variable). Summary statistics on the independent variable are reported in table 1.a (appendix).

IV.II. Specification 2. The effect of section 232 steel and aluminum tariff enactment on the producer price indexes of the respective U.S. steel and aluminum industries.

There are two types of data underlying the second specification, respectively being: data on PPI's and data on the section 232 steel and aluminum tariff.

The dependent variable are the monthly PPI's for the period January 2004 through December 2019 for respectively the U.S. steel industry and an appropriate synthetic control group, idem for the U.S. aluminum industry commencing as of January 2005. The PPI's of the respective U.S. steel and aluminum industries were retrieved from the PPI's Industry Data of the BLS. The PPIs of the respective synthetic control groups were established by the establishment of the PPI for a large number of entities and subsequent enactment of the synthetic control method minimizing the mean squared forecast error for certain pretreatment periods. Part of the entities the PPI was established for are listed in table 2.b. In addition, the import and export price indexes of al nonferrous (except aluminum) metal commodities and metal ores were included, and the PPIs of several groups of commodities were included. The PPI data and import-export price index data were retrieved from the PPI's Industry Data, the PPI's Commodity data, and the Import-Export Price Indexes data of the BLS. The producer price indexes of the mining sector and the producer price indexes of fuels and related products and powers were included since iron ore and electricity constitute key inputs for the steel industry (Liebman, 2006). The producer price index of the U.S. steel industry might therefore track the producer price indexes of the mining sector and fuels and related products and power. The PPI of the U.S. steel industry is depicted in figure 2.a. (appendix). The PPI of the U.S. aluminum industry is depicted in figure 2.b. (appendix). Summary statistics on the price indexes of all entities used for possible selection for the synthetic control group are displayed in table 2.a.

The independent variable is a group time indicator variable of the section 232 steel and aluminum tariff. The period the section 232 steel and aluminum tariff was effective was ascertained based on Presidential proclamation 9704 and 9705, which were retrieved from the Federal Register.

IV.III. Specification 3. The effect of section 232 steel and aluminum tariff enactment on employment of the respective U.S. steel and aluminum industries.

There are two types of data underlying the third specification, being respectively: data on employment and data on the section 232 steel and aluminum tariff.

The dependent variable is the monthly employment for the period January 2001 through December 2019 for respectively the U.S. steel industry and an appropriate synthetic control group, idem for the U.S. aluminum industry. The employment of the respective U.S. steel and aluminum industries was retrieved from the Quarterly Census of Employment and Wages of the BLS. The employment of the respective synthetic control groups was established by the establishment of the employment for a large number of entities and subsequent enactment of the synthetic control method minimizing the mean squared forecast error for certain pretreatment periods. The entities employment data were established for are listed in table 3.b. The employment data for these entities was retrieved from the Current Employment Statistics and Quarterly Census of Employment and Wages of the BLS; the Survey of Employment, Payrolls and Hours of Statistics Canada; and the Employment by Activity Data of the Organization for Economic Co-operation and Development. The (durable) manufacturing employment for a number of areas was included, since manufacturing employment in key manufacturing centers like Toledo and Detroit might be good predictors for U.S. steel industry employment. Employment in the construction sector was included for the same reason (Worldsteel Association, n.d.).

U.S. steel industry employment is depicted in figure 3.c. (appendix). U.S. aluminum industry employment is depicted in figure 3.d. (appendix). Summary statistics on the employment of all entities used for possible selection in the synthetic control group are displayed in table 3.a.

The independent variable is identical to the one of specification 2.

IV.IV. Specification 4. The effect of section 232 steel tariff enactment on the producer price index of a selection of sanctioned steel articles.

There are nine types of data underlying the fourth specification, respectively being: 1. data on the PPI (of certain steel articles), 2. data on the section 232 steel tariff, 3. data on antidumping and safeguard measures, 4. data on the industrial production index, 5. data on the PPI (of certain inputs), 6. data on average hourly earnings, 7. data on the capacity index of the U.S. steel industry, 8. data on the trade-weighted U.S. dollar and 9. data on the steel imports by China.

The dependent variable are the monthly PPIs for the period August 2006 through December 2019 of eight steel articles (all other data are also for this period). The PPI's were retrieved from the PPI's Commodity Data of the BLS. The PPI's are depicted in figure 4.b (appendix).

The independent variable is a steel article time indicator of the section 232 steel tariff. To establish those steel articles subject to the section 232 steel tariff, a two-step process was implemented. First, personal judgment was used in attributing Harmonized System (HS) codes to each of the eight steel articles, since: "the commodity classification structure of the PPI organizes products and services by similarity or material composition, regardless of the industry classification of the producing establishment. This system is unique to the PPI and does not match any other standard coding structure" (U.S. Bureau of Labor Statistics, 2020). Second, those HS-codes were compared to the HS-codes subject to the section 232 steel tariff as stipulated in presidential proclamation 9705 retrieved through the Federal Register. To establish the time period the section 232 steel tariff was effective, presidential proclamation 9705 was used.

The first control variable, the antidumping variable, was constructed in a four-step fashion. First, using personal judgment, 10-digit HS codes were attributed to the eight steel articles. Second, using the World Bank's Global Antidumping Database for the period 2006 – 2015 and the USITC import injury investigation overview in conjunction with the Federal Register for the period 2015-2019, all newly enacted and expiring antidumping duties affecting the eight steel articles were established. Third, in accordance with Liebman, (2006), for each of the HS-codes belonging to a particular steel article for each of the months August 2006 through December 2019, the sum of all individual country antidumping rates was calculated. The antidumping rate referring to the "all other manufacturers/ exporters" duty rate. Fourth, the antidumping “rates” for all of the HS-codes belonging to a particular steel article were combined into a single antidumping “rate” using the general customs value in the year 2017 as weight. The general customs value was retrieved through the “usatrade.census.gov” website of the U.S. Census Bureau.

The second control variable, the safeguard variable, was constructed similarly to the antidumping variable, the only amendment being the use of the Global Safeguard Database instead of the Global Antidumping Database. The safeguard variable was excluded since no safeguards affecting the eight steel articles were implemented nor rescinded during the period August 2006 through December 2019.

The third to seventh and eleventh control variables and accompanying data sources are listed in table 4.a (appendix).

The eighth control variable are the average hourly earnings of production and nonsupervisory employees in the primary metal manufacturing sector. The average hourly earnings were retrieved from the Current Employment Statistics of the BLS. The average hourly earnings […] in the primary metal manufacturing industry were used with regard to the non-availability of the average hourly earnings […] in the U.S. steel industry and the current adjustment constituting the minimum adjustment.

The ninth control variable, the steel production capacity index, is instantiated by the capacity index of iron and steel. The capacity index of iron and steel was retrieved from the Board of Governors of the Federal Reserve System.

The tenth control variable, the trade-weighted U.S. dollar index, is instantiated by the “trade-weighted U.S. dollar index, broad, goods’. The “trade-weighted U.S. dollar index, broad, goods’ is published by the Federal Reserve Board of Governors and was retrieved from the Federal Reserve Bank of St. Louis FRED Economic Data.

V. Results

V.I. Specification 1. The effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles.

Refer to table 1.b (appendix). Table 1.b. displays the estimation results of specification 1. Column 1 displays the estimation results when data for the period 2017-2018 is used; column 2 displays the estimation results when data for the period 2017-2019 is used.

The respective F-statistics are not available, presumably given the use of robust clustered standard errors and negligible between cluster variance (0.001; <0.000, for the two respective time spans) (Statalist, 2015). Estimating the specification with non-clustered standard errors yields statistically significant ($p < 0.001$) F-statistics.

The coefficient on the independent variable in column 1 indicates a negative association between section 232 steel tariff enactment and the external import price of sanctioned steel articles. A one percent increase of the twelve-month change in the logarithm of one plus the tariff rate is associated with an -0.007 to -0.236 percent reduction in the twelve month change of the logarithm of the external import price. The point estimate is -0.121 percent ($p = 0.04$). The coefficient on the independent variable in column 2 is not statistically significant at the 5 percent significance level ($p = 0.07$).

The first estimate, indicating a negative association between section 232 steel tariff enactment and the external import price of sanctioned steel articles, is in terms of the sign consistent with conventional trade theory and in terms of the magnitude consistent with Amiti et al. (2020). The second estimate, strictly indicating none (or more freely a slight positive) association between section 232 steel tariff enactment and the external import price of steel, is in terms of sign inconsistent with conventional trade theory and in terms of magnitude inconsistent with Amiti et al. (2020). Amiti et al. (2020) estimate a passthrough rate of 50 percent for tariffs on steel inputs one year after tariff enactment. In columns 3 and 4, I implement specification 1 on a different dataset containing the external import price for 33 steel product categories; I find a similar pattern as for columns 1 and 2. The non-statistically significant and statistically significant positive associations between section 232 steel tariff enactment and the external import price of sanctioned steel articles found in columns 2 and 4 could be due to the use of a control group that is quite limited in size compared to the treatment group.

V.II. Specification 2. The effect of section 232 steel and aluminum tariff enactment on the producer price indexes of the respective U.S. steel and aluminum industries.

2.a. U.S. Steel industry

Refer to figure 2.a (appendix) displaying the PPI of the U.S. steel industry in tandem with the PPI of a suited synthetic control group. The PPI of the synthetic control group constitutes a weighted average of the PPIs of the entities constituting the synthetic control group. The synthetic control group was selected based on the periods January 2004 (12 months after rescission of the George W. Bush administration safeguards on certain steel articles) through November 2007 and July 2009 through April 2016 (22 months before the enactment of the section 232 steel tariff by the Trump administration). The PPI of the synthetic control group continues to track the PPI of the U.S. steel industry reasonably well over the out-of-sample forecast period April 2016 through February 2018, with limited deviations now and then, yielding confidence in the synthetic control group being subject to similar outside influences as the U.S. steel industry. The decreasing PPI effect of section 232 steel tariff enactment after around December 2018 is consistent with Amiti et al., (2020), finding the pass-through rate decreasing from ±100 percent as of March 2018 to ±50 percent as of March 2019.

