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Tariff's effect on local employment

An empirical study on the steel tariffs imposed by the Bush administration.

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Abstract

This study examines how tariffs affect employment on a county level in the U.S.. To measure this effect, George W. Bush's steel tariffs implemented in March 2002 and the 67 counties within the State of Pennsylvania was used. The counties were separated into 2 groups, steel producing or non-steel producing and were examined between the years 1998-2014. The effect tariffs had on employment was examined with panel data through OLS. The conclusion is that Bush's steel tariffs had a negative effect on employment within all counties in Pennsylvania but steel producing counites were more affected.

Keywords : Tariffs, George W. Bush, Steel, Pennsylvania, Heckscher-Ohlin model, International trade, protectionism

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1 Introduction

In March 2018 the president of the United States of America, Donald Trump, imposed tariffs on all steel products imported into the U.S. (United States Trade Representatives, 2019), with a total worth close to 78.8 billion USD (TRAINS, 2019). The president argued that the newly imposed tariffs would bring back jobs to the American steel industry, especially to steel intensive states like Pennsylvania, Indiana and Ohio (Trump, 2018).

Economists have for a long time observed the great benefits associated with the practice of free trade, which can be observed in section 4 of this study. Therefore the tariffs imposed in 2019 were met with great opposition as over 1,100 economists signed a letter to Congress opposing the bill (National Tax Payers Union, 2018). The allocation of labor is for one, the main reasons for it. The British economist David Ricardo demonstrated that technological advantages in capital or labor in different countries affects the total world output. With free trade, companies in certain industries relocate themselves to the part of the world in which they can be most effective, which is beneficial for all involved countries (Feenstra and Taylor, 2017). This theory has given ground to the highly referenced Ricardo model.

Another economic model arguing for open trade is the Heckscher-Ohlin model. The model does, in contrast to the Ricardian model, demonstrate that trade is beneficial due to the differences in resource endowment, including capital and labor (Krugman, Obstfeld and Melitz, 2014). The Swedish economists showed that an open market would lead to capital intensive countries having capital intensive industries while labor intensive countries would have labor intensive industries (Feenstra and Taylor, 2017).

One may argue, that based on economic theory, the tariffs could be nothing but disadvantageous for the overall U.S. and world economy. The unfavorable traits of tariffs is clearly seen in the theory (Krugman, Obstfeld and Melitz, 2014), yet steel tariffs have been used in practice prior to the tariffs imposed by the Trump cabinet.
In 2002 George W. Bush imposed tariffs on 106 steel related products, measured from a 6-digit Harmonized number (U.S. Government Printing Office, 2002). The U.S. cabinet claimed that the tariffs would generate new jobs in the steel manufacturing industry and thus benefit the American workforce (Office of the Press Secretary, 2002). Economists have afterwards

demonstrated that the tariffs resulted in a significant rise of cost for industries dependent on steel, and instead of creating jobs, the tariffs resulted in national downsizing in employment (Francois and Baughman, 2003).

Thus this study plans to contribute to the research of tariffs by analyzing the effects that George W. Bush's 2002-2003 steel tariffs had on employment within one of U.S.'s top steel producing states, Pennsylvania.

The continued disposition of this study will proceed as following : Chapter two presents the U.S.'s historical background regarding international steel trade as well as historical steel tariffs. This is done in order to give the reader a deeper understanding of the topic. In chapter three the theory used within this study is displayed. Chapter 4 present specifically chosen studies previously done upon the subject discussed in this study. Chapter 5 contains the sources of the chosen data, the definition of the variables used within this study as well as limitations in context to the gathering of the dataset. In Chapter 6 a description of the economic model which lays a foundation for the analysis within this study is given. Chapter 7 presents and interpret the results that have been established. Chapter 8 discusses the said results as well as provides reasoning to support it. Chapter 9 summarizes the study and provides the author's thoughts on the continuation on further studies upon the subject of trade and tariffs.

2 Institutional background

In the 50s, U.S. manufacturing was a global powerhouse and steel was one of the main reasons for it (Carbaugh, 2015). In the 60s the technology started to become outdated and more foreign steel was imported, which turned the USA into a net importer of steel (Carbaugh, 2015). In the year 2000, the US had a net import of 12,319 million USD worth of steel and going even further, this number had grown to 15,430 million USD in 2016 (United States International Trade Commission, 2019)

Ever since the manufacturing started to decline, the big U.S. steelmakers have been wanting to see some sort of trade barrier on imports of steel. This pressure from the big manufacturers have been placed on most of the presidents in recent years and when George W. Bush, in 2001, launched an investigation on the unfairness of trade, most manufactures saw it as a small victory (Carbaugh, 2015).

The investigation conducted by the U.S. International Trade Commission resulted in the group of upgraded tariffs on imported steel. These tariffs are shown in the table 1 where the eleven steel products subjected to the rise are presented.

The tariffs were raised from the year 2002 and the initial idea was for them to gradually decline over a three year period (U.S. Government Printing Office, 2002). Figure 1 shows the 3 year change of tariffs involving the 106 different steel products affected by the new policy.

The tariffs were withdrawn in December 2003 and as the general tariff rate had decreased in the years 2002 and 2003, the new tariff rates in 2004 were significantly lower compared to prior years (United States International Trade Commission, 1999-2004).

In this thesis, the tariff will be represented in a dummy variable were 1= the months of the imposed tariffs. A dummy will be used instead of a rate in order to see if the imposed tariff in the short period did have an effect instead of showing how a specific rate affects employment.

Table 1. Overall tariff rate of steel products affected by the imposed tariffs

	Tariff rate (%)			
Product	***2001***	***2002***	***2003***	***2004***
Plate. hot-rolled sheet	1.84	31.27	24.68	0.10
Plate cold-rolled sheet	1.55	31.03	24.52	0
Plate. coated sheet	1.63	31.07	24.52	0
Tin mill products	1.52	31.01	24.52	0
Hot-rolled bar	1.07	30.71	24.35	0
Cold-finished bar	1.80	31.19	24.63	0
Rebar	1.50	16.00	12.50	0
Welded tubular products	1.34	15.89	12.45	0
Carbon and alloy flanges	4.28	17.19	14.12	3.04
Stainless steel bar	2.42	16.59	12.83	0
Stainless steel rod	2.42	16.59	12.83	0
Stainless steel wire	1.87	9.27	7.60	0

Source: *(U.S. Government Printing Office, 2002).*

Tariffs have historically been used as political tool to gain votes as imposed tariffs typically provide benefit to some specific states, states that often were evenly contested between Republicans and Democrats (Hoekman and Kostecki, 2009). In the election in 1998 the democrats won in Pennsylvania but the state have in history been evenly contested (Statistics of The Congressional Election, 1997-2003), what could have led to the imposing of the tariffs. Indiana and Ohio were states that would gain from the tariffs and both were evenly contested between the Democrats and Republicans in the prior election coming up to the year 2002 (Statistics of The Congressional Election, 1997-2003).

Table 2. Top 15 steel producing states

State	Output (million $)
Indiana	26,817
Pennsylvania	22,455
Ohio	21,890
Texas	16,307
Illinois	11,787
Michigan	11,567
Alabama	10,283
California	9,535
Arkansas	6,549
Wisconsin	5,476
Minnesota	5,402
Kentucky	4,891
Tennessee	4,478
South Carolina	3,675
North Carolina	3,657
U.S. mean	4,133

Source: *(American Iron and Steel Institute, 2020).*

The state of Pennsylvania is one of the states in the United States with the largest output of Steel (American Iron and Steel Institute, 2020). This can be seen in table 2 were the top 15 producing states are labeled as well as the U.S. mean. Despite this, only 13 of the state´s 67 counties are steel producers (AIM Market Research, 2013). In table 3 the 13 counties that have a steel output has been labeled in order of total output, with the largest output at the top.

One common feature in steel producing counties is that companies with a high demand for steel also situate themselves within steel producing counties (Centre for Workforce Information & Analysis, 2019). These steel demanding manufacturing industries have seen a decline in number of employees, especially during the time when George W. Bush’s steel tariffs were levied (Bureau of Labor Statistics, 2019).

