The Effect of U.S. Steel Antidumping Duties on Trade Patterns and Trade Diversion

By
Jackson Trice

Senior Honors Thesis
Economics Department
University of North Carolina at Chapel Hill

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Dr. Patrick Conway, Thesis Advisor
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Abstract

This paper examines the impact of U.S. steel antidumping duties on trade patterns with both countries that are named on the duty and countries that are not named. The purpose of an antidumping duty is to punish the named dumping countries (companies) and reduce imports from them, which will help U.S. firms regain market share. The issue that arises from antidumping duties is the idea that trade may be diverted from the named countries to the non-named countries once a duty is imposed, leaving U.S. firms in a similar position as before the antidumping duty was imposed. The panel dataset the paper uses comes from antidumping data from the Global Antidumping Database of the World Bank and U.S. import data from the U.S. International Trade Commission. This paper uses four different specifications to measure the impact of a steel antidumping duty on U.S. steel imports. The first and second specifications focus on how U.S. steel imports from named countries are impacted, while the third and fourth focus on how U.S. steel imports from non-named countries are impacted. I find that after an antidumping duty is initiated and/or imposed, steel imports from named countries decrease. I also find that steel imports from non-named countries increase once a duty has been placed on a named country. That shows that trade diversion does occur as a result of a steel antidumping duty.
1. Introduction

President Trump has greatly raised the visibility of U.S. tariff policy during his presidency. The Trump Administration’s use of tariff policy is largely retaliatory, by imposing tariffs on countries, and firms in countries, whom he accuses of competing unfairly in international markets. President Trump has imposed tariffs on many goods such as steel and aluminum. Producers from many countries are affected by these tariffs, such as the European Union, Canada, and Mexico. President Trump’s tariffs on China especially have escalated and led to a trade war between the two countries. His goal of the tariffs is to counteract the unfair advantages of foreign producers so that U.S. firms will face a level playing field.

While this has been a very active U.S. policy, it is difficult to assess how successful it has been. Success is defined as reducing trade with the accused country and improving the position of U.S. firms. In this paper, I examine the evidence from earlier U.S. use of retaliatory tariff policy on steel to judge what impact it has had on trade with the accused country. I also look to see whether the retaliatory tariffs led to an increase in steel imports from other non-accused countries, leaving the U.S. steel firms in a similar position compared to the international marketplace. By using an estimation that follows the format of an import function, I find that imported good from the accused country is reduced impacted by the duty. I also find an increase in steel imports from the non-accused countries, which means that trade diversion takes place.

This paper focuses on the U.S. steel industry since many of the Trump Administration’s tariffs focus on steel goods. Also, the U.S. steel industry had been the major world supplier of steel during the mid-20th century, but began to fall out of position towards the end of the century. This may have been due to increases in steel production in other countries, leading them to not rely on U.S. steel anymore. With less share of the world steel market and more competition, U.S.
Steel antidumping duties may have been seen as a way to combat unfair trade with foreign steel companies and help U.S. steel firms regain market share. By focusing on U.S. steel antidumping duties, we examine whether they reduced imports from accused countries and helped domestic firms regain their market share.

The layout of this paper will proceed as follows. The market implications of tariff policy are discussed in section 2. Literature on how to measure the effects of retaliatory tariffs is presented in section 3. The data, empirical model, and results of this paper are detailed in section 4. Lastly, the conclusions drawn from this paper and possible extensions from this paper are discussed in section 5.

2. Market implications of tariff policy

Commercial Policy

Commercial policy is an umbrella term that is used to describe government interventions to influence the pattern and volume of international trade. There are different types of trade policies that could be used to achieve either trade expansion or trade compression (Appleyard & Field, 2013). Trade expansion policies would be used to help incentivize trade between countries. Some examples of this kind of policy are import and export subsidies. Trade compression policies are the opposite of trade expansion policies, since they are used to decrease trade between countries. Import tariffs would fall into this category of commercial policy.

Goals of import tariffs

There can be different goals of an import tariff. One goal would be to raise revenue for the government. An import tariff is a tax on an imported good and that tax will go to the
government treasury. Many developing countries have used import tariffs as a way of generating revenue. Another goal of an import tariff would be to protect newly established domestic industries from foreign competitors. Since the domestic industry is new, it may be difficult to compete with a well-established competitor, so countries can implement an import tariff to help the new domestic industry grow and establish itself. One last goal of an import tariff is to protect domestic producers from low-cost foreign competition. The domestic producers need the assistance of a tariff since there is low demand for their good compared to the high demand for a low-cost foreign good.

*Evolution of tariffs*

The use of tariffs in the U.S. has changed significantly over time. When the Great Depression hit, international trade contracted immensely. The U.S. Congress enacted the Smoot-Hawley Tariff Act of 1930, which raised tariffs on over 20,000 imported goods (Irwin, 2017). These tariff rates were the second highest in U.S. history and they led to major consequences. Other countries retaliated against the U.S. by significantly increasing their own trade barriers. In 1934, Congress passed the Reciprocal Tariff Act, which gave the executive branch the power to negotiate bilateral tariff reduction agreements with other countries (Irwin, 2017). This power was used to help reduce tariff rates with multiple countries. After World War II, the General Agreement of Tariffs and Trade (GATT) was created, where multiple nations joined together to help promote international trade by reducing barriers to trade. Through multilateral negotiations, tariff rates were negotiated downward multiple times from 1948 to 1994 (Irwin, 2017). GATT was then replaced by the World Trade Organization (WTO) in 1994, which continued the effort to negotiate uniform tariff rates.
Import tariffs can sometimes be classified as retaliatory tariffs when a country is either retaliating against unfair trading practices or against a destabilizing inflow of goods from foreign producers. Retaliatory tariffs have become more commonly used in recent years. They can be broken down further into specific types of retaliatory tariffs. A countervailing duty is a tariff that is imposed on a specific good from a specific country where the government is subsidizing the export of that good (Appleyard & Field, 2013). Because of the subsidy, firms in the foreign country can export the good at a lower price, which hurts domestic producers. Another type of retaliatory tariff is a safeguard duty. This duty can be imposed if a sudden increase in imports of a specific good causes concern for the domestic industry (Appleyard & Field, 2013). These duties are on a specific good, but are imposed on all countries instead of specified export countries. These duties do not require evidence of unfair competition in order to be enacted.