Refer to table 2.d (appendix). Table 2.d. displays data on the first to twenty-second lag of the treatment variable. The fifth to sixteenth lag of the treatment variable are not significant at the five percent significance level; the first to fourth and seventeenth to twenty-second lags, however, are significant. The significance of the first to fourth lag is probably indicative of anticipatory effects. The statistical significance of the first to fourth and seventeenth to twenty-second lags formally indicates a violation of the parallel trends assumption. However, given the majority of lags not being statistically significant and the fact that the first to fourth lag deviation can be ascribed to anticipatory effects, assuming parallel trends seems reasonable.

Refer to table 2.c (appendix) column 1 through 8. The eight specifications differ in terms of the treatment period (denoted below the table) and the inclusion of a 2007-2009 economic recession indicator variable. Given the non-statistical significance of the coefficients of the 2007-2009 economic recession indicator variable, the specifications excluding this variable are preferred. I have no clear preference between the remaining four specifications since these specifications profess a tradeoff between capturing full adjustment to the section 232 steel tariff and possible subjection to extra confounding factors. The respective F-statistics of the remaining four specifications are respectively significant at the 1 percent level, respectively rejecting the hypothesis the coefficients are jointly zero. The respective coefficients belonging to the section 232 steel tariff variable, the key coefficients, ranging from 0.029 to 0.048, implying section 232 steel tariff enactment is associated with a 2.9 to 4.8 (0.7 – 6.6)($p<0.01$) percent increase in the PPI of the U.S. steel industry.

2.b. U.S. Aluminum industry

Refer to figure 2.b (appendix) displaying the PPI of the U.S. aluminum industry in tandem with the PPI of a suited synthetic control group. The PPI of the synthetic control group constitutes a weighted average of the PPIs of the entities constituting the synthetic control group. The synthetic control group was selected based on the periods January 2005 through November 2007 and July 2009 through May 2015 (22 months before April 2017 as of when the U.S. Department of Commerce announced the initiation of an investigation to determine the effect of imported aluminum on U.S. national security). The PPI of the synthetic control group continues to track the PPI of the U.S. aluminum industry well over the out-of-sample forecast period June 2015 through March 2017, except for the last month, yielding confidence in the synthetic control group being subject to similar outside influences as the U.S. aluminum industry.

Refer to table 2.d (appendix). Table 2.d displays data on the first to twenty-second lag of the treatment variable. The second to twenty-second lag of the treatment variable are not significant at the five percent significance level; the first lag, however, is significant. The significance of the first lag is probably indicative of anticipatory effects. The statistical significance of the first lag formally indicates a violation of the parallel trends assumption; however, given the majority of lags not being statistically significant and the fact that the first lag deviation can be ascribed to anticipatory effects, assuming parallel trends seems reasonable.

Refer to table 2.c (appendix) column 9 and 10. The two specifications differ in terms of the inclusion of a 2007-2009 economic recession indicator variable. Given the non-statistical significance of the coefficient of the 2007-2009 economic recession indicator variable, the specification excluding this variable is preferred. The F-statistic of the preferred specification is significant at the 1 percent level, rejecting the hypothesis the coefficients are jointly zero. The coefficient belonging to the section 232 aluminum tariff variable, the key coefficient, is 0.100, implying section 232 aluminum tariff enactment is associated with a 10.0 (8.6 – 11.4)($p<0.01$) percent increase in the PPI of the U.S. aluminum industry.

Refer, once more, to table 2.c (appendix), now, column 11. The specification of column 11 is the specification of column 9 amended in that the “section 232 aluminum tariff” indicator variable is now split to capture the effect of section 232 aluminum tariff enactment on the PPI of the U.S. aluminum industry once full adjustment to the tariff has occurred. The F-statistic of the current specification is significant at the 1 percent level, rejecting the hypothesis the coefficients are jointly zero. The coefficient belonging to the section 232 aluminum tariff variable, the key coefficient, is 0.134, implying section 232 aluminum tariff enactment is associated with a 13.4 (12.8 – 14.0)($p<0.01$) percent increase in the PPI of the U.S. aluminum industry once full adjustment has occurred.

V.III. Specification 3. The effect of section 232 steel and aluminum tariff enactment on employment of the respective U.S. steel and aluminum industries.

3.a. U.S. Steel industry.

Refer to figure 3.c (appendix) displaying the employment of the U.S. steel industry in tandem with the employment of a suited synthetic control group. The employment of the synthetic control group constitutes a weighted average of the employment of the entities constituting the synthetic control group. The synthetic control group was selected based on the respective periods January 2001 through February 2001; January 2005 (12 months after rescission of the George W. Bush administration safeguards on certain steel articles) through November 2007 and July 2009 through May 2017 (nine months before the enactment of the section 232 steel tariff by the Trump administration). The employment of the synthetic control group continues to track the employment of the U.S. steel industry reasonably well over the out-of-sample forecast period June 2017 through February 2018, yielding confidence in the synthetic control group being subject to similar outside influences as the U.S. steel industry.

Refer to table 3.d (appendix). Table 3.d displays data on the first to ninth lag of the treatment variable. The second to ninth lag of the treatment variable are not significant at the five percent level of significance; the first lag, however, is significant at the one percent significance level. Furthermore, the point estimate of the first lag is considerably larger compared to the point estimates of the other lags. The first lag is probably indicative of anticipatory effects. The statistical significance of the first lag formally indicates a violation of the parallel trend assumption. I however judge this, given the current context, to be non-problematic.

Refer to table 3.c (appendix), column 1 through 3. The three specifications differ in terms of their inclusion of an indicator variable for the George W. Bush administration safeguards on certain steel articles and their inclusion of indicator variables for the respective 2001 and 2007-2009 economic recessions. Given the statistical significance of the coefficients for the George W. Bush administration safeguards […] indicator variable, the 2001 economic recession indicator variable, and the 2007-2009 economic recession indicator variable, the specification including those three variables is preferred. The F-statistic of the preferred specification is significant at the 1 percent level, rejecting the hypothesis the coefficients are jointly zero. The coefficient belonging to the section 232 steel tariff variable, the key coefficient, is 0.011, implying section 232 steel tariff enactment is associated with a 1.1 (0.3 – 1.9)($p<0.01$) percent increase in the number of employees of the U.S. steel industry.

Refer, once more, to table 3.c. (appendix), now, column 6. The specification of column 6 is the specification of column 3 amended in that the "section 232 steel and aluminum tariff" variable is now split to capture the effect of section 232 steel tariff enactment on the number of employees of the U.S. steel industry once full adjustment to the tariff has occurred. The F-statistic of the current specification is significant at the 1 percent level, rejecting the hypothesis the coefficients are jointly zero. The coefficient belonging to the section 232 steel tariff variable, the key coefficient, is 0.029, implying section 232 steel tariff enactment is associated with a 2.9 (2.7 – 3.1)(p<0.01) percent increase in the number of employees of the U.S. steel industry once full adjustment has occurred.

3.b. U.S. Aluminum Industry.

Refer to figure 3.d (appendix) displaying the employment of the U.S. aluminum industry in tandem with the employment of a suited synthetic control group. The employment of the synthetic control group constitutes a weighted average of the employment of the entities constituting the synthetic control group. The synthetic control group was selected based on the respective periods January 2001 through February 2001, December 2001 through November 2007, and July 2009 through May 2017 (nine months before enactment of the section 232 aluminum tariff by the Trump administration). The employment of the synthetic control group continues to track the employment of the U.S. aluminum industry moderately well over the out-of-sample forecast period June 2017 through February 2018: at the end of the period, a deviation becomes visible, possibly indicating an anticipatory effect. The evidence is to meager to yield confidence in the synthetic control group being subject to similar influences as the U.S. aluminum industry and not tracking U.S. aluminum industry employment well due to pure coincidence. The fact that the trends in the employment of the U.S. aluminum industry and synthetic control group once more track each other reasonably following September 2018 is additional evidence regarding the first scenario, but evidence remains meager. The divergence in employment between the U.S. aluminum industry and synthetic control group in the nine months out-of-sample forecast is consistent with figure 6.b. where the U.S. aluminum industry PPI already starts outperforming the PPI of the synthetic control group as of March 2017.

Refer to table 3.d (appendix). Table 3.d displays data on the first to ninth lag of the treatment variable. Consistent with visual inspection, the fifth to ninth month lags of the treatment variable are not significant at the five percent significance level. The first to four-month lags, however, are significant. The point estimates display an increasing trend indicative of a positive anticipatory effect. The statistical significance of the first to fourth lag formally indicates a violation of the parallel trends assumption. Assuming the divergence in employment trends between the U.S. aluminum industry and synthetic control group is due to anticipatory effects warrants the inclusion of the first four lags in the treatment period. Inclusion of the first four lags in the treatment period does reduce the employment effect associated with section 232 aluminum tariff enactment discussed below somewhat to 7.4 (6.4 – 8.4) percent when the preferred specification is used. A recommendation for future research is the use of a slightly longer out-of-sample forecast period (± + 4 months) to be able to ascertain with more certainty whether U.S aluminum industry employment and the employment of the synthetic control group track each other well due to coincidence or due to both entities subjection to similar outside influences.

Refer to table 3.c (appendix), column 4 and 5. Column 4 reports estimates for a specification excluding indicator variables for the respective 2001 and 2007-2009 economic recessions. Column 5 reports estimates for a specification including indicator variables for the respective 2001 and 2007-2009 economic recessions. Given the insignificance of the coefficients of the 2001 and 2007-2009 economic recession indicator variables, the fourth specification is considered the preferred specification. The F-statistic of the fourth specification is significant at the 1 percent level, rejecting the hypothesis the coefficients are jointly zero. The coefficient belonging to the section 232 steel and aluminum tariff variable, the key coefficient, is 0.081, implying section 232 aluminum tariff enactment is associated with an 8.1 (7.3 – 8.9)($p<0.01$) percent increase in the number of employees of the U.S. aluminum industry.

Refer, once more, to table 3.c. (appendix), now, column 7. The specification of column 7 is the specification of column 4 amended in that the “section 232 steel and aluminum tariff” variable is now split to capture the effect of section 232 aluminum tariff enactment on the number of employees in the U.S. aluminum industry once full adjustment to the tariff has occurred. The F-statistic of the current specification is significant at the 1 percent level, rejecting the hypothesis the coefficients are jointly zero. The coefficient belonging to the section 232 steel and aluminum tariff variable, the key coefficient, is 0.088, implying section 232 aluminum tariff enactment is associated with and 8.8 (8.2 – 9.4)($p<0.01$) percent increase in the number of employees of the U.S. aluminum industry once full adjustment has occurred.