Table 3. Output of steel per county

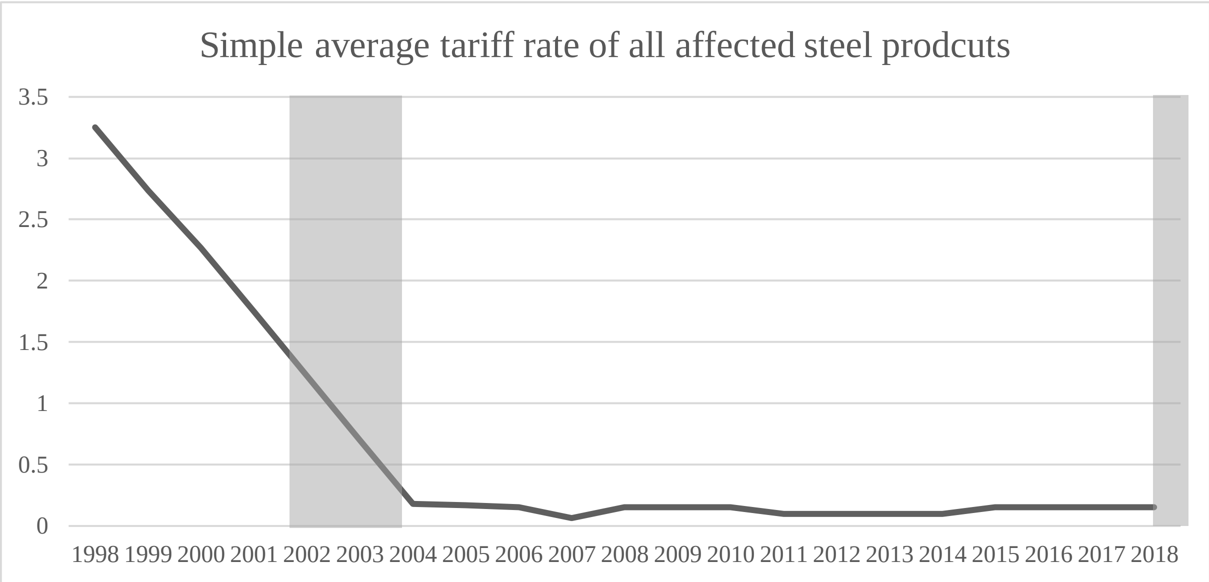
County	***Output (tons)***
Allegheny (BOF)	2899
Butler (EAF)	1543
Dauphen (EAF)	1213
Beaver (EAF)	1112
Chester (EAF)	970
Allegheny (EAF)	700
Lawrence (EAF)	386
Somerset (EAF)	298
Miffing (EAF)	231
Westmoreland (EAF)	207
Berks (EAF)	193
Warren (EAF)	77
Venango (EAF)	61
Washington (EAF)	35

BOF- Basic Oxygen Furnace, EAF- Electric Arc Furnance Source: *(AIM Market Research, 2013).*

Manufacturing is overall a very common profession in the state of Pennsylvania. In March 2002 when George W. Bush's steel tariffs first were implemented (Office of the Press Secretary, 2002), Pennsylvania's total employment were 5,870,685 individuals (Bureau of Labor Statistics, 2019) and total manufacturing employment consisted of 772,500 individuals (Bureau of Labor Statistics, 2019). Meaning that the manufacturing industry were responsible for 13,1 % of Pennsylvania's total employment in March of 2002. In 2019 the same calculation shows a decline to 9 % of Pennsylvania's total employment (Bureau of Labor Statistics, 2019) , were as steel production is not even included in the top 50 most common professions within the state of Pennsylvania (Centre for Workforce Information & Analysis, 2019).

The U.S.'s manufacturing industry has, compared to many countries, a high usage of domestically produced basic materials as for instance steel. But despite this, the manufacturing industry is still very reliant on imports for its production (Levinson, 2015).

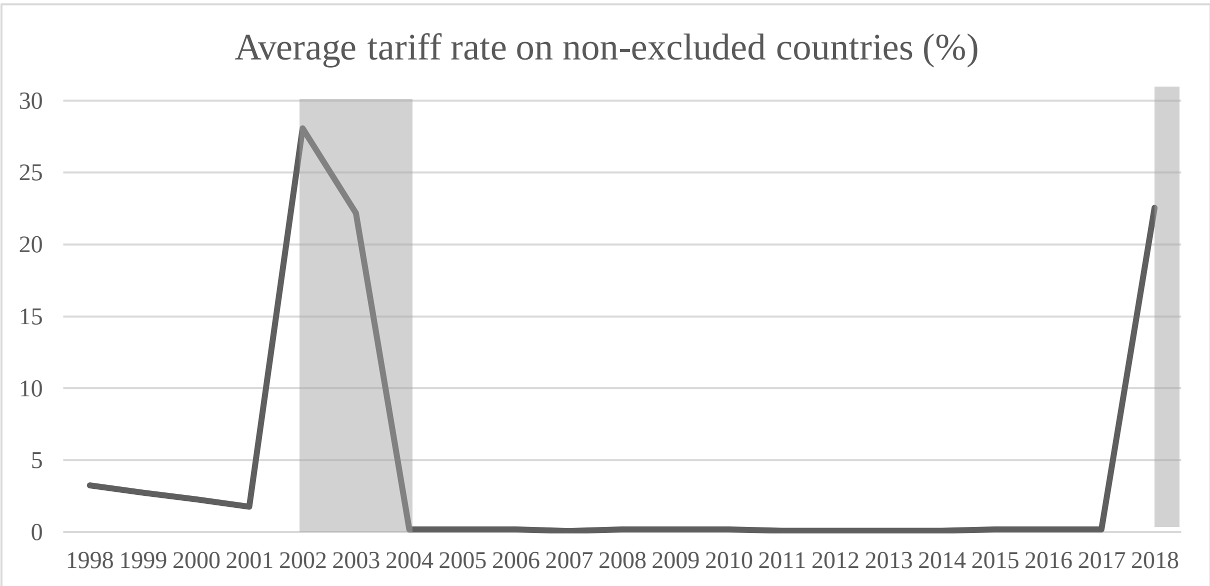
Figure 1. Average tariff rates on imports from non-excluded countries,



Area shaded-years of tariffs, Source: *(United States International Trade Commission, 2019).*

Figure 1 and figure 2 shows the changes in tariff rates over the 1998 to 2018. The figures include two different periods where the U.S. cabinet imposed tariffs. The periods are represented in the shaded areas of the figures. The tariffs imposed by the Bush administration is the larger of the two but the tariffs imposed by the Trump administration are still ongoing.

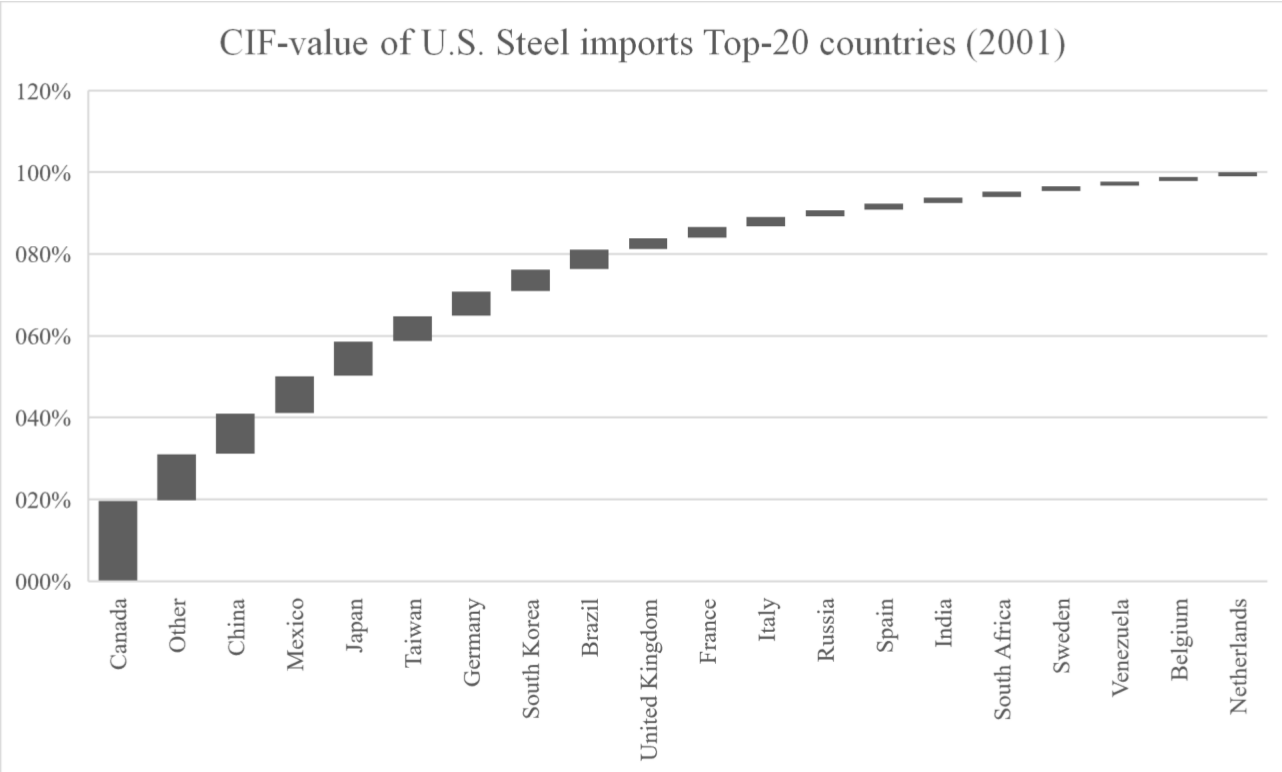
Figure 2. Average tariff rates on imports of steel products from non-excluded countries



Area shaded-years of tariffs, Source: *(United States International Trade Commission, 2019).*

In figure 2 the ad valorem rate of the 106 affected steel products is shown. As mentioned, the general ad valorem rates did drop substantially in the period of the extra steel tariff as the world of free trade expanded into China (Pierce and Schott, 2016), the second largest export of steel to the U.S., measured in CIF value (United States International Trade Commission, 2019).