One more type of retaliatory tariff is a response to a firm in a foreign country that dumps its exports on the domestic country. Dumping occurs when an exporting foreign company sells a product to an importing country at a price that is lower in the importing country’s market than the exporting country’s market (WTO | Anti-dumping—Technical Information, n.d.). This is unfair since the foreign company artificially lowered its export price in order to drive out the domestic competition. The retaliatory tariff that is used to combat dumping is an antidumping duty. It should be made clear that antidumping duties are imposed on the specific foreign companies that are dumping and not the entire foreign country. An antidumping duty is imposed on the exporting company at a value that is equal to the dumping margin. The dumping margin is defined as the difference between the fair market price of the good and the lower export price from the foreign company to the importing country (Appleyard & Field, 2013).
For the U.S. there is a process that takes place in order for an antidumping duty to be levied. First, the domestic industry files an antidumping petition to both the International Trade Administration (ITA) of the U.S. Department of Commerce and the International Trade Commission (ITC). The ITA will determine whether the dumping occurred and, if so, the margin of dumping. The ITC will determine if there is material injury to the firm as a result of the dumping (Understanding Antidumping & Countervailing Duty Investigations | USITC, n.d.). If the petition is accepted by both the ITA and ITC, then an antidumping investigation is initiated (Malhotra et al., 2008). If the ITA and ITC find evidence of dumping and injury, then an antidumping duty is imposed on the exporting company at a value that is equal to the dumping margin.

**Impact of tariffs**

To illustrate the impact of a tariff, we must first understand how trade works in the free market scenario. First, we will define the dumping margin to see how it applies in both the free market and dumping scenarios. The dumping margin equation is

\[ DM = \frac{P_W - P_{SN}}{P_W}, \]

where the variable \( P_W \) represents the world price of the good (in this case steel), while the variable \( P_{SN} \) is the export price of the foreign company in the named country group. We can solve for \( P_{SN} \), which results in the equation

\[ P_{SN} = P_W (1 - DM). \]

Now in the free market scenario, the dumping margin would be equal to zero, so \( P_{SN} = P_W \).

Next, we can create quantity demand and quantity supply equations for three different country groups, the United States (U), the named countries (N), and non-named countries (NN).
In this free market example, the named countries are not dumping and have not been imposed with a tariff. We split up both named and non-named countries now so that when the tariff is placed on the named countries we will know how it impacts each of those groups.

The Global Steel Market

Supply

\[ Q_{SU} = 700 + 10 \times (P_w - 40) \]
\[ Q_{SN} = 100 + 10 \times (P_w - 40) \]
\[ Q_{SNN} = 100 + 10 \times (P_w - 40) \]

Demand

\[ Q_{DU} = 15460 - 10P_w \]
\[ Q_{DN} = 8320 - 10P_w \]
\[ Q_{DNN} = 8320 - 10P_w \]

The variable \( Q_S \) is the quantity supplied of steel goods from a country. The variable \( Q_D \) is the quantity demanded of steel goods by that country. The total quantity supplied can be calculated by adding each of the quantity supplied equations together. The same process can be done for demand in order to get the total quantity demanded. In this example, the total quantity supplied and demanded are represented by the equations

\[ Q_{ST} = 900 + 30 \times (P_w - 40), \]
\[ Q_{DT} = 32100 - 30P_w. \]

To find the free market price, we can set \( Q_{ST} \) and \( Q_{DT} \) equal to each other and then solve for \( P_w \). By doing this, we find that \( P_w = $540 \). We can then solve for the quantity supplied and quantity demanded for each of the country groups. For the U.S., quantity supplied equals 5,700 units. For both the named and non-named countries, quantity supplied equals 5,100 units for each.
demand side, quantity demanded by the U.S. equals 10,060 units, and for the named and non-named countries quantity demand equals 2,920 units for each. This example shows that in the free trade market, the U.S. has the largest quantity supplied and quantity demanded for the steel goods.

Next, we focus on the imports and exports from each of these country groups. The imports equation for each group are calculated by subtracting the $Q_S$ equation from the $Q_D$ equation for each group. This results in the following equations

\[ Q_{DU} - Q_{SU} = 15160 - 20P_w \]
\[ Q_{DN} - Q_{SN} = 8620 - 20P_w \]
\[ Q_{DNN} - Q_{SNN} = 8620 - 20P_w \]

We then input $P_w=$540 to calculate the imports by each group. The U.S. imports equal 4,360 units. The imports for the named and non-named country groups equal -2,180 units for each. The negative means that both of these groups are actually exporting 2,180 units to the United States. That means the U.S. is importing the same number of units from both named and non-named countries in this free trade equilibrium.

Now let’s see what changes when we add in the dumping done by the named countries. As stated previously, dumping is when an exporting foreign company artificially sets the price of steel goods lower than fair market value. Going back to the equation

\[ P_{SN} = P_w(1 - DM) \]

we can see how the named foreign company now has a lower price, $P_{SN}$, since the dumping margin no longer equals zero.
There are also changes to the quantity supplied and demanded equations. First, we will focus on the changes to quantity supplied equation of the named countries. Their new quantity supplied equation is

\[ Q_{SN} = 100 + 10 \times [P_W (1 - DM) - 40] + 20P_W \times DM. \]

Now that \( P_{SN} = P_W (1 - DM) \), we see that \( P_{SN} \) has been substituted in order to include the dumping margin. With a dumping margin greater than zero, the new price for named steel products will decrease. This is artificially and purposefully done by the named company in that country in order for them to have a greater market share in the United States. To better understand the new \( 20P_W \times DM \) part of the equation, we can look back to free market quantity supplied for named countries and solve for \( P_{SN} \). This gives us the equation

\[ P_{SN} = \frac{Q_{SN} - 100}{10} + 40. \]

Next, in order to change this to represent dumping from a named company, we can add in this new portion of the equation in order to get

\[ P_{SN} - 20P_W \times DM = \frac{Q_{SN} - 100}{10} + 40. \]

This \( 20P_W \times DM \) part of the equation represents the loss that the name company in the country accrues due to artificially lowering their price of steel exports. This loss will hurt the name company in the short run, but if they are able to reach their goal of increasing market share in the U.S. then they will be able to make up for these losses in the future. That explains how at first dumping is unprofitable for the named company, but could become greatly beneficial to the company.