V.IV. Specification 4. The effect of section 232 steel tariff enactment on the producer price index of a selection of sanctioned steel articles.

Refer to table 4.b (appendix). Table 4.b. reports summary results of sixteen instantiations of specification 4. The sixteen instantiations differ with respect to the period of the underlying data, the inclusion of a capacity index, the use of robust clustered standard errors and the use of the lag lengths used by Liebman, (2006), or the use of the lag lengths minimizing the Akaike information criterion. The term “summary” in “summary results” refers to the reported estimates constituting the sum of the coefficients on the lags significant at the five percent significance level.

The estimates in table 4.b. indicate section 232 steel tariff enactment to be associated with a 5.2 to 8.8 percent increase in the producer price index of a selection of sanctioned steel articles. The preferred estimates are those of instantiation 11 and 15. The lag structure consistent with minimization of the Akaike information criterion is regarded as the most appropriate given amendments made to the specification of Liebman, (2006) and changing factors over time that together might cause the lag structure of Liebman, (2006) to be no longer appropriate. Exclusion of the capacity index is regarded the most appropriate given the recent trend in the number of establishments under the U.S. steel industry, as displayed in figure 4.a. The sole significant preferred estimate indicates an association between section 232 steel tariff enactment and the producer price index of a selection of sanctioned steel articles of 5.4 percent.

The general signs of the coefficients in table 4.a. are consistent with Liebman, (2006), except for the general sign of the trade-weighted U.S. dollar. A possible, partial explanation is the observation that during economic recessions, the trade-weighted U.S. dollar and the producer price index of the U.S. steel industry appreciate sharply, given the role of the U.S. dollar as a safe currency and the relatively high capital intensity of the U.S. steel industry.

VI. Conclusion, limitations, and implications for future research.

VI.I. Conclusion

As of March 8th, 2018, U.S. President Donald J. Trump declared his intention to enact a tariff on numerous steel and aluminum articles effective as of March 23rd, 2018, to adjust the import of steel and aluminum articles into the U.S.

The existing literature relating specifically to the effects of the section 232 steel and aluminum tariff is limited. The majority of existing literature focusses on the general impact of all tariffs imposed by the Trump administration in 2018 (and 2019); these tariffs including the section 232 steel and aluminum tariff. This article focusses specifically on the effects of the section 232 steel and aluminum tariff and extends the breadth of the existing empirical literature.

The evidence I find suggests a negative effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles. Next, I find the section 232 steel and aluminum tariff to have had a positive effect on the producer price indexes of the respective U.S. steel and aluminum industries, estimating an effect of <u>0.7 – 6.6</u> percent for the U.S. steel industry and estimating an effect of <u>12.8 – 14.0</u> percent for U.S. aluminum industry. Then, I find the section 232 steel tariff to have exerted a positive effect on the producer price index of a selection of sanctioned steel articles, estimating an effect of <u>5.2 – 8.8</u> percent. Finally, I find the section 232 steel and aluminum tariff to have had a positive effect on employment of the respective U.S. steel and aluminum industries with estimates of respective <u>2.7 – 3.1</u> and <u>8.2 – 9.4</u> percent employment increases.

Table 0.b (appendix) provides a general overview of results.

The reduction in the external import price of sanctioned steel articles, the increase in the producer price indexes of the respective U.S. steel and aluminum industries, the increase in the producer price index of a selection of sanctioned steel articles, and the increase in employment of the respective U.S. steel and aluminum industries are consistent with the empirical literature.

VI.II. Limitations

The four specifications implemented in this study profess limitations as regards to data availability and exogeneity.

Regarding data availability. In specification four, the average hourly earnings of production and non-supervisory employees of the primary metal manufacturing sector are used. Ideally, the average hourly earnings […] of the U.S. steel industry would have been used. Additionally, in specification four, the PPI's for industrial electricity, coal, steel scrap, and iron ore are used. Ideally, the prices paid for these inputs by the U.S. steel industry would have been used. It is conceivable there exists considerable slippage between the average output price of U.S. producers and the average input price paid by the U.S. steel industry.

Regarding exogeneity. The four specifications implemented in this study are of differing levels of credibility. Credibility, referring to the stringency of the assumptions necessary in order for the established estimate to be able to be interpreted as causal. For the established estimate of a standard multiple regression to be interpreted as causal, the conditional independence assumption must hold. The fourth specification by incorporating a product dummy controls for all initial differences in factors affecting the dependent variable between products (articles) and thereby reduces the stringency of assumptions that have to be made to interpret the established estimate as causal. The first specification by incorporating a product dummy and a country time dummy controls for all initial differences in factors affecting the dependent variable between products while additionally controlling for the change over time in country-specific factors affecting the dependent variable. The first specification further reduces the stringency of the assumptions that have to be made to interpret the established estimate as causal. The second and third specifications by incorporating product and time dummies control for the initial difference in factors affecting the dependent variable between the treatment and control group while additionally controlling for the average change over time in factors affecting the dependent variable. The fact that the section 232 steel tariff is assumed to be exogenous (or unanticipated) by multiple authors (e.g., Amiti et al. 2019) further bolsters confidence in the exogeneity of the second and third specifications.

One more remark regarding exogeneity. Specifications two and three make use of synthetic control groups composed of numerous entities. The employment and PPI's of some of the entities could be subject to spillover effects related to the section 232 steel and aluminum tariff enactment. In selecting the array of entities possibly to be selected for inclusion in the synthetic control group, the decision was made to exclude all steel and aluminum industry related sectors under NAICS category 331: primary metal manufacturing and to exclude all sectors under NAICS category 332: fabricated metal product manufacturing. The direction of the bias caused by the possible presence of spillover effects is unclear. The array of entities possibly to be selected for inclusion in the synthetic control group contains upstream as well as downstream industries from the perspective U.S. steel and aluminum industries.

Two final remarks. First, the duration of the treatment period is not clear. In this study, either estimates for the maximum duration possible given limitations in data availability or estimates for the duration used by the author of the original method or estimates for different duration choices or estimates for the duration appearing most appropriate based on a visual inspection of accessory figures were provided. In general, the choice of a short duration has the benefit of limiting the amount of confounding factors, but has the drawback of possibly not capturing full adjustment to the section 232 steel and aluminum tariff—Vice versa for the choice of a long duration. Second, regarding specification two and three. In specification two and three, only once a sizeable anticipatory effect was found for the PPI of the U.S. aluminum industry. This large anticipatory effect is an anomaly, and it is questionable whether the deviation in the PPIs of the U.S. aluminum industry and the synthetic control group from April 2017 through March 2018 really constitutes an anticipatory effect or whether another factor was responsible for the deviation. I did not find one, not implying there is none.

VI.III. Implications for future research

Regarding specification two and three. The four dependent variables belonging to the respective synthetic control groups track the respective dependent variables of the four treatment groups moderately. This outcome is congruent with the selection of a synthetic control group of which the dependent variable most accurately matches the dependent variable of the treatment group in certain pre-intervention periods and abstraction from the use of matching on other explanatory variables. To improve the fit of the dependent variable of the synthetic control group matching on other explanatory variables could be added. i.e., the capital intensiveness of the sector, sales growth, productivity growth, and wage growth (as provided for in the Annual Survey of Manufacturers of the U.S. Census Bureau and the Labor Productivity and Cost Data of the BLS).

Once more, regarding specification two and three. Of the four respective treatment effects ascertained by conjunctive execution of the synthetic control method and difference-in-difference regression, the statistical significance reported is biased. The reason for this is that the standard procedures to compute standard errors are appropriate in light of using a sample, but here I draw the entire population (the entire U.S. steel industry). The unbiased statistical significance of these four treatment effects is ascertainable. The procedure used for ascertaining the statistical significance is named "permutation-based inference." The procedure roughly entails the ascertainment of hypothetical treatment effects for the entities up for possible selection into the synthetic control group and a comparison of these hypothetical treatment effects to the treatment effect of the treatment group. Casu quo, the hypothetical treatment effects are of moderate magnitude compared to the treatment effect of the treatment group statistical significance is assumed. The reason the statistical significance of the four respective treatment effects was not ascertained using permutation-based inference is the impracticability of implementing the permutation-based inference procedure, in the current context, on a normal computer.

Regarding specification four. Specification four could be estimated using data at a more disaggregated level than the current level of aggregation.

Regarding specification one. Specification one could be estimated using a larger control group to determine whether the abnormal associations found are due to the relatively small size of the control group.

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APPENDIX

Table of Contents 2.	Page
General	
Table 0.a. Definitions of certain relevant NAICS sectors.	33
Table 0.b. Summary of results.	35
Specification 1.	
Table 1.a. Summary statistics for the twelve-month change in the logarithm of the external import price and the twelve-month change in the logarithm of unity plus the tariff rate variables.	37
Table 1.b. Effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles.	38
Specification 2.	
Table 2.a. Summary statistics of the producer price indexes of the entities up for possible selection into the synthetic control group.	39
Table 2.b. List of entities up for possible selection into the synthetic control group.	40
Figure 2.a. Producer price index of the U.S. steel industry and a suited synthetic control group.	41
Figure 2.b. Producer price index of the U.S. aluminum industry and a suited synthetic control group.	43
Table 2.c. Estimates of the effect of section 232 steel and aluminum tariff enactment on the producer price indexes of the respective U.S. steel and aluminum industries.	44
Table 2.d. Lags of the treatment indicator.	46
Specification 3.	
Table 3.a. Summary statistics of the employment of the entities up for possible selection into the synthetic control group.	48
Table 3.b. List of entities up for possible selection into the synthetic control group.	49
Figure 3.a. Twelve self-composed clusters of counties in the Rust Belt area of the United States	51
Figure 3.b. U.S. metropolitan areas for which the employment in the manufacturing sector is up for possible inclusion into the synthetic control group	52
Figure 3.c. Respective employment of the U.S. steel industry and a suited synthetic control group.	53

Table 0.a. Definitions of certain relevant NAICS* sectors.