Figure 3. U.S. steel Import by country



Source*: (United States International Trade Commission, 2019).*

From figure 3 we see that both Mexico and Canada were two of the more prominent exporters of steel to the U.S., together covering almost a third of all steel imports. Both counties were granted an exclusion from the tariffs due to the North American Free Trade Agreement (NAFTA) and along with Mexico and Canada, Israel and Jordan were also excluded from tariffs (United States International Trade Commission, 2003-2005). The tariff resulted in an increased market share of steel trade for both Mexico and Canada as in the following year, the supply chain of U.S. imports changed when Canada´s share increased by 1.22 percentage points and Mexico’s share increased by 1.20 percentage points (United States International Trade Commission, 2019).

3 Theoretical framework

As mentioned in the introduction, this study uses two models which incorporate international trade. These two models both demonstrate that an open market and free trade is beneficial for the world economy but they have two different theoretical mechanisms behind the final result.

3.1 Models of trade

The Ricardian model is based on the work of the British economist David Ricardo, who demonstrated that trade arises between countries due to the different advantages and disadvantages in technological resources between the countries. David Ricardo established that a country should focus and expand the industry in which the marginal product is the greatest. This will lead to an upshift in the Product Possibility Frontier (PPF) and a higher total domestic consumption (Feenstra and Taylor, 2017). PPF is the constraint in which the possible output is being put and is also defined as the opportunity cost of producing products in one industry compared to the other (Feenstra and Taylor, 2017).

When the marginal product in the manufacturing industry is greater than the marginal product of the service industry, the wages in that industry will be higher due to the efficiency in the production. As resources moves to manufacturing, the country will specialize in that industry and it will grow as long as the gain is lower than the opportunity cost. Without trade, there will be an inefficiency in resource allocation due to the demand from both a manufacturing sector and a service sector (Krugman, Obstfeld and Melitz, 2014).

As two countries commence trade, two different PPF constraints are combined in the world market. In this example we can use the USA and China. Comparing the U.S. and China, there is an advantage in skilled labor force for the U.S. (World Bank, 2014). This benefits the service sector due to the high educational requirements from the sector (Feenstra and Taylor, 2017).

Trade, due to this advantage, will for the U.S. result in an even further specializing in the service sector and a higher export of services, take for example financial services. The labor force in the U.S. will therefore move from manufacturing to the service sector (Feenstra and Taylor, 2017).

When the domestic market apply most of the resources of labor in the industry with the highest marginal product, the output will increase and as the trade partner apply its labor to the opposite industry, the export will increase in the applied domestic industry. As the demand for export of the domestic product increases, price will rise and wages in the domestic market will increase (Feenstra and Taylor, 2017). The price increase in exported goods also corresponds to an increase in terms of trade. When the allocation of resources is being weighted to one specific industry, the import of the goods of the other industry will rise and since foreign country has an advantage in the manufacturing of the good, the prices will be lower compared to the prices seen when there is no trade (Feenstra and Taylor, 2017). Just as an increase in export prices gives a greater terms of trade, the lower prices on the import side will do the same (Feenstra and Taylor, 2017).

One major assumption in the Ricardian model is the lack of unemployment. If the jobs in one industry decreases, labor shifts to the next industry. Due to this assumption, employment is hard to measure in the Ricardian model (Krugman, Obstfeld and Melitz, 2014).

The Ricardian model focus on the labor while the Heckscher-Ohlin model, developed from the Ricardian model, apply both labor and capital (Feenstra and Taylor, 2017). The steel industry is capital intensive and the Heckscher-Ohlin model is therefore the preferred model in this thesis.

Swedish economists Eli Heckscher and Bertil Ohlin developed the Ricardian model as they demonstrated that trade arise due to advantages (and disadvantages) some countries have in resource endowments. Bertil and Heckscher stated that with free trade, capital intensive countries would allocate its resources (labor and capital) to capital-intensive industries. Labor intensive countries would on the other hand, allocate its resources to labor-intensive industries. In this way, the world's resources are allocated in the most efficient way. The deadweight loss is minimized (Feenstra and Taylor, 2017).

The model can be applied to the example used earlier. The manufacturing sector has in the U.S., when adjusted for population growth seen a decline. The service sector has in contrast seen a massive rise (Bureau of Labor Statistics, 2019). Comparing the US and China, there is an advantage in skilled labor force in the U.S. (World bank, 2014) which is benefiting the service sector due to the high requirements in human capital from the sector (Feenstra and Taylor, 2017). Due to the advantage in human capital, the U.S. has specialized in the service sector (World Bank, 2014) . This applies the theory of the Heckscher-Ohlin model in the real world.

From the trade theory based in the Heckscher-Ohlin model, the Stolper-Samuelson theorem was developed. The theorem states that when production factors, in the long run, are mobile, the real earnings in the production factor used intensively will increase as the relative price of the product increases. The opposite will happen in the sectors where the other production factor is being used (Feenstra and Taylor, 2017). This implies that when there are free trade, the industry, in a specific country, with the intensively used factor will drain the other industries of productions factors. Applying a tariff to a specific good will lead to a reduction in this effect.

Terms of trade is a term rooted in the two models of trade described in this chapter and is defined as the ratio between import prices and export prices. A country is aiming for a high terms of trade since it benefits the country´s total welfare (Feenstra and Taylor, 2017). When tariffs are applied to imported goods, the import value will increase which corresponds to decrease in a country's terms of trade.

3.2 Reallocation due to trade

When prices in the domestic market exceeds the price in foreign markets, everything else held constant, trade will arise. This will lower prices in the domestic markets and raise prices in the foreign markets due to the increase in demand for foreign goods. Policymakers can by applying tariffs on imported goods regain the former demand for the product in the domestic market. (Feenstra and Taylor, 2017)

Due to the increased cost tariffs submit, demand will decrease in the foreign market while the domestic market will see an increase. This market reaction will lower the prices in the foreign market and raise prices in the home market (Krugman, Obstfeld and Melitz, 2014).

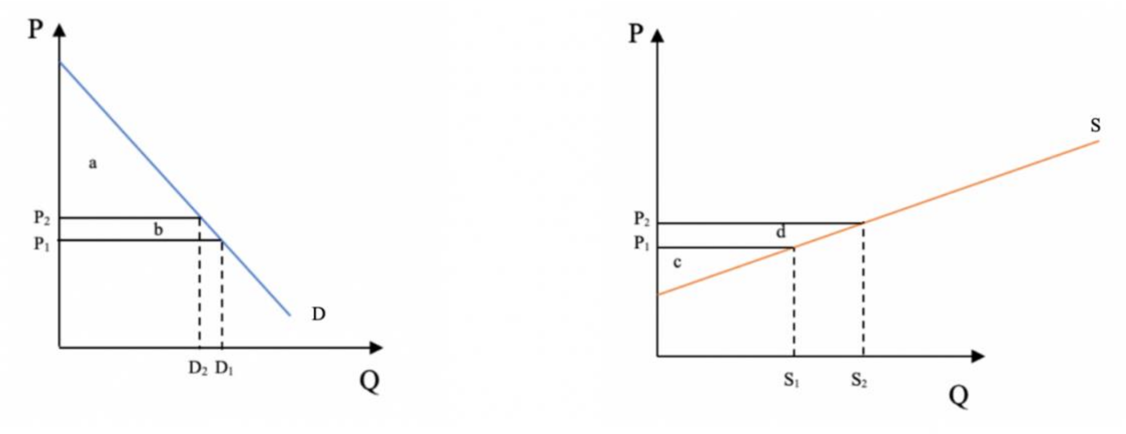
As there is an increase in prices, the consumer surplus (in this study, steel demanding industries) will decrease in the domestic market while the producers of the dutiable goods will have an increase in producer surplus (Krugman, Obstfeld and Melitz, 2014).

USA is a big country with a big economy. This implies that policy changes concerning protectionism will have an effect on the prices on the world markets. When a big economy applies import tariff on a specific good, the domestic demand for that good will go up in case of a lower relative price. The exporting countries affected by the tariffs may lower their prices and reduce the effect of the tariff in order to regain the demand (Feenstra and Taylor, 2017). If a small export demanding economy like Sweden were to impose the tariffs, the prices in world market would not shift as it does to policy changes in the U.S..