Next we can focus on how dumping changes the quantity supplied equation for the United States. The new equation would become

\[ Q_{SU} = 700 + 10 \times [P_W (1 - DM) - 40]. \]
The only change is that the price is now equal to $P_{SN}$, just with $P_{w}(1 - DM)$ substituted in. This happens due to the elasticity of substitution of domestic and foreign goods. That means since the named companies reduced their price of steel, the U.S. producers will have to reduce their price as well in order to compete. With a high elasticity of substitution, domestic firms will change to the same price, because if they do not they will easily lose their share of the market.

The last change occurs with the quantity demanded equation for the United States. The new equation becomes

$$Q_{DU} = 15460 - 10P_{w}(1 - DM).$$

Again, the change is that the demanded price is now equal to $P_{SN}$. Now that the cheaper steel products are being dumped into the U.S., the price in the quantity demanded equation will drop to the foreign price. This also explains why the price in the U.S. quantity supplied changes as well, since all the demand will be for steel goods that are sold at the cheaper price.

The remaining quantity supplied and demanded equations will remain the same. The respective equations for all country groups in the dumping example are

**The Global Steel Market**

**Supply**

$$Q_{SU} = 700 + 10 \times [P_{w}(1 - DM) - 40]$$

$$Q_{SN} = 100 + 10 \times [P_{w}(1 - DM) - 40] + 20P_{w} \times DM$$

$$Q_{SNN} = 100 + 10 \times (P_{w} - 40)$$

**Demand**

$$Q_{DU} = 15460 - 10P_{w}(1 - DM)$$

$$Q_{DN} = 8320 - 10P_{w}$$

$$Q_{DNN} = 8320 - 10P_{w}$$
Both the quantity demanded equations for the named and non-named countries remain the same since neither are benefiting from the cheaper price of named exports of steel. The named companies are dumping only on the U.S., so the other country groups still have the same price. The quantity supplied for non-named countries remains the same since they are not being dumped by the named countries and do not have to compete with the cheaper steel products.

We can see what happens when the named foreign companies artificially decrease their exporting price of steel to $340, and create a dumping margin of 0.4138. By solving the dumping margin equation for the world price, we find the equation

\[ P_W = \frac{P_{SN}}{1-DM} \]

When we input $340 for \( P_{SN} \) and 0.4138 for \( DM \), we find that \( P_W \) equals $580. We can now use these prices to find the new amount of quantity supplied and demanded for each country group. The U.S. quantity supplied becomes 3,700 units, while named country quantity supplied becomes 7,900 units and non-named quantity supplied becomes 5,500 units. Comparing these numbers to the ones in the free market scenario, the quantity supplied for the U.S. decreases by 2,000 units. Non-named countries quantity supplied increases by 300 units, while quantity supplied for named countries increases by 2,800 units.

We see changes in quantity demanded as well, with U.S. quantity demanded becoming 12,060 units, while named and non-named countries quantity demanded becoming 2,520 units each. U.S. quantity demanded increased by 2,000 units, while named and non-named countries quantity demanded decreased by 400 units each. We see that in the dumping scenario, named countries are supplying much more steel compared to the other groups, while the U.S. is demanding more for steel products since they are the ones that are being dumped with the cheaper steel products.
Changes in quantity demand and quantity supply also cause changes in the import equations. By subtracting the $Q_D$ equation by the $Q_S$ equation for each group, we see the following import equations

$$Q_{DU} - Q_{SU} = 15160 - 20P_W(1 - DM)$$

$$Q_{DN} - Q_{SN} = 8620 - 20P_W - 10P_W \times DM$$

$$Q_{DNN} - Q_{SNN} = 8620 - 20P_W.$$  

We can calculate the number of imports by each group by inputting $580$ for the world price and $0.4138$ for the dumping margin. By doing this we see that the U.S. imports become 8,360 units. The named countries exports become 5,380 units and the non-named countries exports become 2,980 units. Comparing these imports and exports to the free market example, the U.S. imports 4,000 more units, with the majority coming from the named countries, since the named countries are exporting 3,200 more units. This makes sense because with a lower export price, named country steel exports should greatly increase due to higher demand from the United States.

**Figure 1: U.S. Steel Market After Dumping**
The impact of the dumping on the U.S. can be further explored in Figure 1 above. This figure shows the U.S. market for steel goods and how it is impacted by the dumping country. The market price decreases from $540 to $340, since the U.S. goes from importing at the free market price to the lower export price of the foreign companies. That causes quantity demand to increase and quantity supply to decrease for the United States. Both consumer surplus and producer surplus are affected by this change in price due to dumping. Consumer surplus is defined by the area bounded by the demand curve on top and the market price on the bottom. Producer surplus is the area bounded by the market price on top and the supply curve on the bottom (Appleyard & Field, 2013). We see that consumer surplus increases by the area $ABJG$, while producer surplus decreases by the area $ABDE$. It makes sense that consumers would benefit since they can now purchase steel goods for a cheaper price, even if that price is artificially set. Producers would be hurt from the dumping since they are now competing against a cheaper product. Welfare loss from the dumping good can also be seen from the areas $CDE$ and $GJI$. This represents the cost to society by the dumping of the steel goods. This provides another reason that the U.S. is negatively impacted by the dumping countries.