NAICS Sector Code	NAICS Sector Title	NAICS Sector Description
331110	Iron and Steel Mills and Ferroalloy Manufacturing	This industry comprises establishments primarily engaged in one or more of the following: (1) direct reduction of iron ore; (2) manufacturing pig iron in molten or solid form; (3) converting pig iron into steel; (4) making steel; (5) making steel and manufacturing shapes (e.g., bar, plate, rod, sheet, strip, wire); (6) making steel and forming pipe and tube; and (7) manufacturing electrometallurgical ferroalloys. Ferroalloys add critical elements, such as silicon and manganese for carbon steel and chromium, vanadium, tungsten, titanium, and molybdenum for low- and high alloy metals. Ferroalloys include iron-rich alloys and more pure forms of elements added during the steel manufacturing process that alter or improve the characteristics of the metal.
331313	Alumina Refining and Primary Aluminum Production	This U.S. industry comprises establishments primarily engaged in one or more of the following: (1) refining alumina (i.e., aluminum oxide) generally from bauxite; (2) making aluminum from alumina; and/or (3) making aluminum from alumina and rolling, drawing, extruding, or casting the aluminum they make into primary forms. Establishments in this industry may make primary aluminum or aluminum-based alloys from alumina.
331	Primary Metal Manufacturing	Industries in the Primary Metal Manufacturing subsector smelt and/or refine ferrous and nonferrous metals from ore, pig or scrap, using electrometallurgical and other process metallurgical techniques. Establishments in this subsector also manufacture metal alloys and superalloys by introducing other chemical elements to pure metals. The output of smelting and refining, usually in ingot form, is used in

	rolling, drawing, and extruding operations to make sheet, strip, bar, rod, or wire, and in molten form to make castings and other basic metal products. Primary manufacturing of ferrous and nonferrous metals begins with ore or concentrate as the primary input. Establishments manufacturing primary metals from ore and/or concentrate remain classified in the primary smelting, primary refining, or iron and steel mill industries regardless of the form of their output. Establishments primarily engaged in secondary smelting and/or secondary refining recover ferrous and nonferrous metals from scrap and/or dross. The output of the secondary smelting and/or secondary refining industries is limited to shapes such as ingot or billet that will be further processed. Recovery of metals from scrap often occurs in establishments that are primarily engaged in activities, such as rolling, drawing, extruding, or similar processes. Excluded from the Primary Metal Manufacturing subsector are establishments primarily engaged in manufacturing ferrous and nonferrous forgings (except ferrous forgings made in steel mills) and stampings. Although forging, stamping, and casting are all methods used to make metal shapes, forging and stamping do not use molten metals and are included in Subsector 332, Fabricated Metal Product Manufacturing. Establishments primarily engaged in operating coke ovens are classified in Industry 32419, Other Petroleum and Coal Products Manufacturing.

Adapted from the 2017 NAICS manual as published by the U.S. Census Bureau (Executive Office of the President Office of Management and Budget, 2017). *NAICS: North American Industry Classification System.

Table 0.b. Summary of results.

Specification	(1)	(2)	(4)	(2)	(3)	(3)
Title	Effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles.	Effect of section 232 steel tariff enactment on the producer price index of the U.S. steel industry.	Effect of section 232 steel tariff enactment on the producer price index of a selection of sanctioned steel articles.	Effect of section 232 aluminum tariff enactment on the producer price index of the U.S. aluminum industry.	Effect of section 232 steel tariff enactment on the employment of the U.S. steel industry.	Effect of section 232 aluminum tariff enactment on the employment of the U.S. aluminum industry.
Point estimate	A one percent increase in the twelve-month change of the logarithm of one plus the tariff rate is associated with an -0.121 percent decrease in the twelve month change in the logarithm of the external import price.	2.9 – 4.8 percent increase in the producer price index.	5.2 – 8.8 percent increase in the producer price index.	13.4 percent increase in the producer price index.	2.9 percent increase in employment.	8.8 percent increase in employment.
Confidence interval	-0.237 – -0.005	0.7 – 6.6 percent increase in the producer price index.	n.a.	12.8 – 14.0 percent increase in the producer price index.	2.7 – 3.1 percent increase in employment.	8.2 – 9.4 percent increase in employment.

Except for specification 4, preferred estimates are reported. For specification 2 and 3, where relevant, the magnitude of the effect after full adjustment has occurred is reported.

Specification 1.

Table 1.a. Summary statistics for the twelve-month change in the logarithm of the external import price and the twelve-month change in the logarithm of unity plus the tariff rate variables.

Variable	Time period	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
12-month change in the logarithm of the external import price.	2018	16,260	0.031	0.110	-0.485	0.477
12-month change in the logarithm of unity plus the tariff rate.	2018	16,260	0.027	0.044	0.000	0.176
12-month change in the logarithm of the external import price.	2018-2019	32,520	0.011	0.111	-0.487	0.478
12-month change in the logarithm of unity plus the tariff rate.	2018-2019	32,520	0.015	0.046	-0.097	0.176

Table 1.b. Effect of section 232 steel tariff enactment on the external import price of sanctioned steel articles.

Dependent variable: 12-Month Change in the Log External Import Price of Steel - $\boldsymbol{\Delta \ln (P_{ijt})}$	**(1)**	**(2)**	**(3)**	**(4)**
12-Month Change in the Logarithm of Unity Plus the Tariff Rate - $\Delta \ln (1 + Tariff_{ijt})$	-0.121**	0.070*	-0.046	0.153***
	(0.058)	(0.039)	(0.175)	(0.053)
Time Period	2018	2018-2019	2018	2018-2019
R^2	0.005	0.012	0.006	0.017
F-stat	-	-	-	-
Number of observations	16,260	32,520	4,632	7,728

Heteroskedasticity-robust clustered (at the HS-8 digit level (column 1 and 2)) standard errors in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, resp. Product and Country*Year fixed effects suppressed for enhanced readability. Preferred estimate is underlined.

Specification 2.

Table 2.a. Summary statistics of the producer price indexes of the entities up for possible selection into the synthetic control group.

Number of Observations	Mean	Standard Deviation	Minimum	Maximum
89,472	155.6	78.5	-125.5	1,390.4

Table 2.b. List of entities up for possible selection into the synthetic control group.

NAICS sectors
331 and 4, 5, and 6 digit subsectors, excluding those sectors engaged in steel or aluminum production.
333 and 4, 5 and 6 digit subsectors
334 and 4, 5 and 6 digit subsectors
335 and 4, 5 and 6 digit subsectors
336 and 4, 5 and 6 digit subsectors
337 and 4, 5 and 6 digit subsectors
339 and 4, 5 and 6 digit subsectors
211 and 4,5 and 6-digit subsectors
212 and 4,5 and 6-digit subsectors
213 and 4,5 and 6-digit subsectors
Industries
Total Manufacturing Industries
Total Mining Industries
Commodities
All commodities (aggregate index) – BLS PPI Commodity Data
All commodities under the subcategory “Fuels and related products and powers (05)” – BLS PPI Commodity Data
All commodities under the subcategory “Plastic (072)” – BLS PPI Commodity Data
Jewelry (gold and platinum) and silverware (159402) – BLS PPI Commodity Data
All commodities under the subcategory “Metals and metal products (10)” – BLS PPI Commodity Data

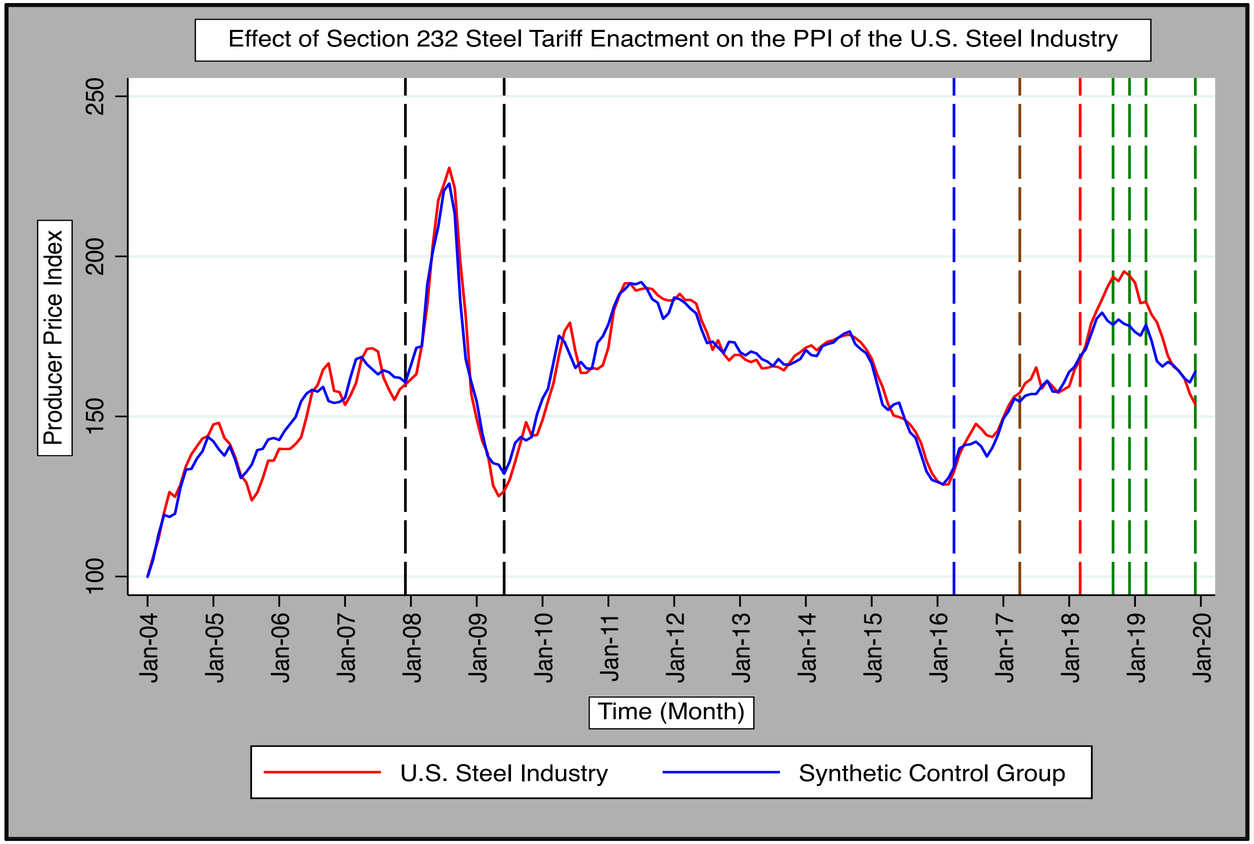

Figure 2.a. Respective producer price indexes of the U.S. steel industry and a suited synthetic control group. Control group based on the respective periods January 2004 through November 2007 and July 2009 through April 2016. The black dotted lines indicate the 2007-2009 economic recession. The brown dotted line indicates April 2017; as of April 2017, the U.S. Department of commerce announced the commencement of an investigation regarding the national security implications of (certain) steel imports. The blue dotted line indicates April 2016. The period May 2016 through February 2018 (area between the blue and red dotted lines) constitutes an out-of-sample prediction. The red dotted line indicates March 2018. As of March 2018 the section 232 steel tariff first became effective for a first group of countries. The four

green dotted lines indicate the ends of the four different treatment periods used. The first green dotted line indicates September 2018. The second green dotted line indicates December 2018. The third green dotted line indicates March 2019. The fourth green dotted line indicates December 2019. The area between the red dotted line and the fourth green dotted line constitutes the first treatment period used, the area between the red dotted line and the third green dotted line constitutes the second treatment period used etc.