Figure 5 shows the shift in the demand curve when there is an increase in prices due to tariffs. Area b corresponds to the loss in consumer surplus as the price increases from $P_1$to P_2. The demand from the consumer automatically reduces as the prices goes up (Feenstra and Taylor, 2017)

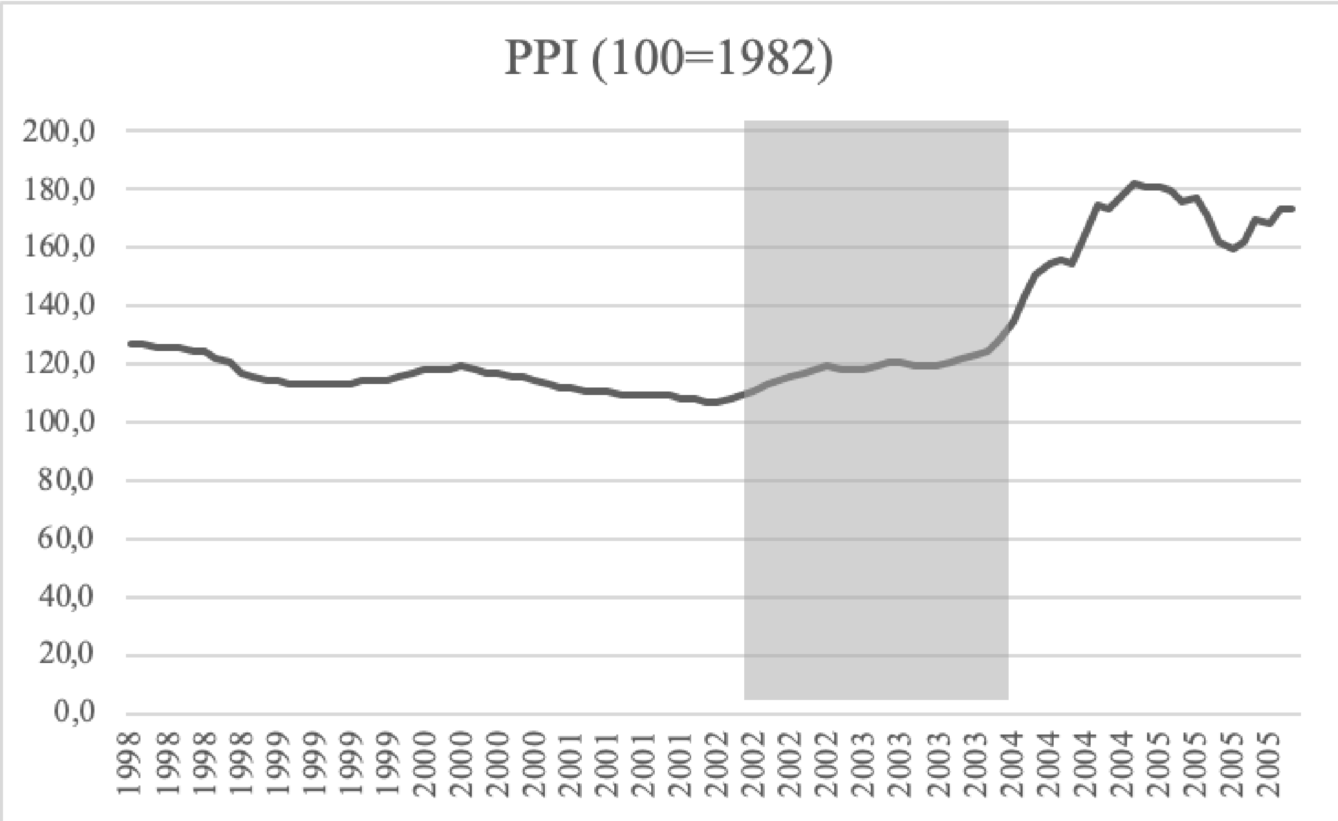
On the other hand, area d corresponds to the addition in producer surplus as the tariffs are imposed and domestic prices goes from $P_1$to P_2.

Figure 5. Demand and Supply curve



Source: *(Krugman, Obstfeld and Melitz, 2014).*

Figure 6. steel PPI



Area shaded-years of tariffs, Source: *(Bureau of Labor Statistics, 2019).*

Similarly to price, do the wages increase when a tariff on a specific good is imposed. The wage of a worker is based on the price of the product (Krugman, Obstfeld and Melitz, 2014). This implies that when the PPI rose in 2002, as seen from figure 6, the wages should have risen with it. This rise can be seen in figure 7 where there was a trend break in steel wages when the tariffs on steel where imposed.

Feenstra and Taylor (2017) shows that as tariffs are imposed on a specific good there will be a higher demand for the products produced in the domestic market. This product demand will lead to a higher demand for labor in the industry affected by the protection policy and will in turn lead to higher wages in that specific industry (Gottfries, 2013).

As seen from figure 7, there is a rise in wages as the tariffs were imposed. Paul Krugman et al. (2014) writes that as the ratio between wages in the domestic market and the foreign market, the demand for the good in the home market will fall. The domestic product will be seen as more expensive compared to the foreign good and as the cost of labor increases, less products will be produced which will reduce the demand even further (Krugman, Obstfeld and Melitz, 2014).

Another wage determining aspect, not considered within this study's regression is unions. When companies are subjected to international competition and are forced to fire employees', senior workers will have a low probability of layoff due to their valuable experience while the opposite is true for junior associates. This causes unions to negotiate lower wages for junior members in order to avert layoffs while still negotiating higher wages for senior members in order to satisfy its members (Grossman, 1984). In summary, unions have different effects on wages primarily depending on the total variation in the experience its members possess. It is important to stress that depending the capability of the union and its total number of members, the magnitude of these effects may vary (Grossman, 1984).

Figure 7. Wages in steel industry

Area shaded-years of tariffs, Source: (Bureau of Economic Analysis, 2019

3.3 Theory based model

To find a the demand function for the input of labor in a profit maximizing company we can start in the profit maximizing function for a company in the long run and rewrite it.

$$\max pf(x_1, x_2) - w_1x_1 - w_2x_2 \tag{1}$$

Equation 1 shows the base function of profit maximization. In the function we find x which corresponds to the inputs, including labor and capital, and w which is the price of the inputs found in the model (Varian, 2014). In the equation x_1 is the labor input while x_2 is the capital input.

We can write this equation to find the first-order condition and the optimal choices for x_1 and x_2.

Deriving equation 1 gives us the following first-order conditions:

$$pMP_1(x_1^*, x_2^*) = w_1 \tag{2}$$

$$pMP_2(x_1^*, x_2^*) = w_2 \tag{3}$$

Equation 2 is equivalent to the inverse demand function for labor and equation 3 is equivalent to the inverse demand function for capital. Since we are examining the demand for labor we can neglect equation 3.

Without an increase in capital in the steel industry (Bureau of labor statistics, 2019) we assume that there is a diminishing return to labor in the production and the marginal product is seen in equation 4 where γ is a constant.

$$MP = \gamma - x_1 \tag{4}$$

We can insert this equation into the inverse demand function for labor seen in equation 2.

$$p(\gamma - x_1) = w_1 \rightarrow x_1 = \gamma - \frac{w_1}{p} \tag{5}$$

The empirical model seen in section 6 and equation 8 will be logged and therefore the demand function for labor will also be logged.

$$lnx_1 = ln\gamma - \left(ln\frac{(w_1)}{p}\right) \rightarrow ln\gamma - (lnw_1 - lnp) \rightarrow ln\gamma - lnw_1 + lnp \tag{6}$$

From this function we can find the optimal amount of labor for the profit maximizing company. The constant corresponds to the capital variable used, the w_1 corresponds to wages and p is found in the import and export variables used in the empirical model.

4 Earlier Studies

Protectionism is defined as political policies meant to safeguard domestic businesses by levying taxes on imported goods (Dictionary.cambridge.org, 2019). With the aforementioned definition in consideration, this chapter will provide an overview of preceding studies which are primarily written on the subject of tariffs and trade. This is done in order to provide a fundamental foundation for this study's examination of tariffs effect on employment within the state of Pennsylvania.

Kilkenny and Partridge's (2009) study from Journal of Agricultural Economics explored export within different business sectors in rural U.S. areas. Not only did they reject the hypothesis that employment in export sectors stimulated rural growth, they even discuss the finding of a negative association between export intensity and rural development growth. To be clear, the study do not claim that export have no form of stimulus on economic growth or employment. Instead it demonstrates that increases in rural areas employment associated export, have a tendency of crowding out local employment. Other than that, Kilkenny & Partridge's establish that an increase in export and thus manufacturing productivity, may result in labor-saving technological investments which releases excessive labor. This may be linked to Pierce & Schott (2016) who detected that increases in manufacturing sector´s productivity is highly connected to intensification of capital and reduction in manufacturing employment which is further discussed later in our study. To summarize Kilkenny & Partridge's 2009 study, they emphasize that contrary to popular belief, export is not the most effective way to increase employment in all business sectors, as it may even have the opposite effect for some industries.

Madanizadeh and Pilvar (2019) examined the effects trade tariffs had on labor force participation rate within 90 countries over a 22 year time period from 1990 to 2012. They found that on average a 10 percentage point increase in weighted tariffs decreased labor force participation rate by 4-6 percentage points. Furthermore it was concluded that the long-run effect of tariffs was not statistically significant for developing countries, but the opposite for developed countries. Here it was found that a 10 percentage point increase in tariffs resulted in a 8-12 percentage point decrease in labor force participation rate in the long-run.