To counteract the dumping from the foreign companies, the U.S. can implement a tariff to retaliate. In this case, the tariff would be an antidumping duty. The value of the duty would be equal to the dumping margin, so in this case it would equal 0.4138. In the equations from above, the tariff ($T$) would be included in the equation for $P_{NS}$ seen below

$$P_{SN} = P_W(1 - DM)(1 + T).$$

As stated above, $T = DM$ so that means that $(1 - DM)(1 + T)$ would approximately equal 1. This is done by the U.S. in order to bring the price from the named countries back to equaling the world price. If the name companies continue dumping while the tariff is in place, then they will
continue to be hurt by the losses of $20P_w \times DM$, and that will continue in the long-run as long as the tariff remains in place. Implementing an antidumping duty should effectively increase the price of steel from the named foreign companies and lead to a decrease in imports from those companies.

While these impacts of an antidumping duty are expected, there are other ways that trade could be impacted from the duty. Instead of the U.S. going back to buying steel from U.S. steel producers, trade could be diverted from the named countries to the non-named countries instead. That would leave U.S. firms back in the situation as when the named countries were dumping, since consumers start importing from non-named countries instead of going back to relying on U.S. firms for the steel goods. That is one of the main issues of antidumping duties explored in this paper and should be taken into consideration when a country implements an antidumping duty.

3. Literature Review

My paper contributes to literature focused on free trade agreements and trade diversion. Russ and Swenson (2019) look at the impact of the South Korea-U.S. Free Trade Agreement (KORUS) on trade diversion from other countries. They look at U.S. imports two years after the creation of KORUS to see how U.S. import patterns change and if there is any diversion that takes place. Their estimates find that the trade diversion sum was 13.1 billion in 2013 and 13.8 billion in 2014. They also find that these estimates of trade diversion are roughly the same magnitude as the increase in the U.S. bilateral good trade deficit with South Korea. This study is similar to my paper since it focuses on estimating the amount of trade diversion that occurs after
an international policy is imposed. The difference is that my paper focuses on antidumping duties impact on trade diversion instead of Free Trade Agreements.

My paper also contributes to literature that looks specifically at antidumping duties. Prusa (1996) looks at the effect of all U.S. antidumping duties (AD duty) from 1980 to 1988 on trade volume and trade diversion. He looks at the trade effect on named countries in the duties, as well as on non-named countries in order to show the level of trade diversion, which is the same method that is applied in this paper. The findings were that AD duties restricted the volume of trade for named countries, substantial trade diversion from named countries to non-named countries occurred, and AD petitions that were rejected still decreased imports from those named countries. While his study is fairly similar to this paper, there still are some key differences. This paper focuses only on one U.S. industry (steel), studies more recent AD duties (1990-2000), and uses more than just a year dummy variable to control for macroeconomic trends. By using more controls for macroeconomic trends, my paper helps control for potential bias from omitting key variables that impact U.S. imports (ex. U.S. production, foreign prices, exchange rate).

Malhotra, Rus, and Kassam (2008) take a different approach compared to Prusa by focusing only on the U.S. agriculture sector. Their paper is important since it focuses on a specific industry (agriculture) to understand the effect of antidumping duties, which is similar to how my paper focuses on U.S. steel imports. The results show that there is a significant effect of antidumping duties on imports from named countries. Imports decrease by 64% in the first year if the decision is affirmative and the duty is imposed. If the decision is negative, though, there is no significant change in imports from named countries. Interestingly, there is no significant evidence of trade diversion, even for affirmative decisions.
These studies have covered the topic of antidumping duties by focusing on all U.S. antidumping duties, as well as just U.S. agricultural duties. My paper will attempt to explore U.S. steel antidumping duties. It is important to understand the effectiveness of antidumping duties on U.S. steel industry, since the industry lost world market share towards the end of the 20th century (Bartholomew, 2019). After World War II, the demand for steel across the globe increased, since many countries needed to rebuild infrastructure and did not have enough steel production to do so. The U.S. steel industry greatly benefitted by providing many of these countries with steel. After some time, though, these countries were able to rebuild their steel mills and increase their own steel production (Bartholomew, 2019). This lead to the U.S. steel industry having less influence in the world market and also having to deal with more strong competition. In order to retain market share, U.S. steel antidumping duties may have been a way to combat unfair steel trade and help domestic steel producers compete with foreign companies.

The issue that may arise, though, is the idea that trade will be diverted to other countries that are not impacted by an AD duty. Malhotra, Rus, and Kassam (2008) saw no significant evidence of trade diversion for the U.S. agriculture industry. They considered this may make sense because there are few large supplier countries for agriculture. If an AD duty is imposed on the large suppliers, then it would be difficult for the remaining non-named countries to replace them. This is how the steel industry may be different when it come to trade diversion. There are many strong foreign competitors in the steel industry, so if some are targeted with an AD duty, trade could be shifted to the others that are not impacted by the duty. With the substitution of trade from named to non-named country being more elastic for steel compared to agriculture, we may see more significant trade diversion with steel.
My paper also uses a model that will be different than these studies’ models. The key variables will be similar to previous papers, but this model will contain more control variables to minimize the omitted variable bias within the model. Previous models only include calendar dummies to control for macroeconomic trends, but this paper will include variables for foreign prices, U.S. production, foreign production, exchange rates, and then month and year dummies to control for seasonality. Looking at the steel industry and adjusting the model will help in further understanding antidumping duties and their impact on trade diversion.

4. Empirical Results

I. Data

In order to examine the effects of antidumping duties on trade, panel trade data is constructed. First, the antidumping data is collected from the Global Antidumping Database (GAD) which is maintained by the World Bank (Data Catalog, n.d.). This dataset contains information on all the antidumping duties the U.S. has introduced from 1980 to 2015, including the country it was imposed on, the initiation date, and the actual size of the duty (as a percentage). The U.S. uses Harmonized Tariff Schedule (HTS) to categorize different products by assigning each product with an HTS number. Antidumping duties are levied by product, so the GAD data contains the HTS number for each product that was imposed with a duty. The duties that covered steel products from 1990 to 2000 are selected since they are the type of products and time period that this paper centers on. These selected duties cover 37 different types of steel products (flat-rolled steel, bars and rods of stainless steel, hot-rolled coil steel, etc.) Table 1 shows the most frequent countries that were named in an antidumping duty. Table 2 shows the
number of countries with firms that were initiated with an antidumping case per year. It shows that 1992 had the largest number of countries with initiated firms, while 1995 only had three.