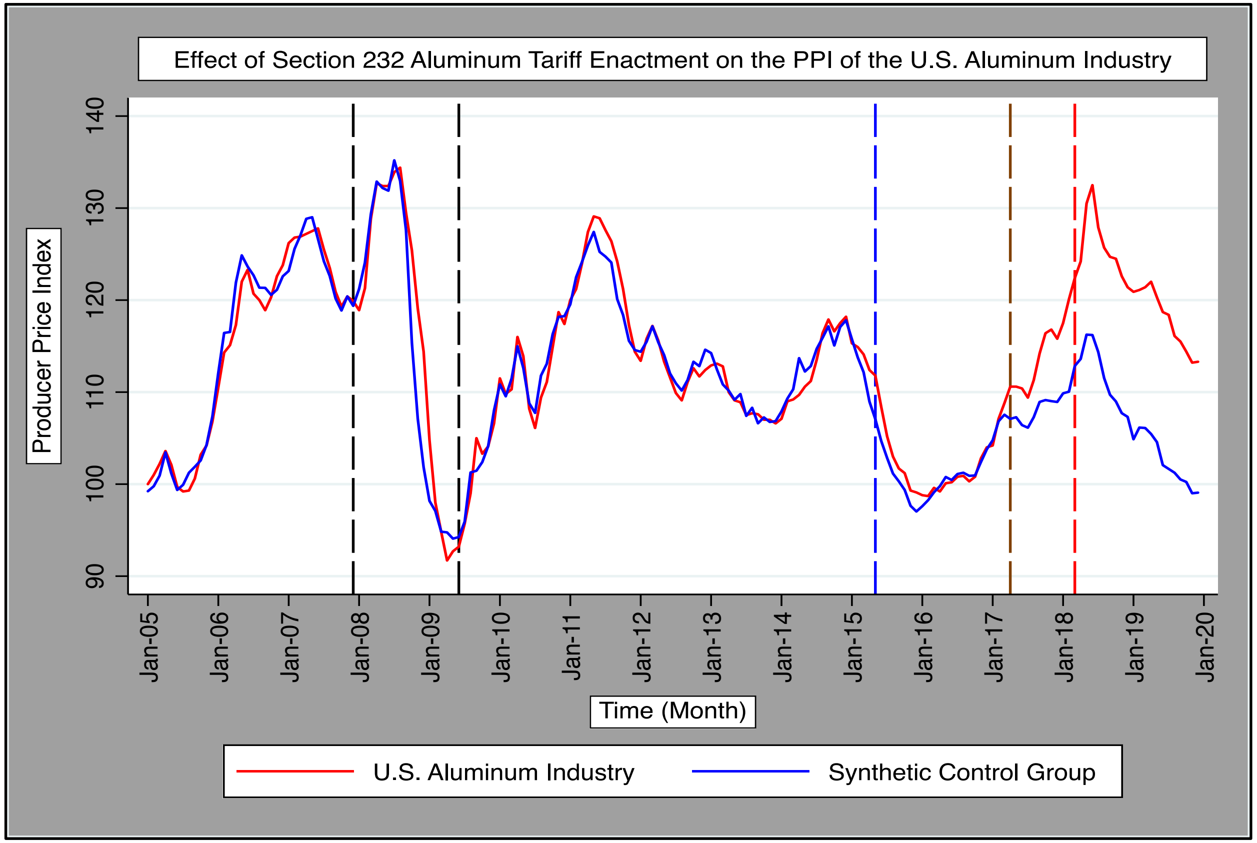

Figure 2.b. Respective producer price indexes of the U.S. aluminum industry and a suited synthetic control group. Control group based on the respective periods January 2005 through November 2007 and July 2009 through May 2015. The black dotted lines indicate the 2007-2009 economic recession. The brown dotted line indicates April 2017; as of April 2017, the U.S. Department of commerce announced the commencement of an investigation regarding the national security implications of (certain) aluminum imports. The blue dotted line indicates May 2015. The period June 2015 through March 2017 (area between the blue and brown dotted lines) constitutes an out-of-sample prediction. The red dotted line indicates March 2018. As of March 2018, the section 232 aluminum tariff first became effective for a first group of countries.

Table 2.c. Effect of section 232 steel tariff enactment on the producer price index of the U.S. steel industry.

Dependent Variable: Log Employment U.S. Steel Industry	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Section 232 Steel Tariff	<u>0.033***</u>	0.033***	<u>0.048***</u>	0.048***	<u>0.044***</u>	0.044***	<u>0.029***</u>	0.028***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.011)	(0.011)	(0.011)	(0.011)
Treatment Group	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
2007 – 2009 Economic Recession	N.A.	-0.004	N.A.	-0.004	N.A.	-0.004	N.A.	-0.004
		(0.009)		(0.009)		(0.009)		(0.009)
Constant	4.605***	4.605***	4.605***	4.605***	4.605***	4.605***	4.605***	4.605***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
F-Statistic	10,095.6 9***	36,026.5 3***	10,584.5 6***	37,739.9 6***	10,753.4 0***	38,279.9 2***	10,938.9 2***	39,009.9 9***
Number of Observations	384	384	366	366	360	360	354	354

Heteroskedasticity-robust standard errors in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, resp. Treatment period: (1) & (2) March 2018 through December 2019. (3) & (4) March 2018 through March 2019. (5) & (6) March 2018 through December 2018. (7) & (8) March 2018 through September 2018. Preferred estimates are underlined.

Table 2.c. (continued). Effect of section 232 aluminum tariff enactment on the producer price index of the U.S. aluminum industry.

Dependent Variable: Log Employment U.S. Aluminum Industry	**(9)**	**(10)**	**(11)**
Section 232 Aluminum Tariff	0.100***	0.102***	N.A.
	(0.007)	(0.007)	
First Section	N.A.	N.A.	0.068***
			(0.008)
Second Section	N.A.	N.A.	0.134***
			(0.003)
Treatment Group	0.003*	0.001	0.003*
	(0.002)	(0.001)	(0.002)
2007-2009 Economic Recession	N.A.	0.015	N.A.
		(0.010)	
Constant	4.600***	4.601***	4.600***
	(0.003)	(0.003)	(0.003)
F-Statistic	5,784.93***	2,427.67***	6,766.12***
Number of Observations	360	360	360

Heteroskedasticity-robust standard errors in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, resp. Treatment period: March 2018 through December 2019. Preferred estimates are underlined. (11). First section: March 2018 through August 2018. Second section: September 2018 through December 2019.

Table 2.d. Lags of the treatment indicator.

Lag	U.S. Steel Industry (1)	U.S. Aluminum Industry (2)
1	-0.784**	0.923***
	(0.366)	(0.193)
2	-2.641**	0.428
	(1.356)	(0.403)
3	-2.419***	-0.020
	(0.965)	(0.475)
4	-1.878**	-0.046
	(0.899)	(0.380)
5	-1.156	-0.025
	(0.990)	(0.328)
6	-0.969	-0.104
	(0.869)	(0.303)
7	-0.940	-0.231
	(0.771)	(0.302)
8	0.268	-0.294
	(1.295)	(0.288)
9	0.790	-0.339
	(1.255)	(0.276)
10	1.141	-0.370
	(1.184)	(0.266)
11	1.322	-0.439*
	(1.100)	(0.264)
12	1.281	-0.448*
	(1.021)	(0.260)
13	1.340	-0.442
	(0.956)	(0.258)
14	1.289	-0.405
	(0.902)	(0.256)

15	1.317	-0.316
	(0.885)	(0.264)
16	1.479*	-0.177
	(0.825)	(0.287)
17	1.840**	-0.080
	(0.846)	(0.293)
18	2.098***	0.018
	(0.838)	(0.299)
19	2.337***	0.081
	(0.828)	(0.298)
20	2.432***	0.166
	(0.800)	(0.301)
21	2.370***	0.271
	(0.775)	(0.308)
22	2.188***	0.441
	(0.770)	(0.332)

Heteroskedasticity-robust standard errors in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, resp. Estimates significant at the 5% significance level are colored red. Estimates not significant at the 5% significance level are colored green.

Specification 3.

Table 3.a. Summary statistics of the employment of the entities up for possible selection into the synthetic control group.

Number of Observations	Mean	Standard Deviation	Minimum	Maximum
333,564	86,855	426,435	7	16,900,000

Table 3.b. List of entities up for possible selection into the synthetic control group.