Additionally, it was established that raising tariffs will increase the unemployment rate in countries with a low job matchmaking friction and a competitive advantage in any industry sector. An example of a country having both these attributes is Norway. Norway's hiring agency (NAV, 2020) help facilitate a low labor market matchmaking friction while its highly educated citizens contribute to its competitive advantage within the biotech industry (Forskningsradet.no, 2019) . The opposite is found for less developed economies with a competitive advantage in an industry sector such as Nepal or Nigeria. Due to the high friction within the labor markets matchmaking, it is found that raising tariffs will decrease the unemployment rate.

Madanizadeh and Pilvar's findings about tariffs effect on Labor force participation correspond to the theory discussed in this study theoretical framework. But it is worth noting that these findings are at national levels and average across 90 countries. Since these countries' industries and competitive advantage vary, the assistance of the conclusion provided by Madanizadeh and Pilvar's study will not suffice in form of support for this study's narrow examination within Pennsylvania.

Before mentioned Pierce and Schott (2016) instead analyzed the previously discussed macroeconomic variables with an exception to employment which was primarily measured within the manufacturing industry from 1948 to 2013 in the U.S.. The authors establish that with the reduction of Chinese tariffs, the U.S. imports from China increased. The repercussions of this were a rise in unemployment within the U.S. manufacturing industry, primarily caused by offshoring, overwhelming competition and the reallocation to a less labor intensive production within the United States' manufacturing industry.

Pierce and Schott's study provides a wider understanding of how the specific industry of manufacturing was affected by tariffs, however this study is still in need of an even broader perspective. Francois and Baughman's (2003) report on the consequences of U.S. steel tariffs of 2002 instead analyzed tariffs effect on employment across the whole of the U.S.. They concluded that that even though 187,500 jobs were created within the steel production industry, upwards 200,000 jobs were lost due to the higher steel prices. Out of these 200,000 jobs, Pennsylvania lost approximately 8,400 jobs which results in Pennsylvania being the state that lost the sixth most workers out of all the U.S.'s states.

A summarization of these preceding studies is that levying a tariff tax on imported goods have an overall negative effect on nationwide employment and that reducing tariffs may result in some industries losing the positive effects on employment associated with trade barriers deterrence of foreign competition.

5 Data

5.1 Sources

Our analysis draws on a variety of data sets. The data sets have been compiled mainly through U.S. governmental databases were bundles of data has been downloaded. Some data, mainly data associated with trade has been drawn from international institutions. In table 4 the sources of the data have been labeled in a table that shows from which database each and every variable has been retrieved.

Table 4. Descriptive data table

Variable	***Definition***	***Symbol***	***Source***	***Expected Sign***
Wages	Income per capita of analyzed area	*W*	**Bureau of Economic Analysis**	+
Employment	Employment for all analyzed areas	E	**Bureau of Labor Statistics**	+
Capital	Capital Index of Iron and steel mills (2007=100)	C	**Bureau of Labor Statistics**	+
Export	Total export in Pennsylvania	*X*	**United States International Trade Commission**	+
Import	Total import in Pennsylvania	*IM*	**United States International Trade Commission**	-
Bush_tariff	George. W Bush´s steel tariffs data on 106 affected steel products	τ_B	**United States trade Representatives**	+/-

Variables, their sources and expected coefficient signs.

5.2 Descriptive data

In table 5 the summarization table for the panel data set is presented. The data for the regression have been obtained from each of the 67 counties in Pennsylvania. The dataset used is therefore a panel dataset which is defined as a bundle of data where several entities will be observed for more than one time (Stock and Watson, 2012). In our case each county will be observed in each month between the years 1998 to 2014, resulting in 204 observation for each entity.

Table 5. Summarizing table

Variable	Observations	Mean	Median	Standard deviation	Min	Max
E_{PT}	13,668	47,124.690	40,269.500	2,936.572	1,511	646,115
E_{ST}	2,652	13,5369.100	90,055.500	15,3097.800	18,545	646,115
$E_{N\text{-}ST}$	11,016	76,970.900	33,842.000	109,838.100	1,511	644,712
W_{PT}	13,668	32,453.340	31,367	8,496.574	18,163	74,046
W_{ST}	2,652	35,234.330	33,894	9,865.475	19,519	72,118
$W_{N\text{-}ST}$	11,016	31,783.780	30,948	7,989.851	18,163	74,046
M_T	13,668	3.96e+09	4.24e+09	1.47e+09	1.57e+09	8.23e+09
X_T	13,668	1.01e+09	9.88e+08	3.95e+08	3.72e+08	1.89e+09
τ_{BT}	13,668	0.103	0	0.304	0	1
C_T	13,668	107.520	101.823	14.323	90.801	133.732
Y_{Penn}	13,668	47,124.690	47,322	2,936.572	41,524	52,114

Sum table for panel data

5.3 Data demarcations

When searching and obtaining the data for this study some obstacles emerged. In order to find the perfect link between the used variables, it would have been preferred if all the data existed on county level within the U.S. government's databases. But since all data do not exist on county level our dataset have been divided in the form that the variable *Bush_tariff* is on a national level, while the variable *Capital* and the variables defining the terms of trade, *Import* and *Export* are on a regional level. For the aforementioned variables the data is identical for all counties in Pennsylvania. The variables *Wages* and *Employment* are to the contrary unique for every county.

Another problem that came forth was the time series. We wanted to observe every fluctuation in *Employment* on the most precise level, therefore the data covering *Employment* was collected on a monthly basis. The problem is that all databases do not collect raw data on such a narrow basis. The rest of the variables are collected yearly. For the analysis to be the most precise, it would have been preferred for all variables to be on a monthly level.

Thirdly, the HS-digit level had some restrictions. Since *The World Trade Organization* as well as *The World Bank* presents tradable goods on a 6-digit HS level, all trade data have been collected through that specific HS level. But to the contrary The Harmonized Tariff Schedule of the United States, reported by the United States International Trade Commission (USITC), present the tradable goods on a 8-digit HS level. This became a problem when a good on 6-digit HS level where dutiable but when looking at it divided on a 8-digit HS-level, only some of the goods where dutiable. This was solved by finding the simple average of the tariffs rate on the 8-digit HS-level and applying that number as the tariff rate.

Finally, there was a problem finding the data for the human capital. The Heckscher-Ohlin model says that labor intensive countries will be the dominant producers in the labor intensive industries (Feenstra and Taylor, 2017). This has led to a bigger service sector in the U.S., a sector where higher education is required in services like law and finance (Feenstra and Taylor, 2017). Human capital would therefore be required in the model to give the most precise analysis based on the theory. The data for human capital, were not able to be acquired on a county basis for the whole period, examined within this study, and has therefore been left out of the final model.

5.4 Variable definition

Table 6. Table of variable definitions

Variable	***Symbol***	***Definition***
Employment	E_{CT}	Total number of employed individuals which are not students, not part time employees, not younger than 16 nor older than 64, situated in the analyzed areas. Measured anually.
	E_P	Employment in Pennsylvania
	E_S	Employment in Steel producing counties
	$E_{N\text{-}S}$	Employment in non-producing counties
Bush_tariff	τ_B	Dummy variable for the years of tariffs, 1=months of tariff
Wages	W_{CT}	Average income per capita for the analyzed areas within the regression. Measured annually in dollars were the population is measured by the Census Bureau's midyear survey.
	W_P	Wages in Pennsylvania
	W_S	Wages in steel producing counties
	$W_{N\text{-}S}$	Wages in non-steel producing counties
Capital	C_T	Total amount of Capital used within steel mills in Pennsylvania. The variable is measured annually in an Index, 2007=100.
Import	M_T	Pennsylvania's total import from all countries in the world measured in CIF value, annually.
Export	X_T	Pennsylvania's total export to all countries in the world measured in FAS value, annually.

In table 6 all variables used in the regression are shown as well as the symbol used in equation 8 and equation 9. The last column defines the variables.

6 Empirical model

6.1 Ordinary least Square

The empirical model used in order to find the relationship between U.S. employment and rates of tariff will be estimated through an OLS estimator.

Pierce and Schott (2016) used an Ordinary Least Square Regression in order to find the link between the Permanent Normal Trade Relations (PNTR) to China and U.S. manufacturing unemployment. Similarly did Madanizadeh and Pilvar (2019) use an OLS regression when testing for their hypothesis. Leichenko and Silva (2004) differed from the standard procedures of conducting the regression model as they used the same independent variables when conducting the OLS. The dependent variable changed in three different regression, once when measuring rural area, when measuring urban area, and finally when measuring the overall relationship.

The basic regression used by Stock and Watson (2012) is shown in equation 7. This single regression accounts for the single regressor (X_i) and the value of its coefficient β_1. The intercept of the y axis is shown in β_0 and the error term in, which is used to incorporate the factor that are not defined into the result, is defined in u_i (Stock and Watson, 2012).

$$Y_i = \beta_0 + \beta_1 X_i + u_i \tag{7}$$

The OLS regression estimator is the most widely used method to find the coefficients, by economist and statisticians (Stock and Watson, 2012). The method gives an estimated regression line that is said to be the closest possible estimate to the data points (Stock and Watson, 2012)

6.2 The model

Our model will be based on the international trade theory described in previous section of this paper. The basic regression model is the following:

$$E_{CT} = \beta_0 + \beta_1 \tau_{B_T} + \beta_2 W_{CT} + \beta_3 C_T + \beta_4 M_T + \beta_5 X_T + \alpha_i + \lambda_t + \varepsilon_i \tag{8}$$

Employment in each respective county will be analyzed as the dependent variable. Meaning that the variable will differ in the three different conducted regressions. The first regression covers steel producing counties, the second one non steel producing counties and in the third one all of Pennsylvania will be analyzed. A steel producing county is defined as a county in

Pennsylvania in which there are companies refining iron into steel. The counties with a production of steel are displayed in table 2.3.