**Table 1: Most Frequently Named Countries, 1990-2000**

<table>
<thead>
<tr>
<th>Country</th>
<th>Number of AD Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>18</td>
</tr>
<tr>
<td>South Korea</td>
<td>16</td>
</tr>
<tr>
<td>Brazil</td>
<td>15</td>
</tr>
<tr>
<td>Taiwan</td>
<td>12</td>
</tr>
<tr>
<td>Germany</td>
<td>12</td>
</tr>
<tr>
<td>Canada</td>
<td>10</td>
</tr>
<tr>
<td>France</td>
<td>9</td>
</tr>
<tr>
<td>India</td>
<td>8</td>
</tr>
</tbody>
</table>

**Table 2: Number of countries initiated with AD case per year**

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of countries initiated with AD case</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>3</td>
</tr>
<tr>
<td>1991</td>
<td>9</td>
</tr>
<tr>
<td>1992</td>
<td>54</td>
</tr>
<tr>
<td>1993</td>
<td>15</td>
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<td>1994</td>
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<td>1995</td>
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<td>1998</td>
<td>22</td>
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<tr>
<td>1999</td>
<td>21</td>
</tr>
<tr>
<td>2000</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>190</td>
</tr>
</tbody>
</table>

Next, U.S. import data for all the steel products included on an antidumping duty is collected. The U.S. import data is collected from the U.S. International Trade Commission (USITC) import database (*Data Request | DataWeb*, n.d.). The same HTS product numbers from GAD database are used when retrieving import data from USITC. U.S. imports of each steel
product from all countries is collected within the time frame of 1989 to 2003 and are measured in quantity terms. It is also collected as monthly data, in order to see the immediate impact of the duties. One restriction made to the data is dropping countries when they only exported a certain steel product once during the entire 1989-2003 time period. After collecting both the import and AD data, the two datasets are merged and then grouped by country and product in order to create a panel dataset that does not have any duplicate observations.

The merged dataset is the what will be used in the regression. There are 180 months of data (1989-2003) for 37 categories of steel products. For each steel product, the quantity of imports is measured from each exporting country, which is about 50 exporters per steel product.

Within the dataset, named countries and non-named countries are categorized. To do this, a named dummy variable is created to represent which countries have a duty placed on them for a certain steel product at a certain time period. The named variable will equal 1 if a duty is initiated for a specific steel product from a country and it will remain equal to 1 until either the duty is not imposed or the duty was imposed but is no longer imposed. Figure 2 shows a timeline of the antidumping duties process.

**Figure 2: Antidumping Duty Process Timeline**

![Timeline Diagram]

In this timeline the time variable is t, which represents months. We see that in t=2 an antidumping case is opened up, which starts the investigation. The investigation continues until the ITC and ITA decide whether or not the duty should be imposed. Even if the duty is not
imposed, their can be an investigation effect, which means that by just starting an AD investigation imports from the named countries decrease. In this case, the duty is imposed in $t=4$, so we see how imports change after initiation of an investigation in $t=2$ and we see how they change further once the duty is imposed in $t=4$. That duty continues to be imposed on those named companies until a time period when the duty is removed. This would be done if the named company stops dumping or if the U.S. decided it no longer needed the duty to be in place. In this example, the duty remains imposed until $t=10$. In regard to the named variable described above, this company/country would have a named variable equaling 1 from $t=2$ to $t=10$. Otherwise, they are not considered named and the named variable equals 0.

The dependent variable within the dataset is quantity of steel imports, while two key independent variables are duty and an interaction between duty and a decision dummy. Going back to Figure 2, the duty variable will equal the percentage of the duty throughout the antidumping process. There is a preliminary duty percentage announced once the investigation is initiated, but the duty percentage may change when it is decided to impose the duty. The decision dummy variable refers to that decision point on the timeline of whether or not to impose the duty. The decision dummy will equal 1 when a duty is levied and 0 if not. It will also remain 1 for all the months that the duty is imposed. By interacting the duty variable with the decision dummy variable, we are able to see how imports change when a duty is levied or not.

An issue arises when we focus on when countries are not being imposed with a duty. We want to see how these imports from non-named countries are affected when other named countries are initiated/imposed with an AD duty. The challenge is that multiple companies and countries are usually named on an antidumping duty and these different countries could have different duty percentages (ex. both Japan and Spain firms are named in an AD duty, but the
Japanese firm was taxed 50% and the Spanish firm was taxed 20%). That made it difficult to know what the duty variable should be for the non-named countries of that antidumping duty. A way to represent the duty effect is calculating a weighted duty variable for the non-named countries. The calculation is:

\[
WeightedDuty_{i,t} = \frac{\sum_j Duty_{i,t} \cdot Imports_{i,t-1}}{\sum_j Imports_{i,t-1}}.
\]

In this equation, \(Duty_{i,t}\) represents the duty imposed on a country \(j\) for good \(i\) in time \(t\). The variable \(Imports_{i,t-1}\) represents the imports of good \(i\) from a countries \(j\) (including both named and non-named) in time \(t-1\), which is the month prior to the initiation of the duty. The weighted duty equation shows that it is equal to the sum of the duty percentages for all the countries named for a specific antidumping duty, and then multiplied by the share of total U.S. imports coming from the named countries. Imports from the month prior to the initiation of the duty are used in order to have imports that are not already impacted by the initiation of the duty. This new weighted duty variable will be used to represent the trade diversion that occurs from imposing an antidumping duty. It shows how imports from non-named countries are impacted due to the creation of an antidumping duty.

A duty+ variable will also be created and interacted with the weighted duty variable. The duty+ variable will equal 1 whenever the variable duty is not equal to 0, and it will take the value of 0 otherwise. This variable is created and interacted with the weighted duty variable in order to prevent any confounding effects that result from including the weighted duty variable into the regression.