Federal Level*
NAICS sector 331 and 4, 5, and 6 digit subsectors, excluding those sectors engaged in steel or aluminum production.
NAICS sector 333 and 4, 5 and 6 digit subsectors
NAICS sector 334 and 4, 5, and 6 digit subsectors.
NAICS sector 335 and 4, 5, and 6 digit subsectors.
NAICS sector 336 and 4, 5, and 6 digit subsectors.
NAICS sector 337 and 4, 5, and 6 digit subsectors.
NAICS sector 339 and 4, 5, and 6 digit subsectors.
NAICS sector 21 and 3, 4, 5, and 6 digit subsectors.
NAICS sector 23 and 3, 4, 5, and 6 digit subsectors.
NAICS sector 31-33.
Durable goods manufacturing.
State Level
NAICS sector 331 and 4,, 5 and 6 digit subsectors, excluding those sectors engaged in steel or aluminum production.
NAICS sector 333.
NAICS sector 334.
NAICS sector 335.
NAICS sector 336.
NAICS sector 337.
NAICS sector 339.
NAICS sector 21 and 3 digit subsectors.
NAICS sector 23 and 3 digit subsectors.

NAICS sector 31-33.
Durable goods manufacturing.
Regional level
The manufacturing sector for twelve self-composed clusters of counties shown in figure 3.a.
Metropolitan area level
The manufacturing sector for the metropolitan areas shown in figure 3.b.
The durable goods manufacturing sector for the ten largest U.S. metropolitan areas and Pittsburg, Cleveland, Toledo and Detroit.
County level
The manufacturing sector for the counties harboring the cities of Pittsburgh, Cleveland, Toledo and Detroit.
Country level
The nonferrous metal (except aluminum) production and processing sector, the metal ore mining sector, the construction sector, the automotive sector and the manufacturing sector for Canada.
The manufacturing sector for Norway, Sweden, the Netherlands, Belgium, the United Kingdom, Spain, Portugal, Italy, Poland, Australia and New-Zealand.

* Federal Level referring to the United States as a whole.

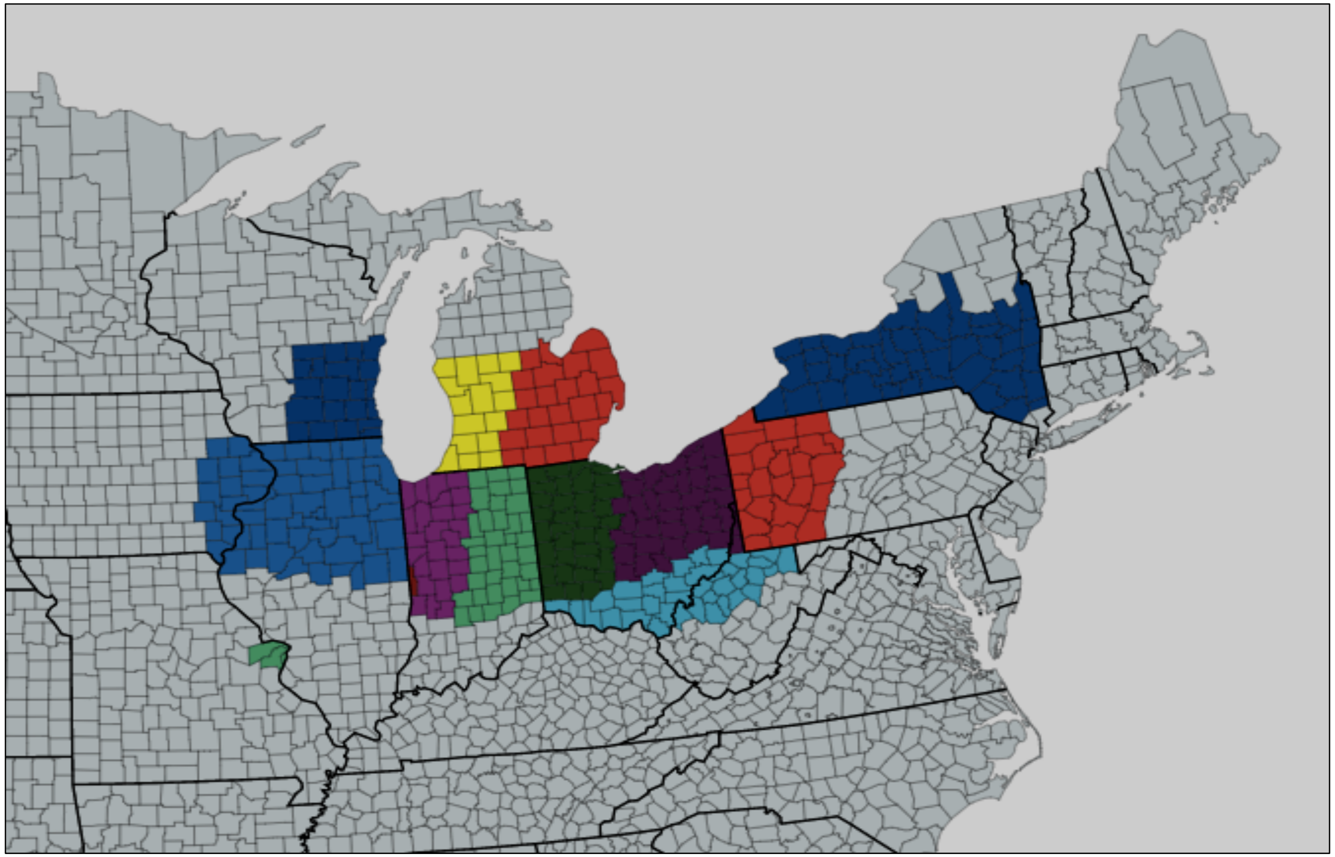

Figure 3.a. Twelve self-composed clusters of counties in the Rust Belt Area of the United States. Courtesy to: mapchart.net. Given copyright issues, for a map of the Rust Belt Area, please refer to Belt Magazine, (2013).

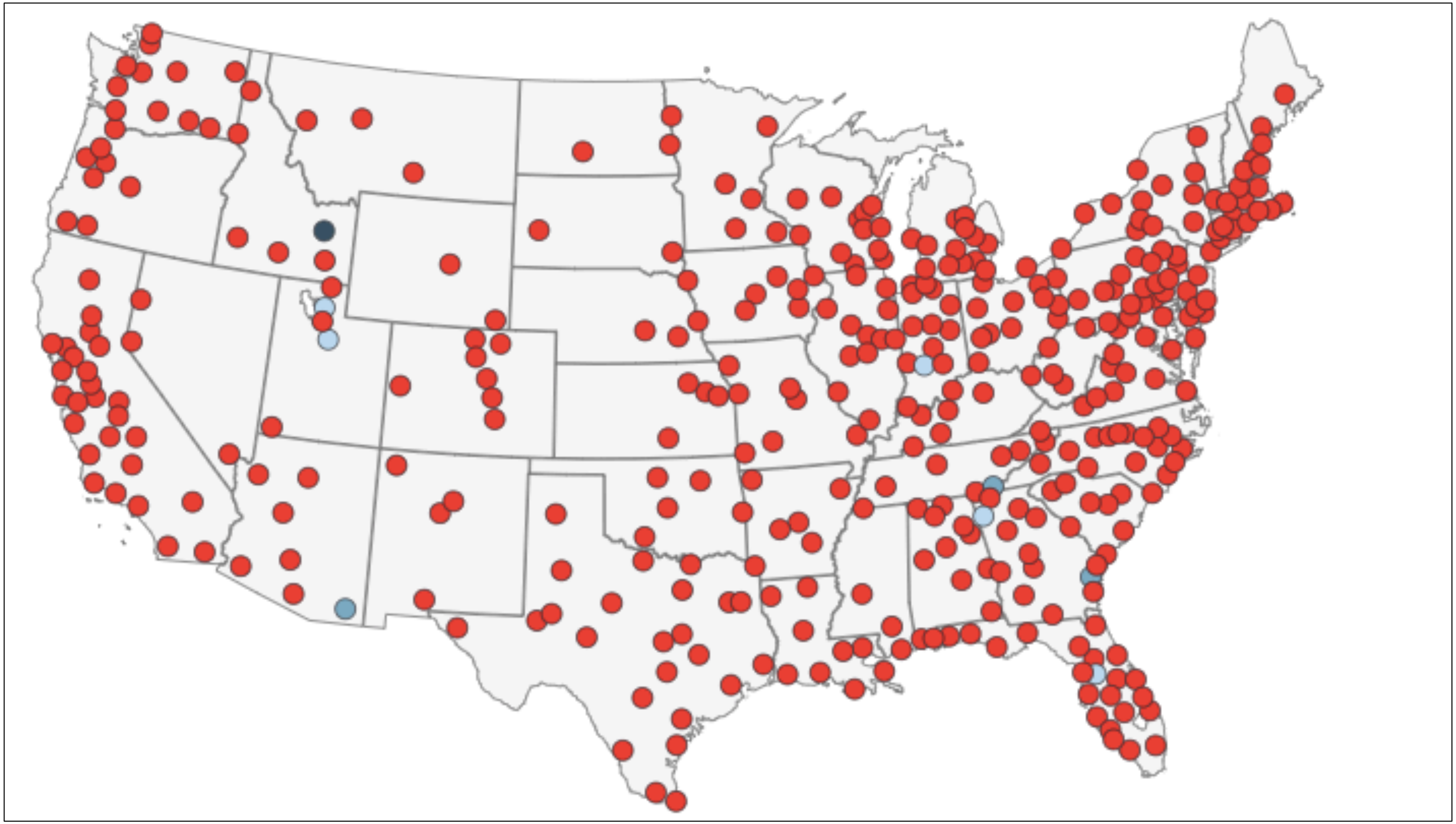

Figure 3.b. U.S. metropolitan areas for which the employment in the manufacturing sector is up for possible inclusion into the synthetic control group. Source: Bureau of Labor Statistics. Bureau of Labor Statistics, (2018b).