The main independent variable used in the regression measure tariffs. To find the link between import tariffs and domestic employment the dummy variable, *Bush_tariff* will be used. Import tariffs will lead to a reallocation of resources in the domestic market, including labor (Feenstra and Taylor, 2017). Since we are measuring a steel manufacturing state, we expect labor moving to the manufacturing jobs in Pennsylvania. The expected sign is therefore positive in the steel counties and negative in the non-steel counties

From section 3.1 we know that the import and export are the two main components in defining the Terms of Trade. Since countries in general are aiming for a greater Terms of Trade (Feenstra and Taylor, 2017) we conclude that the two variables are important in the findings of whether trade affects employment. Since we are measuring the total value of the imports and exports and not the total amount of goods, we can conclude, that the expected sign of *Import* should be negative and the expected sign of *Export* should be positive.

Wages will also be used in the basic model. From section 3.2 we know that wages increases as the domestic price of the good increases. Trade theory also states that when a tariff is imposed on imports of a specific good the labor in the domestic market will reallocate to that sector, partly due to higher wages (Feenstra and Taylor, 2017). Thus, the expected sign of the *Wages* variable is positive.

Since the dataset used is put together through 67 different counties there could be some omitted variable that are unable to be measured through standard variables based in economic theory. Hodler and Raschky (2014) defines the expression, *Regional favoritism* in which leaders of a specific land favorizes the area and its people in which they grew up. This is a typical example of measures we are unable to get our hands on.

To control the regression for county specific events over time a fixed or random variable can be applied (Stock and Watson, 2012). To test for whether random effect or fixed effect is to be applied, a Hausman test is conducted where random effect is to be used if the null hypothesis can be rejected (Wooldridge, 2014). A random effect variable is used in the empirical model shown in equation 8 and 9. α_i will represent the random effect variable.

When applying a time effect variable the model can control for variables that have specific effect that differs over time but are constant for each specific county in the panel data set (Stock and Watson, 2012). This variable will be used in the empirical model and will be represented by the λ_t symbol in equation 8 and 9.

The model will be in a logarithmic form in order to easily see the differences in employment depending on which county is analyzed, take for example Butler and Philadelphia where a change in 10,000 people in employment corresponds to 12% in Butler but only 1.1% in Philadelphia. The model is as follows:

$$lnE_{CT} = \beta_0 + ln\, \beta_1 \tau_{B_T} + \ln\, \beta_2 W_{CT} + \ln\, \beta_3 C_T + \ln\, \beta_4 M_T + \ln\, \beta_5 X_T + \alpha_i + \lambda_t + \varepsilon_i \tag{9}$$

6.3 Testing the model

Collinearity exists within a regression in case two or more independent variables exhibit a vastly linear relationship, where perfect collinearity exists in case there is an exact linear relationship (Wooldridge, 2014). In order to determine if the Ordinary Least Squares regression used in this study possess collinearity, a VIF-test was used. The Variance Inflation Factor test estimates to what magnitude the standard error increases in contrast to if the independent variable had zero correlation to the other independent variables (Wooldridge, 2014).

Heteroscedasticity is a phenomenon that occurs when the error terms variance is not constant. The repercussions of heteroscedasticity is that outlying values interfere with the standard errors and thus causing them to become biased. This in turn means that significance tests on the independent variables shows a skewed result (Wooldridge, 2014). A common countermeasure to heteroscedasticity which this study used, is to apply logged variables or test for this using a Breush-Pagan test. A summarization of the Breush-Pagan test is that it inspects the null hypothesis that claims that the error terms are equal. Meaning that if the null hypothesis is false, the error variance will increase or decrease as the value of the dependent variable increases. (Wooldridge, 2014).

A regression suffers from omitted variable bias when there is an exclusion of one or more appropriate independent variables. The underlying issue with omitted variable bias is that it affects the parameter estimates within the regression since the effect of the missing variables becomes included within the incorporated once. In order to produce a reliable result, this study incorporated a Ramsey Regression Equation Specification Error Test which tests if a non-linear composition of fitted values assist in interpretation of the dependent variable (Wooldridge, 2014).

7 Result

Table 7. Regression table

VARIABLES	(1) Steel counties	(2) Non-producing counties	(3) Pennsylvania
Bush_tariff	-0.0473****	-0.0256***	-0.0274****
	(0.0122)	(0.0091)	(0.0076)
Wages (ln)	-0.1275****	0.0178***	0.0053
	(0.0195)	(0.0083)	(0.0076)
Capital (ln)	0.6701***	0.5700****	0.5953***
	(0.0280)	(0.0204)	(0.0174)
Import (ln)	0.4579****	0.4083****	0.4081****
	(0.0247)	(0.0172)	(0.0147)
Export (ln)	-0.0249	-0.0613****	-0.0532****
	(0.0184)	(0.0140)	(0.0119)
Constant	0	0	0
	(0)	(0)	(0)
Observations	2,652	11,015	13,667
R-squared	0.2794	0.2402	0.2303
Number of id	13	54	67

Standard errors in parentheses

****p<0.001*** p<0.01, ** p<0.05, * p<0.1

In the regression table the displayed regression is controlled for time and county specific variables. The first regression model (1) only displays steel producing counties within Pennsylvania. The second regression (2) shows all counties, in Pennsylvania, lacking steel production and the third regressions model (3) displays all counties within the state of Pennsylvania. Number of id represent the number of counties in the regression.

In the initial regression (1), which contains 2,652 observations, one may observe that *logged Import* and *logged Capital* have a positive coefficient or rephrased, an increase in those variables also increase employment while *logged Wages, logged Export* and George W. Bush’s steel tariffs (*Bush_tariffs*) all have negative coefficients. Additionally, it is also worth noting that all analyzed variables with an exception to *logged Export* may be rejected below a 1 % statistical significance level. *Logged Export* is able to be rejected at a 17.5 % significance level which means that it does not qualify for this study, as it’s rejection limit is set at a 5 % statistical significance level.

George W. Bush's steel tariffs of 2002-2003 (*Bush_tariffs*) have a negative impact on employment within the steel producing counties of Pennsylvania. Meaning that during the years Bush's tariffs were in effect, employment within the steel producing counties of Pennsylvania decreased on average with 4.7 percent, ceteris paribus.

The second regression (2) which contains 11,015 observations, displays all none steel producing counties in Pennsylvania. All variables except *logged Wages* and *logged Export* have a positive coefficient. The coefficients of *logged Import, logged Export* and *Bush's Steel tariffs* are all able to be rejected below a 0.1 % significance level while the coefficient of *logged Wages* is able to be rejected at a 3.3% statistical significance level.

Furthermore George W. Bush's steel tariffs between 2002-2003 (*Bush_tariffs*) does similarly to previous regression have a negative impact on employment. Meaning that during the years Bush's tariffs were in effect, employment within the none steel producing counties of Pennsylvania decreased on average with 2.5 percent, ceteris paribus.

Lastly, the third regression (3) which contains 13,667 observations and regard all 67 counties within Pennsylvania have almost identical coefficient signs as the first regression. However, a substantial difference from the first regression is the negative coefficient on *logged Wages* which furthermore is able to be rejected at a 48.8 % significance level. Meaning it will not be included in the final regression as this study's rejection limit is set at a 5 % significance level. Other than *logged Wages* all variables are rejectable below a 1 % significance level.

The interpretation of George W. Bush's steel tariff variable (*Bush_tariffs*) does once more result in a negative impact on employment, just as the previous regressions. Meaning that during the years George W. Bush's tariffs were in effect, employment within the state of Pennsylvania decreased on average with approximately 4 percent, ceteris paribus.

All regression models display Significant Ramsey RESET and Breusch-Pagan tests, meaning they are refusable below a 1 % significance level. The original model which is not included in this study, contained GDP for Pennsylvania. However, collinearity could not be excluded from the model as GDP and Capital displayed high correlation, as seen in table 1 found Appendix 1. This resulted in the model for the whole of Pennsylvania exhibiting a mean VIF value over the this studies threshold of a mean VIF of ten. By discarding the GDP variable the average VIF value was lowered significantly which can be observed in the Appendix 2. As the final models all surpasses Omitted Variable Bias tests, collinearity tests as well as heteroscedasticity tests discussed in section 6.3, they are deemed valid be used within this study.

8 Discussion

As the different regressions in section 7 have different populations, the coefficient's value cannot be compared between steel counties and non-steel producing counties. For the coefficients to be compared the two bundles of counties need to be separated from each other in one regression. This has been done in appendix 3. The reader must therefore be critical to comparing the coefficients found in section 7.