The data for the control variables are collected from different sources. The USTIC import database reports both U.S. import values and quantities by source country. Unit values (foreign
prices) are calculated by dividing the import values by the quantities. The producer price index for steel and iron U.S. commodities comes from the Federal Reserve Economic Data \((Producer Price Index by Commodity for Metals and Metal Products: Iron and Steel (WPU101) | FRED | St. Louis Fed, n.d.)\). A drawback of this index is that it includes more steel goods than those covered by the antidumping duties, but it still helps represent U.S. steel prices in the model. The exchange rate data is collected from the International Monetary Fund \((Exchange Rate Archives by Month, n.d.)\). The exchange rate here is defined as the amount of foreign currency that can be purchased by one U.S. dollar. The foreign production of steel products (quantity produced in kilograms) is collected from Comtrade, which is made by the United Nations \((Download trade data | UN Comtrade: International Trade Statistics, n.d.)\).

The inclusion of the foreign prices, U.S. prices and exchange rate are meant to represent the real exchange rate. Since we use a producer price index for U.S. steel commodities, this representation of the real exchange rate is not perfect. In order to improve this estimation, two new variables are created to be another representation of the real exchange rate. These variables are created by the ratios

\[
\frac{FPrice_{ij}}{FPrice_i} \times \frac{FPrice_i}{(ER_j \times PPI)}
\]

In the first ratio, \(FPrice_{ij}\) is the foreign price of steel good \(i\) from country \(j\), and \(FPrice_i\) is the foreign price of steel good \(i\) across all countries. In the second ratio, \(ER_j\) is the exchange rate from country \(j\) and \(PPI\) is the producer price index for U.S. steel commodities. The first ratio will represent whether country \(j\) is a low-cost supplier of the steel product across all importers, and the second ratio will represent whether imports of steel product \(i\) are expensive on average relative to domestic producers.
Table 3: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Observations</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imports</td>
<td>259,560</td>
<td>281061.6</td>
<td>2005111</td>
<td>0</td>
<td>1.32e+08</td>
</tr>
<tr>
<td>Duty</td>
<td>259,560</td>
<td>1.019262</td>
<td>0.1363964</td>
<td>1</td>
<td>6.9566</td>
</tr>
<tr>
<td>Duty*Decision</td>
<td>259,560</td>
<td>0.0478194</td>
<td>0.2733709</td>
<td>0</td>
<td>3.4346</td>
</tr>
<tr>
<td>Weighted Duty</td>
<td>259,560</td>
<td>1.065725</td>
<td>0.2527017</td>
<td>1</td>
<td>3.68296</td>
</tr>
<tr>
<td>Weighted*Duty+</td>
<td>259,560</td>
<td>0.0477288</td>
<td>0.2487615</td>
<td>0</td>
<td>3.68296</td>
</tr>
<tr>
<td>PPI US Steel</td>
<td>259,560</td>
<td>118.6167</td>
<td>5.928704</td>
<td>107.1</td>
<td>130.4</td>
</tr>
<tr>
<td>Foreign Price</td>
<td>259,560</td>
<td>4.449438</td>
<td>84.26966</td>
<td>0</td>
<td>9179</td>
</tr>
<tr>
<td>Exchange Rate</td>
<td>259,560</td>
<td>88.30646</td>
<td>451.4898</td>
<td>0.3845</td>
<td>10125.1</td>
</tr>
<tr>
<td>Foreign Prod</td>
<td>259,560</td>
<td>1.22e+08</td>
<td>2.57e+08</td>
<td>2</td>
<td>3.09e+09</td>
</tr>
<tr>
<td>FPrice$_i$/FPrice$_i$</td>
<td>259,560</td>
<td>2.714384</td>
<td>88.92502</td>
<td>0</td>
<td>21737.5</td>
</tr>
<tr>
<td>FPrice$_i$/ (ER*PPI)</td>
<td>259,560</td>
<td>0.0030113</td>
<td>0.009211</td>
<td>0</td>
<td>0.2435102</td>
</tr>
</tbody>
</table>

Table 3 shows the summary statistics of the different variables, with the dependent and key variables at the top of the table. For the regression model, these variables will be converted to logarithmic form. This is done to respond to skews in the data towards large values. There are countries that the U.S. imports extremely large quantities of steel from, while other countries export much smaller quantities. Converting to logarithmic form will help reduce this skew in the data. One note about this conversion is that any imports that equal zero will be excluded from the regression. Taking the log of zero results in an undefined value, which means these observations are not included. Table 3 shows there are 259,560 observations of imports, but after converting to logarithmic form the number of observations drop to 64,045. This unfortunately is not quite as many observations as previously stated, but it still is a large enough sample size to derive significant results.

II. Empirical Model

This paper uses an empirical model that relates to the equations displayed in section 2, but also adds other key variables that affect imports. It is similar since it uses imports as the
dependent variable and also uses a U.S. steel producer price index and unit values of foreign steel products to account for price, but the model adds other variables to control for different demand and supply shifters. The first model that is used in the regression is

\[
\ln \text{Imports}_{i,t} = \beta_0 + \beta_1 \ln \text{Duty}_{i,t} + \beta_2 (\text{Dec}_{i,t} \times \ln \text{Duty}_{i,t}) + \beta_3 \ln \text{PPI}_t + \beta_4 \ln \text{Price}_{i,t} + \beta_5 \ln \text{ER}_t + \beta_6 \ln \text{Prod}_{i,t} + \beta_7 \ln \text{Imports}_{i,t-1} + \beta_8 \text{month}_t + \beta_9 \text{year}_t + \beta_{10} \text{product}_t + \epsilon_{i,t}.
\]

The dependent variable \(\ln \text{Imports}_{i,t}\) is the quantity of U.S. imports of product \(i\) from all countries \(j\) at time \(t\) (monthly). The variable \(\ln \text{Duty}_{i,t}\) denotes the size of the antidumping duty, as a percentage. The next variable is an interaction between \(\text{Dec}_{i,t}\) and \(\ln \text{Duty}_{i,t}\). The variable \(\text{Dec}_{i,t}\) is a decision dummy for each AD case and is equal to 1 when an AD proposal is affirmed and remains 1 for all months where the duty is imposed. These two variables are the key variables of this model and represent the impact of an antidumping duty on U.S. imports from the named countries. Adding the interaction will show the effect of not just proposing a duty, but also if the duty is levied.