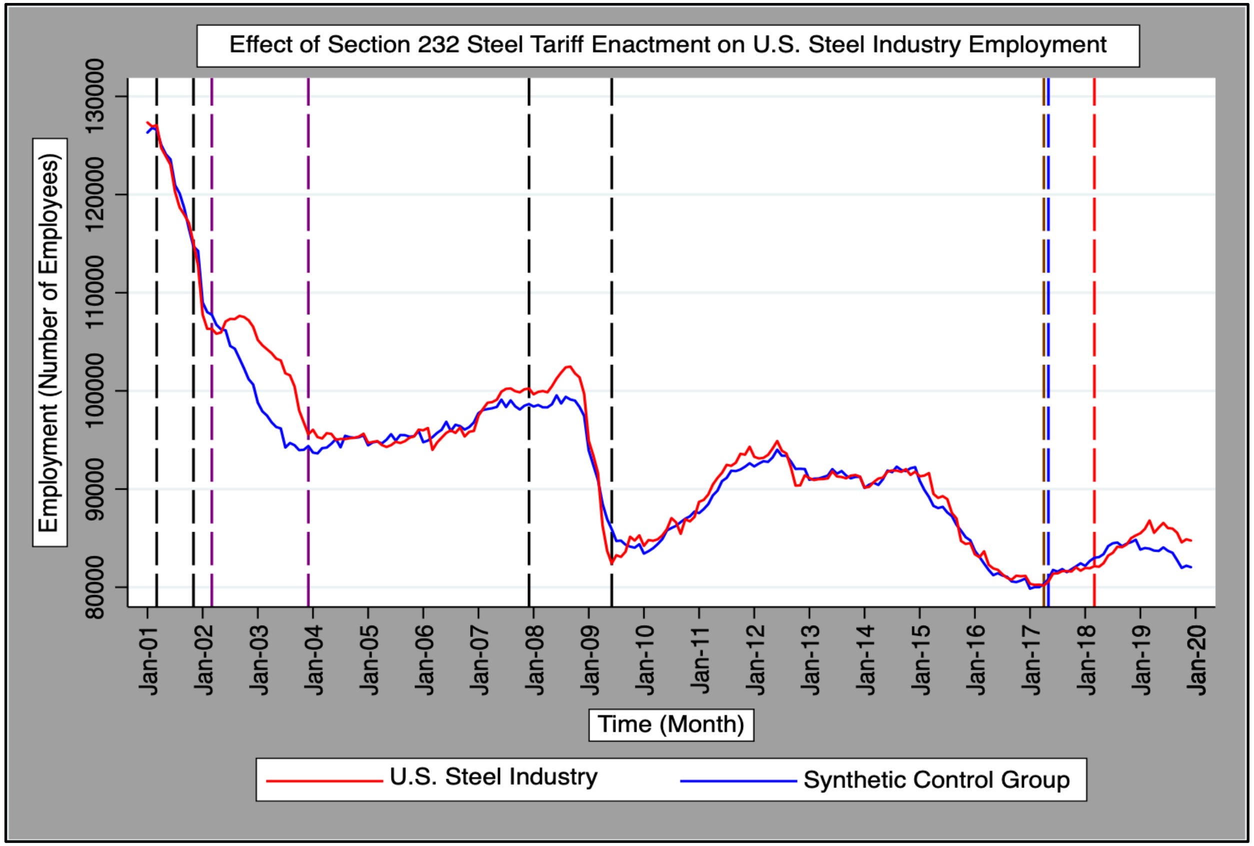

Figure 3.c. Respective employment of the U.S. steel industry and a suited synthetic control group. Control group based on the respective periods January 2001 through February 2001; January 2005 through November 2007 and July 2009 through May 2017. The black dotted lines indicate the respective 2001 and 2007-2009 economic recessions. The purple dotted lines indicate the George W. Bush administration safeguards on certain steel articles. The brown dotted line indicates April 2017; as of April 2017 the U.S. department of commerce announced the commencement of an investigation regarding the national security implications of (certain) steel imports. The blue dotted line indicates May 2017. The period June 2017 through February 2018 (area between the blue and red dotted lines) constitutes an out-of-sample prediction. The red dotted line indicates March 2018. As of March 2018 the section 232 steel tariff first became effective for a first group of countries.

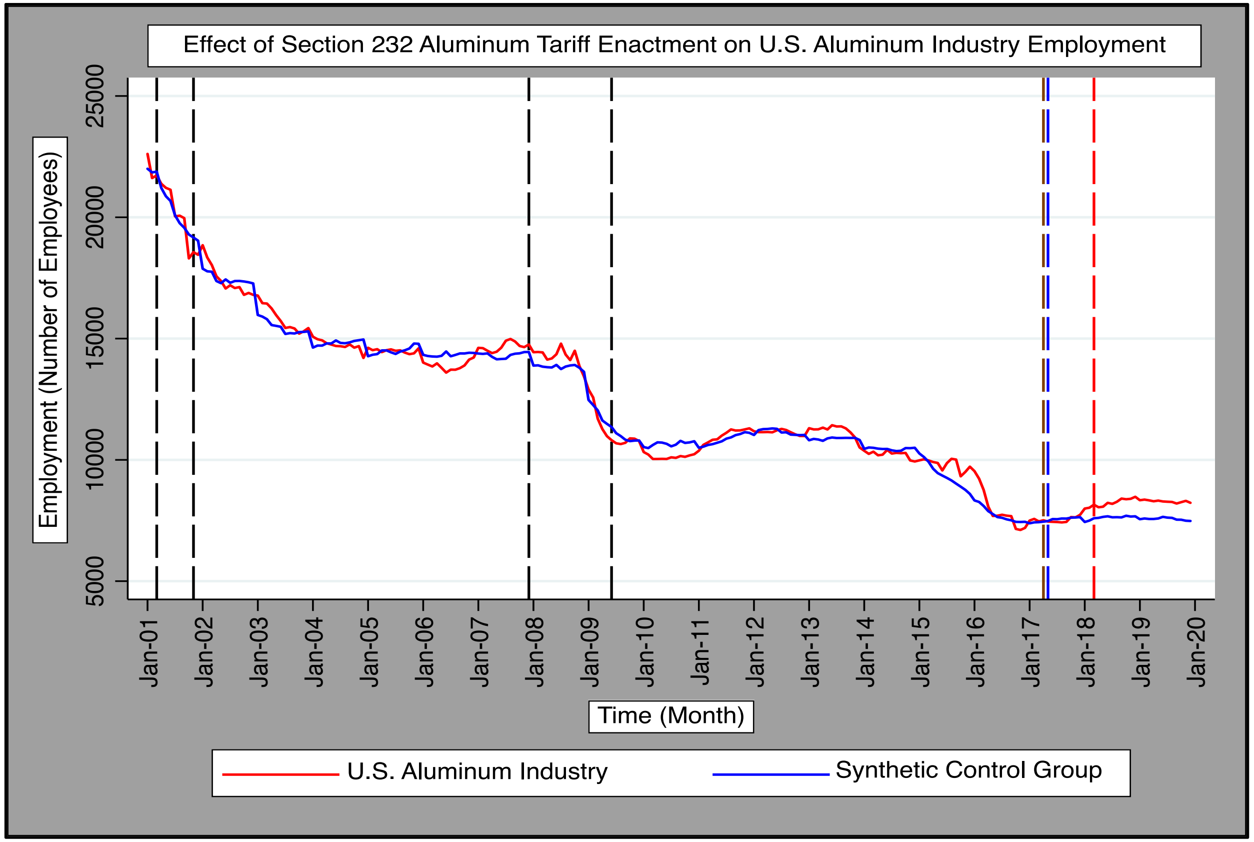

Figure 3.d. Respective employment of the U.S. aluminum industry and a suited synthetic control group. Control group based on the respective periods January 2001 through February 2001; December 2001 through November 2007 and July 2009 through May 2017. The black dotted lines indicate the respective 2001 and 2007-2009 economic recessions. The brown dotted line indicates April 2017; as of April 2017 the U.S. department of commerce announced the commencement of an investigation regarding the national security implications of (certain) aluminum imports. The blue dotted line indicates May 2017. The period June 2017 through February 2018 (area between the blue and red dotted lines) constitutes an out-of-sample prediction. The red dotted line indicates March 2018. As of March 2018 the section 232 aluminum tariff first became effective for a first group of countries.

Table 3.c. Effect of section 232 steel and aluminum tariff enactment on the employment of the respective U.S. steel and aluminum industries.

Dependent Variable: Employment	U.S. Steel Industry **(1)**	U.S. Steel Industry **(2)**	U.S. Steel Industry **(3)**	U.S. Aluminum Industry **(4)**	U.S. Aluminum Industry **(5)**	U.S. Steel Industry **(6)**	U.S. Aluminum Industry **(7)**
Section 232 Steel and Aluminum Tariff	0.006	0.010***	0.011***	0.081***	0.082***	N.A.	N.A.
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)		
First Section	N.A.	N.A.	N.A.	N.A.	N.A.	0.003	0.062***
						(0.004)	(0.004)
Second Section	N.A.	N.A.	N.A.	N.A.	N.A.	0.029***	0.088***
						(0.001)	(0.003)
Treatment Group	0.007***	0.003***	0.002***	0.004*	0.003	0.002***	0.004*
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.001)	(0.002)
2001 Economic Recession	N.A.	N.A.	-0.004**	N.A.	-0.005	-0.004**	N.A.
			(0.002)		(0.009)	(0.002)	
George W. Bush Administration Safeguards on Certain Steel Articles	N.A.	0.040***	0.041***	N.A.	N.A.	0.041***	N.A.
		(0.006)	(0.006)			(0.006)	
2007-2009 Economic Recession	N.A.	N.A.	0.009*	N.A.	0.011	0.009*	N.A.
			(0.005)		(0.008)	(0.005)	
Constant	11.747***	11.749***	11.750***	10.010***	10.011***	11.750***	10.010***
	(0.001)	(0.003)	(0.003)	(0.012)	(0.012)	(0.003)	(0.012)
F-Statistic	7,185.58 ***	>99,999.00 ***	>99,999.00 ***	44.304,68 ***	>99,999.00 ***	>99,999.00 ***	43,904.69 ***

Number of Observations	456	456	456	456	456	456	456

Heteroskedasticity-robust standard errors in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, resp. Treatment period: March 2018 through December 2019. Preferred estimates are underlined. (6). U.S. steel industry. First section: March 2018 through May 2019. Second section: June 2019 through December 2019. (7). U.S. aluminum industry. First section: March 2018 through August 2018. Second section: September 2018 through December 2019.

Table 3.d. Lags of the treatment indicator.