The interpretation of this study's final regression reveals that the additional steel oriented tariffs imposed by George W Bush did during the time they were levied, similarly to the theory and other studies discussed within this study, have a negative effect on employment within the state of Pennsylvania.

A surprising discovery is that Bush's steel tariffs had a greater negative effect on employment in the steel producing counties of Pennsylvania, than in the none steel producing ounces. This study advocate that the possible explanation for the latter finding lies in the steel demanding manufacturing industry's substantial higher presence in counties with steel production than the counties without. As seen in section 2.

In section 3 it is concluded and then shown for steel within the U.S. in figure 6, that as a tariff is imposed on a specific product, the price on the home market will increase. The price did have a substantially greater increase post the abolishment of the tariffs, but this is partly due to the period of high economic growth resulting in an increase in demand (Gottfries, 2013).

Within the same section 3.2, it is discussed that big countries with huge economies can lower smaller economies prices on specific goods via policy changes as for instance tariffs (Feenstra and Taylor, 2017). USA and Bush's steel tariffs should in theory be the perfect example but as discussed in Francois and Baughman's (2003) report, previously mentioned in this study, does both Europe's and Korean's steel prices rise during the period Bush's steel tariffs were in effect. Francois and Baughman's find that the uncertainty that arose with the announcement of future steel tariffs in 2001, made manufactures stop buying steel. When the exact tariff percentages later were announced in 2002 the demand became too much for U.S. manufactures to handle which thus forced them to import from foreign steel manufacturers, enabling them to increase their prices.

Rising steel prices naturally results in higher expenditures for steel demanding manufacturers. With the conjecturable assumption of all other business related variables, as for instance revenue, remaining approximately the same. It is only logical for employment within the steel product manufacturing industry to be reduced, as shown in section 2, in order to save profit.

Workers in product manufacturing corresponded to 13,1 % of Pennsylvania's employment in March 2002 with similar numbers in 2019. Unfortunately data for steel mills employment was not recorded by the U.S. up until 2018 and 2019's steel production was not even included in the top 50 most common jobs in Pennsylvania, which can furthermore also be observed in section 2. George W. Bush's steel tariffs on average having higher negative impact on employment in steel producing counties than in those lacking it, might thus be explained by the negative effect on employment in the steel product manufacturing industry exceeding the positive effect on employment in the steel producing industry.

As can be observed in regression 1 in table 6, an increase in *Wages* will on average have a negative effect on employment within the steel producing counties of Pennsylvania. This result corresponds to the one of the findings in Pierce & Schott's (2016) and Kilkenny & Partridge's (2009) studies but mainly to theory discussed in Krugman et al. (2014) in section 2. To summarize, it claims that increasing the domestic wages may lead to further differences in relative wage expenses compared to foreign markets. This deepening increase in relative production costs gives companies an increased incentive to offshore their production with the motivation to reduce costs. Which reduce employment in the manufacturing industries within the domestic country.

The theory shown in chapter 3 under section 3.1 states that, as the value of export increases or the value of imports decreases the terms of trade will grow, which is beneficial for the countries total welfare. From all 3 regressions in table 6 we see that the import variable is positive. This might be explained by the manufacturing industry's high presence in Pennsylvania which is highly reliant on imports, as mentioned in section 2. Meaning that if import increases, then so has most likely the manufacturing industry's production and its need of workers (Levinson, 2015). Other than the aforementioned reason, the most probable reason for the import value to result in a positive sign is that in the period examined, free trade had massive expansion in China (Pierce and Schott, 2016). This expansion would result in lower cost for most companies which is accompanied with higher overall employment (Varian, 2014).

The export variable's negative coefficient sign in all 3 regressions contravene nationwide trade theory as it states that increase in export reduced employment in all counties within Pennsylvania (Gottfries, 2013). This result corresponds to the result of the study conducted by Kilkenny & Partridge's (2009) which demonstrates that increased export in some sectors as for instance manufacturing, may lead to investment in labor saving technology and thus reducing employment.

Capital increase results on average in a positive effect on employment in all the examined areas. The result corresponds to the theory which states that as capital increases, there needs to be additional hiring of labor in order to maintain the Marginal Product of Capital (Feenstra and Taylor, 2017).

This study, has as mentioned in the beginning of the discussion, used three different regressions with different populations in order to observe the effect Bush´s steel tariffs had on the employment within the state of Pennsylvania. The problem with this approach is that the coefficient between two regressions cannot be compared. One may see what affect the variable have but in order to compare the coefficients between two bundle of counties, there must be only one regression containing an interaction variable for the steel counties. This has been done in the regression in table 7 found appendix 3. The result is thereafter calculated to find the mean marginal effect of the tariffs. The interaction variable in this regression is not significant which is the main reason why the method in section 7 used.

The tariffs in the regression in table 7 found appendix 3 is represented through a dummy variable, similar to the regression found in section 7. The reason for this, as found in section 2, is to *"see if the imposed tariff in the short period did have an effect instead of showing how a specific rate affects employment."*. One problem with using a dummy variable as the main dependent variable is that, when the r-squared is low, the dummy can pick up the effect of variables that are not being used in the model. A dummy variable can therefore give a misleading result. A dummy variable would have been preferred if the tariff rate were similar post and prior to the implementation of the additional tariffs as well as if the new tariff rate were constant, which is not the case as the tariffs were reduced from 2002 to 2003.

The tariffs is in the regression table 8 found appendix 3 represented through the actual weighted average tariff rate in the period 1998 to 2014. This should in theory give a more accurate result.

9 Conclusion

This study examined the potential effect that the additional tariffs on steel, imposed by George W. Bush, had on the steel producing state of Pennsylvania. The study separated the 67 counties in two groups, of which one was a producer of steel while the other had a net production of zero tons of steel. The steel tariffs were analyzed alongside *wage, export, import* and *capital* as independent variables while *Employment* was examined as the dependent variable in a regression model controlling for random effects and time effects.

Data gathering became a major obstacle for this study due to the fact that multiple variables as for instance human capital, steel mill employment and the absence of a trade balance on a county level, was not available via U.S. governmental databases or were not on record through the whole measured time period. To circumvent these problems, some variables as for instance *Import, Export* and *Capital* had to be used on a statewide level. Resulting in a limited and thus less than ideal dataset for the regressions performed in this study.

With the prior sentences in mind, it is found within the conclusion of this study that George W. Bush's steel tariffs of 2002 to 2003 had a negative impact on employment, both within the steel producing counties of Pennsylvania as well as those without. Nonetheless it is concluded that employment within steel producing counties were more impacted by the tariffs than those without it. Thus we can establish that the theory of the Heckscher-Ohlin model, including Stolper-Samuelson theorem, holds as there was a reallocation of labor from counties with production of steel.

The subject has been widely discussed through the years but the angle of approach differs. Most studies examining the effects of tariffs use datasets covering whole countries while others limit the model down to states-level. What we have seen here is that the result can be tracked down to even more narrow geographical areas as there can be major differences in neoclassical economic-factors. Economic factors that we believe should be examined further is education and capital for concentrated regional areas as they in theory have profound impact on a majority of U.S. exporting industries. It can be concluded that the subject requires further research in order to deepen our understanding of trade and tariff policy.

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12 Appendix

12.1 Appendix 1

Table 1. Correlation table.

	Employment	*Wages*	*Bush_tariff*	*GDP*	*Import*	*Export*	*Capital*
Employment	1						
Wages	0.4906	1					
Bush_tariff	-0.0027	-0.1735	1				
GDP	0.0076	0.6374	-0.2341	1			
Import	0.0087	0.5451	-0.3219	0.8582	1		
Export	0.0083	0.5744	-0.3453	0.8750	0.8847	1	
Capital	-0.0070	-0.6224	0.1933	-0.9709	-0.8724	-0.8478	1

12.2 Appendix 2

Table 2. VIF table steel-producing counties.

Variable	*VIF*	*1/VIF*
Capital (ln)	9.06	0.110389
Import ((ln)	7.25	0.137887
Export (ln)	6.38	0.156819
Wages (ln)	1.78	0.569463
Bush_tariff	1.24	0.0803649
Mean VIF	5.14	

Table 3. VIF table non-producing counties.

Variable	*VIF*	*1/VIF*
Capital (ln)	9.38	0.106617
Import ((ln)	7.26	0.137785
Export (ln)	6.38	0.156855
Wages (ln)	2.04	0.489128
Bush_tariff	1.24	0.803894
Mean VIF	5.26	

Table 4. VIF table all counties in Pennsylvania.