The next set of variables are control variables that are meant to decrease omitted variable bias by accounting for different macroeconomic factors that could affect U.S. imports of steel products. The first is \(\ln \text{PPI}_t\), which is the producer price index for U.S. steel and represents the U.S. price of steel. Foreign prices of steel are controlled for by the variable \(\ln \text{Price}_{i,t}\), which is the unit values of each product from each country. The exchange rate with each country is controlled for with \(\ln \text{ER}_t\). The variable is \(\ln \text{Prod}_{i,t}\), which is the foreign production of each product \(i\). This would control for an export-supply shifter. The variable \(\ln \text{Imports}_{i,t-1}\) is the lagged U.S. imports for steel product \(i\) from all countries \(j\). This variable represents the inertia of the importing decision, since last month’s imports are a good predictor of this month’s imports,
other things being equal. Lastly, the variables $month_t$ and $year_t$ are month and year dummies that will help control for seasonality and other macroeconomic trends and the variable $product_t$ is a dummy that will control for the different steel products that that U.S. imports.

As stated previously, the model follows a similar format as the equations in section 2. By adding the different duty key variables and accounting for other variables that could impact imports, this model more accurately estimates the amount of steel imports into the United States after accounting for antidumping duties.

The next specification to this model would be changing the control variables to better represent the real exchange rate. This model would take away the separate variables of $lnPI_t$, $lnFPrice_t$, and $lnER_t$, and instead include the logarithms of the two ratio variables. Together, these ratios will provide for a better understanding of the real exchange rate in the model.

In order to calculate the amount of trade diversion that occurs from imposing antidumping duties, another specification to the model is made. For this regression, the model is

$$lnImports_{i,t} = \beta_0 + \beta_1 lnDuty_{i,t} + \beta_2 (Dec_{i,t} * lnDuty_{i,t}) + \beta_3 lnWeightDuty_{i,t} + \beta_4 lnWeightDuty_{i,t} * DutyPlus_t + \beta_5 lnPI_t + \beta_6 lnFPrice_{i,t} + \beta_7 lnER_{i,t} + \beta_8 lnProd_{i,t} + \beta_9 lnImports_{i,t-1} + \beta_{10} month_t + \beta_{11} year_t + \beta_{12} product_t + \epsilon_{i,t}.$$  

The changes in this empirical model are the inclusion of $lnWeightDuty_{i,t}$ and the interaction between $lnWeightDuty_{i,t}$ and $DutyPlus_t$. The calculation of the weighted duty was addressed above, but it is meant to represent the duty effect on all countries. This will provide insight into the extent of trade diversion that occurs once an AD duty is initiated/imposed. The duty+ variable equals 1 whenever the duty variable is not zero. Since the weighted duty variable is applied to the named countries as well, there may be confounding effects from adding it to the
model. We attempt to control these confounding effects by adding in the interaction between weighted duty and duty+. The impact of the antidumping duty on the named countries can be seen by the three coefficients on the variables duty variable, the interaction between duty and decision, and the interaction between weighted duty and duty+. The remaining variables are the same as the first model.

One last specification is taking the third model and changing the variables that represent the real exchange rate. Just like the second specification, the two ratios will be included to have a better representation of the real exchange rate.

III. Results

The first column of Table 4 shows the estimates for the first regression model. The results show that for a 1% change in Duty when a duty is initiated, imports from a named country decrease by 0.36%. This represents an investigation effect, since even though the duty is not imposed there is still a decrease in imports. When the duty is imposed, imports from the named country decrease by an additional 0.8% for a 1% change in Duty. This also makes sense because the purpose of the duty is to reduce the amount of U.S. imports from these named counties. The fact that imports decrease by a larger percentage after imposing the duty shows how effective antidumping duties can be at reducing trade with dumping nations.

The signs of the significant controls also make sense in this regression. The producer price index for U.S. steel has a positive relationship with U.S. imports. That is logical, since an increase in steel prices in the U.S. should lead to an increase in U.S. imports of cheaper steel from other countries. Foreign price has a negative relationship with imports, showing that when foreign steel prices increase U.S. steel imports will decrease. The exchange rate has a positive
relationship with imports, which means that the U.S. imports more as the dollar gets stronger. This does make sense, since a stronger dollar makes imports cheaper, thus increasing imports.

The second column displays the regression results for the second specification of the model. This model contains the two ratios that make up the real exchange rate instead of including those variables independently. These results show a 1% increase in Duty when a duty is initiated leads to a 0.4% decrease in U.S. steel imports from a named country. Imposing the duty leads to an additional 0.915% decrease for a 1% increase in Duty. The investigation effect seems to be similar as the previous specification, but the additional decrease in U.S. steel imports after imposing a duty is even larger than the results from the previous model. This again shows the strong impact against dumping countries when an antidumping duty is imposed. Going back to the example in section 2, we saw that dumping countries take a loss once they begin to dump. If nothing stops them from dumping, then in the long run they will obtain more market share and be able to offset those losses. Imposing an AD duty on the dumping country means that the dumping country will continue to take losses as long as they have an artificially lower price.

The signs on the new ratios to represent the real exchange rate make sense. This first one represents whether a country is a low-cost producer of steel compared to all countries. The sign for this ratio is negative, which means that the higher the cost a country is at producing steel, the less the U.S. will import from them. The second ratio tells us whether imports of a certain steel product are expensive on average relative to domestic production. The negative coefficient on this ratio means that the more expensive the steel product is compared to domestic production, the less the U.S. will import that steel product. Both of these new ratios are significant and show the correct sign.
The third column shows the results for the regression model with weighted duty and the interaction between weighted duty and duty+. The amount of trade diversion that occurs when an antidumping duty is placed on a country is represented in the coefficient for weighted duty. The results show that for a 1% increase in weighted duty, U.S. steel imports from one non-named country increase by 0.088%. This shows that there is trade diversion from imposing an AD duty on a named country. The impact on U.S. steel imports from a named country is represented by the coefficients for duty, duty and decision interaction, and weighted duty and duty+ interaction. The signs are negative for both duty and the interaction between duty and decision, but the sign for the interaction between weighted duty and duty+ is positive, although the value is almost zero. This again shows the decrease in steel imports from these named countries. The controls also continue to display the correct sign.