Lag	U.S. Steel Industry (1)	U.S. Aluminum Industry (2)
1	-501.707***	428.554***
	(73.046)	(28.263)
2	-230.952	496.836***
	(208.437)	(29.512)
3	-392.766*	349.461***
	(157.015)	(124.760)
4	-262.866*	251.958**
	(162.781)	(127.722)
5	-227.251	197.551*
	(145.973)	(114.601)
6	-71.411	132.957
	(137.508)	(113.151)
7	-37.697	83.434
	(123.341)	(108.056)
8	21.072	51.331
	(109.711)	(100.053)
9	-46.040	26.707
	(90.536)	(92.765)

Heteroskedasticity-robust standard errors in parentheses. ***, **, * denote significance at the 1%, 5% and 10% levels, resp. Estimates significant at the 5% significance level are colored red. Estimates not significant at the 5% significance level are colored green.

Specification 4.

Figure 4.a. Number of establishments of the U.S. steel industry. Bureau of Labor Statistics. Bureau of Labor Statistics, (2018c).

Table 4.a. Data Sources for certain variables.

Variable	Data Source
Industrial Production Index	Retrieved from the Board of Governors of the Federal Reserve System through the Federal Reserve Bank of St. Louis FRED Economic Data.
Producer Price Index of Iron Ore	Retrieved from the Producer Price Indexes Commodity Data of the Bureau of Labor Statistics.
Producer Price Index of Coal	Retrieved from the Producer Price Indexes Commodity Data of the Bureau of Labor Statistics.
Producer Price Index of Industrial Electricity	Retrieved from the Producer Price Indexes Commodity Data of the Bureau of Labor Statistics.
Producer Price Index of Steel Scrap	Retrieved from the Producer Price Indexes Commodity Data of the Bureau of Labor Statistics.
Quantity of Steel Imports by China	Retrieved from the General Administration of Customs of the People's Republic of China.

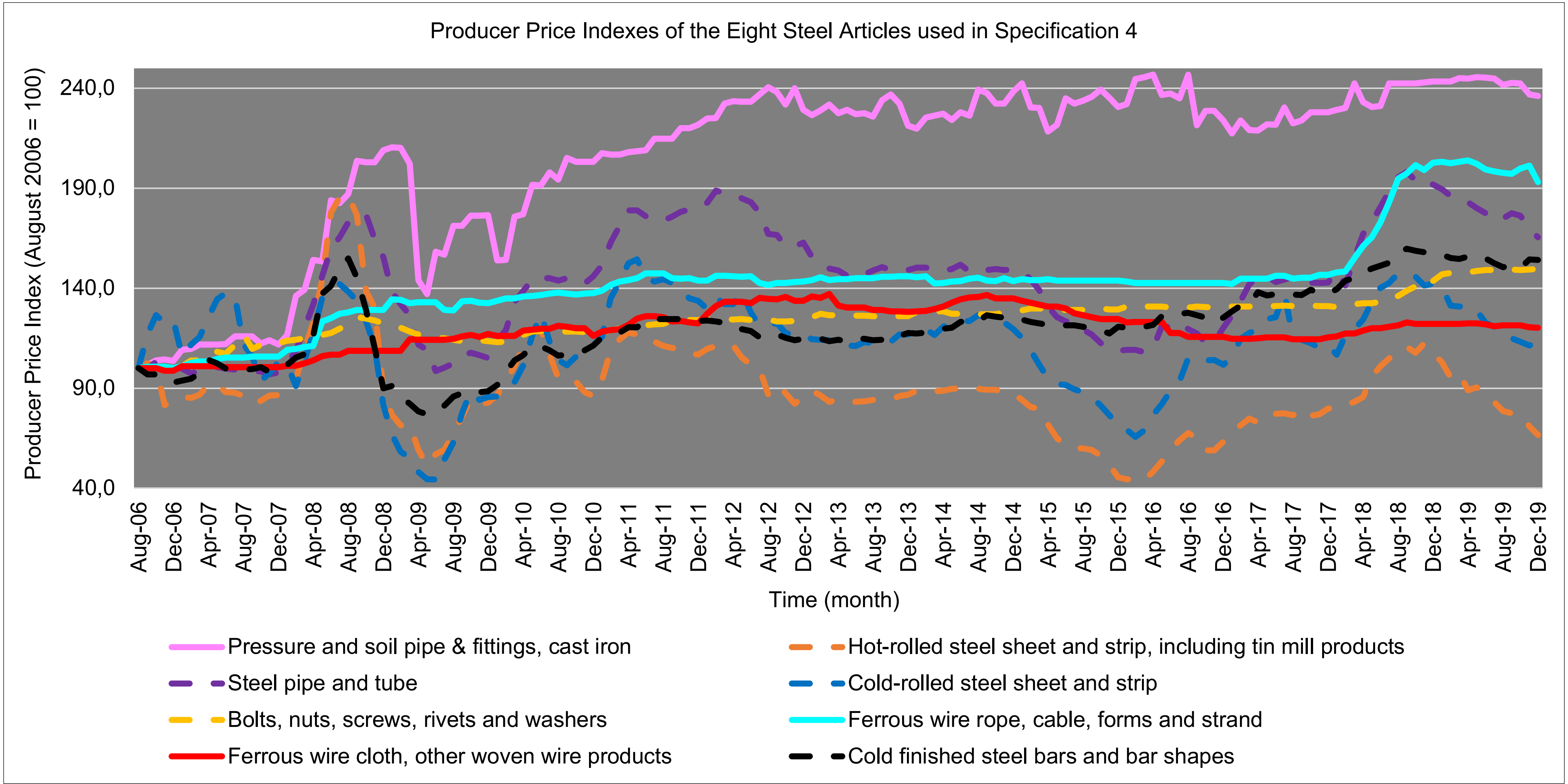

Figure 4.b. Producer price indexes of the eight steel articles used in specification 4. Steel articles 2,3,4,5 and 8 (dotted lines) are subject to the section 232 steel tariff. Steel articles 1, 6 and 7 (normal lines) are not subject to the section 232 steel tariff.

Table 4.b. Summary table. Effect of Section 232 Steel tariff Enactment on the Domestic Producer Price Index of a Selection Sanctioned Steel Articles.

Dependent variable: Producer Price Index $(P_{i,t})$	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Industrial Production Index	-	0.985	-	-0.081	-	-0.086	-	-
Producer Price Index Iron Ore	-	-	-	0.04	-	-	-	-
Producer Price Index Coal	-	-	-	-	-	0.290	-	0.265
Producer Price Index Iron and Steel Scrap	-	0.085	-	0.085	-	-	-	-
Producer Price Index Industrial Electricity	-	-	-	-0.166	-	-	-	-
Average Hourly Earnings	-	-0.233	-	-	-	-0.258	-	-0.281
Industrial Capacity Index Iron and Steel Products	-	-95.504	-	-	-	-	-	-
Trade Weighted U.S. Dollar	-	-	-	0.356	-	0.828	-	0.541
Quantity of Steel Imports by China	-	-	-	-	-	-	-	0.040
Antidumping Duty	-0.000	-	-0.000	-	-0.000	0.000	-0.000	0.000
Section 232 Steel Tariff	-	0.086	-	0.071	-	0.052	-	-
Time Trend	-0.002	-0.002	0.001	0.001	0.001	0.001	0.001	0.001
	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Lag Length Chosen Consistent With:	Liebman	Liebman	Liebman	Liebman	Liebman	Liebman	Liebman	Liebman
Start Period	2010	2010	2010	2010	2006	2006	2006	2006
Industrial Capacity Index Included?	Yes	Yes	No	No	Yes	Yes	No	No
Clustered Standard Errors?	No	Yes	No	Yes	No	Yes	No	Yes
R-Squared	0.766	0.766	0.765	0.765	0.765	0.765	0.764	0.764

F-Statistic	-	-	46.27***	-	-	-	61.23***	-
No. of Observations	798	798	798	798	1,085	1,085	1,085	1,085
Akaike Information Criterion	-1,236.292	-1,348.292	-1,239.793	-1,347.793	-1,380.311	-1,488.311	-1,384.784	-1,492.784
Dependent variable: Producer Price Index $(P_{i,t})$	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
Industrial Production Index	-	0.918	-	-	-	-0.581	-	-
Producer Price Index Iron Ore	-	-	0.111	0.111	-	0.042	-	-0.086
Producer Price Index Coal	-	-	-	-	-	0.249	0.559	0.559
Producer Price Index Iron and Steel Scrap	-	0.003	-	-	-	0.026	0.114	0.114
Producer Price Index Industrial Electricity	-	-0.186	-	-0.134	-	-	-0.393	-0.393
Average Hourly Earnings	-	-0.289	-	-	-	-0.278	-	-
Industrial Capacity Index Iron and Steel Products	-	-64.444	-	-	-	-	-	-
Trade Weighted U.S. Dollar	-	-	-	0.290	-	0.539	0.386	0.386
Quantity of Steel Imports by China	-	-	-	-	-	-	-	-
Antidumping Duty	-0.000	-	0.000	-	-	0.000	-	-
Section 232 Steel Tariff	-	0.088	-----	0.064	-	-	0.054	-
Time Trend	-0.001	-0.001	-0.000	-0.000	0.001	0.001	0.001	0.001
	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Lag Length Chosen Consistent With:	Akaike	Akaike	Akaike	Akaike	Akaike	Akaike	Akaike	Akaike
Start Period	2010	2010	2010	2010	2006	2006	2006	2006
Industrial Capacity Index Included?	Yes	Yes	No	No	Yes	Yes	No	No
Clustered Standard Errors?	No	Yes	No	Yes	No	Yes	No	Yes

R-Squared	0.766	0.766	0.755	0.755	0.791	0.791	0.791	0.791
F-Statistic	-	-	113.06***	-	-	-	105.65***	-
No. of Observations	798	798	812	812	1,043	1,043	1,036	1,036
Akaike Information Criterion	-1,250.163	-1,348.163	-1,306.963	-1,344.964	-1,435.165	-1,533.165	-1,460.361	-1,524.361

For the "Time Trend" variable: heteroskedasticity-robust (clustered) standard errors in parentheses. For the "Time Trend" and "F-Statistic" variable: ***, **, * denote significance at the 1%, 5% and 10% levels, resp. Colors indicate the sign found by Liebman, (2006), where red: negative; grey: zero and green: positive. Preferred estimates are underlined.