Variable	*VIF*	*1/VIF*
Capital (ln)	9.25	0.108066
Import ((ln)	7.26	0.137825
Export (ln)	6.37	0.156866
Wages (ln)	1.93	0.517475
Bush_tariff	1.24	0.803883
Mean VIF	5.21	

12.3 Appendix 3

Table 5. Table of variable definitions

Variable	***Observations***	***Mean***	***Median***	***Standard deviation***	***Min***	***Max***
E_{PT}	13,668	47,124.690	40,269.500	2,936.572	1,511	646,115
τ_{BT}	13,668	0.103	0	0.304	0	1
τ_{TR}	13,668	3.263	0.221	7.413	0.0909	28.805
C_S	13,668	0.194	0	0.395	0	1
$\tau_B * C_S$	13,668	0.020	0	0.140	0	1
$\tau_{TR} * C_S$	13,668	3.263	0.221	7.413	0.0909	28.805
W_{PT}	13,668	32,453.340	31,367	8,496.574	18,163	74,046
M_T	13,668	3.96e+09	4.24e+09	1.47e+09	1.57e+09	8.23e+09
X_T	13,668	1.01e+09	9.88e+08	3.95e+08	3.72e+08	1.89e+09
C_T	13,668	107.520	101.823	14.323	90.801	133.732

Table 6. Table of variable definitions

Variable	***Symbol***	***Definition***
Employment	E_{CT}	Total number of employed individuals which are not students, not part time employees, not younger than 16 nor older than 64, situated in the analyzed areas. Measured annually.
Bush_tariff	τ_B	Dummy variable for the years of tariffs, 1=months of tariff.
Tariff_rate	τ_{TR}	Weighted average tariff rate of steel products.
Steel_county	C_S	Dummy variable for steel producing counties, 1=steel producing county.
Bush_tariff Steel County*	$\tau_B * C_S$	Interaction variable for *Bush_tariff* and *Steel_county*.
Tariff_rate Steel_county*	$\tau_{TR} * C_S$	Interaction variable for *Tariff_rate* and *Steel_county*.
Wages	W_{CT}	Average income per capita for the analyzed areas within the regression. Measured annually in dollars were the population is measured by the Census Bureau’s midyear survey.
Capital	C_T	Total amount of Capital used within steel mills in Pennsylvania. The variable is measured annually in an Index, 2007=100.
Import	M_T	Pennsylvania’s total import from all countries in the world measured in CIF value, annually.
Export	X_T	Pennsylvania's total export to all countries in the world measured in FAS value, annually.

Table 7. Regression table

Variables	*Model 1*	*Model 2*	*Model 3*
Wages (ln)	0.0052	0.0052	0.0052
	(0.0076)	(0.0076)	(0.0076)
Capital (ln)		2.1285****	0.5853****
		(0.02903)	(0.0177)
Import (ln)			0.4035****
			(0.0148)
Export (ln)			-0.0532****
			(0.0177)
Bush_tariff	0.0571****	0.4094****	-0.0270***
	(0.0032)	(0.0095)	(0.0078)
Steel_county	0.7727***	0.7728***	0.7728***
	(0.2722)	(0.2722)	(0.2722)
*Bush_tariff*Steel_county*	-9.32e-06	-9.32e-06	-9.32e-06
	(0.0032)	(0.0032)	(0.0032)
Constant	0	0	0
	(0)	(0)	(0)
Observations	13,667	13,667	13,667
R-squared	0.2303	0.2303	0.2303
Number of id	67	67	67

Standard errors in parentheses
****p<0.001*** p<0.01, ** p<0.05, * p<0.1

In the regression table the displayed regression is controlled for time and county specific variables. All regression controls for the tariffs in Pennsylvania as well as the steel producing counties. Model 1 controls for wages. In Model 2 capital is added to the regression. In model 3, all variables examined is controlled for. The tariff variable is represented through a dummy. Number of id represent the number of counties in the regression.

$$\frac{dlne}{d\tau B} = \beta_5 \times \tau B + \tau B_{steel} \times Steel\_county \quad (1)$$

From equation 1 we can calculate the mean marginal effect of the tariffs on employment within steel producing counties. From appendix 3.3 we find the coefficients. Through this regression we are able to compare the coefficients in steel producing counties and the coefficient for Pennsylvania as a whole.

The interactions variable is not statistically significant which is why the result should be interpreted with caution. The loose interpretation of the result is that the steel producing counties did have a greater negative effect compared to the state of Pennsylvania.

The problem with this method is the interaction variable containing two dummy variables. Since the interaction variable is the main dependent variable in this regression, the dummy is expected to explain the result. As further discussed in section 8, too much data is attached on the dummy for it to be able to give a legitimate result.

Table 8. Regression table

Variables	***Model 1***	***Model 2***	***Model 3***
Wages (ln)	0.0057	0.0056	0.0057
	(0.0075)	(0.0076)	(0.0076)
Capital (ln)		2.332****	0.5815****
		(0.3221)	(0.1764)
Import (ln)			0.4048****
			(0.0146)
Export (ln)			-0.0540****
			(0.0118)
Tariff_rate	-0.0163****	-0.3023	0.0006**
	(0.0028)	(0.005)	(0.0024)
Steel_county	0.7720***	0.7720***	0.7720***
	(0.2722)	(0.2722)	(0.2722)
*Tariff_rate*Steel_county*	0.0002*	0.0002*	0.0002*
	(0.0001)	(0.0001)	(0.0001)
Constant	0	0	0
	(0)	(0)	(0)
Observations	13,667	13,667	13,667
R-squared	0.2305	0.2305	0.2305
Number of id	67	67	67

Standard errors in parentheses
****p<0.001*** p<0.01, ** p<0.05, * p<0.1

In the regression table the displayed regression is controlled for time and county specific variables. All regression controls for the tariffs in Pennsylvania as well as the steel producing counties. Model 1 controls for wages. In Model 2 capital is added to the regression. In model 3, all variables examined is controlled for. The tariff variable is represented through the weighted average tariff rate. Number of id represent the number of counties in the regression.

In the regression in table 8, the tariff is explained by a rate instead of a dummy. The rate is calculated as a weighted average from the steel products trade value and tariff rate in the period 1998 to 2014.

Using equation 1 we find that the tariff rate did have a positive effect on the employment in Pennsylvania, in contrast to the result found in section 7 and in table 7 in appendix 3. Through this method we find how specific tariff rates affect employment in the long run, not how tariffs imposed in a short period of time affect employment.

Also, the coefficient in the interaction variable is only statistically significant on a 90% level furthermore the 95% confidence interval contains positive and negative digits which is why we must be very critical as well as cautious to the result.

Table 9. Regression table

	(1)	***(2)***	***(3)***
VARIABLES	***Steel counties***	***Non-producing counties***	***Pennsylvania***
Tariff_rate	-0.0004	0.0008***	-0.0006***
	(0.0003)	(0.0003)	(0.0002)
Wages (ln)	-0.1275****	0.0178****	0.0053
	(0.0196)	(0.0083)	(0.0076)
Capital (ln)	0.6728****	0.5649****	0.5915****
	(0.0279)	(0.0203)	(0.0173)
Import (ln)	0.4568****	0.41027****	0.4097****
	(0.0245)	(0.0170)	(0.0145)
Export (ln)	-0.0244	-0.0622****	-0.0539****
	(0.0127)	(0.0140)	(0.0118)
Constant	0	0	0
	(0)	(0)	(0)
Observations	2,652	11,015	13,667
R-squared	0.2794	0.2402	0.2303
Number of id	13	54	67

Standard errors in parentheses
****p<0.001*** p<0.01, ** p<0.05, * p<0.1

In the regression table the displayed regression is controlled for time and county specific variables. The first regression model (1) only displays steel producing counties within Pennsylvania. The second regression (2) shows all counties, in Pennsylvania, lacking steel production and the third regressions model (3) displays all counties within the state of Pennsylvania. The tariff variable is represented through the weighted average tariff rate. Number of id represent the number of counties in the regression.

In table 9 the regression is conducted through the same method used in section 7, where there is a new regression for each bundle of counties. The difference is that the tariff is represented through a rate instead of a dummy.

The coefficient of the tariff variable is not statistically significant in regression 1, implying that the result cannot be interpreted correctly. The coefficient of the tariff variable in regression 2 and 3 is statistically significant, and the coefficient in Pennsylvania is negative while it is positive in non-producing counties. One possible reason for this is that the tariffs could have had a negative effect on employment in steel-producing counties, resulting in the overall negative effect in Pennsylvania. Corresponding to the result found in both section 7 and table 7 in appendix 3.

The values of the coefficients are small which means that no clear result can be found, but the result gives an idea of the real effect.

Table 10. Correlation table for new variables .

	Employment	*Wages*	*Import*	*Export*	*Capital*	*Steel_County*	*Tariff_rate*Steel_County*	*Tariff_rate*
Employment	1							
Wages	0.4816	1						
Import	0.0097	0.6292	1					
Export	0.0062	0.6353	0.8842	1				
Capital	(0.0059)	(0.6928)	(0.9151)	(0.8936)	1			
Steel_County	0.2496	0.1547	(0.0001)	0.0000	0.0001	1		
*Tariff_rate*Steel_County*	0.0915	(0.0545)	(0.1680)	(0.1819)	0.3675	0.3675	1	
Tariff_rate	(0.0017)	(0.2571)	(0.4101)	(0.4441)	0.0000	0.0000	0.4097	1

No correlation was found in the new variables.