The fourth column displays the results for the regression with weighted duty and the real exchange rate ratios. We see that for a 1% increase in weighted duty leads to U.S. steel imports from a non-named country to increase by 0.249%. Again, this shows evidence of trade diversion from named countries to non-named countries. This means that U.S. steel firms are being left in a worse off position than what was intended from the antidumping duties. We see that steel imports from named countries decrease once again. The ratios for real exchange rate also show the correct sign again.
These results show that imports from a named country will decrease after implementing an AD Duty, while imports from a non-named country will increase. Each coefficient, though, is in regard to just one named country or one non-named country. Due to this, the amount of trade diversion or destruction is difficult to comprehend. In order to provide a better picture of the extent of trade destruction/diversion, a simulation example was created.
The simulation looks at one antidumping duty on Taiwan for a specific steel product category (7208.10). The first part of the simulation focuses on Taiwan and the change in U.S. imports from them from the month prior to the duty being initiated and the month the duty is initiated. The coefficients from Table 4 column 1 are multiplied by the values of those variables for Taiwan in both of these months. For each month, the multiplied values are summed together to get the predicted value for the logarithm of U.S. imports. The exponent of that predicted value is taken in order to get the simulated amount of U.S. imports for each month. Those simulated values are shown in Table 5. The percentage change in simulated imports in the month prior to initiation and the month of initiation is calculated and reported as a decrease by 8.08%. That shows the trade destruction that occurs after initiated the AD duty on Taiwan.

The next part of the simulation focuses on all 27 non-named countries for this particular AD duty. The coefficients from column 3 of Table 4 are used in this simulation since it includes the weighted duty variable. Each separate countries variable values for the two month periods are multiplied by the corresponding coefficient. These multiplied values are summed for each separate country and then exponent for each of those summed values is taken. Then the exponent value for each non-named country is summed together to get the simulated imports for all non-named countries in each respective month. Those values are presented in Table 5 as well. The percentage change in simulated imports for non-named countries in the month prior to initiation and month of initiation is shown to be an increase of 4.56%.

<table>
<thead>
<tr>
<th>Country</th>
<th>Steel Product Code</th>
<th>Number of Countries</th>
<th>Simulated Imports Month Prior to Duty Initiation</th>
<th>Simulated Imports Month of Duty Initiation</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taiwan</td>
<td>7208.10</td>
<td>1</td>
<td>643</td>
<td>591</td>
<td>-8.08%</td>
</tr>
<tr>
<td>Non-named Countries</td>
<td>7208.10</td>
<td>27</td>
<td>34503</td>
<td>36078</td>
<td>+4.56%</td>
</tr>
</tbody>
</table>
Through this simulation example, we see that imports from the named country do decrease after initiating a duty. We also see the total amount of trade diversion, instead of changes in imports from just one non-named country. The simulation shows an increase in imports from non-named countries by 4.56% once the duty is initiated. This provides a better picture of how imports from all non-named countries of a specific duty change.

One more step that is taken is running the regression solely on Taiwan for this steel product code. After running the regression, the regression’s coefficients are used in the same way as the previous simulation. This is done to test the robustness of the simulation and regression. Table 6 shows the simulated imports from Taiwan for both months after using these new coefficients.

<p>| Table 6: Robustness Check Example of Duty Initiation Effect on Change in U.S. Imports |
|-----------------------------------|---------------------|------------------|------------------|------------------|</p>
<table>
<thead>
<tr>
<th>Country</th>
<th>Steel Product Code</th>
<th>Simulated Imports Month Prior to Duty Initiation</th>
<th>Simulated Imports Month of Duty Initiation</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taiwan</td>
<td>7208.10</td>
<td>1980</td>
<td>1918</td>
<td>-3.13%</td>
</tr>
</tbody>
</table>

The robustness check simulation also shows a decrease in U.S. imports from Taiwan. Table 6 shows that once the duty is initiated, imports decrease by 3.13%. This is less than what we saw in the previous simulation, but it is still showing the trade destruction effect that we were expecting would happen.

5. Conclusion and Extensions

The evidence presented in this paper shows how retaliatory tariffs can impact trade patterns differently based on whether or not a country is initiated/imposed with an antidumping duty. The imports from named countries are negatively effected by initiation of the retaliatory
tariffs and then decrease even further once the tariff is imposed, which is one of the goals of these tariffs. Trade diversion was also shown to take place, since imports from non-named countries increase once a duty is initiated/imposed. Malhotra, Rus, and Kassam (2008) found no significant amount of trade diversion in the U.S. agriculture sector when imposing antidumping duties, so the steel industry may have a higher elasticity of substitution than the agriculture industry, which allows for more trade diversion to take place.

These results may also be applicable to President Trump’s retaliatory tariffs. Those tariffs may have the intended impact on U.S. imports from named countries, which would help fight against foreign companies that are dumping. What needs to be taken into account, though, is the trade diversion from the retaliatory tariffs. The evidence presented in this paper shows that trade diversion does take place and that will leave U.S. firms in a not as favorable position as intended. Policy makers must understand that antidumping duties and other retaliatory tariffs can be effective at reducing named country imports, but other consequences can take place that reduce the effectiveness of these tariffs.

There are some extensions of this paper that could be explored further in future studies. Studies could focus on the countries/companies that are most commonly imposed with antidumping duties and see how the results change. Those countries have many companies that are dumping their product into the U.S. and specifically focusing on these foreign companies could help increase the understanding of the effectiveness of antidumping duties on the most accused companies. Other studies could also attempt to control for U.S. prices by using more precise measurement of each product. Studies could also attempt to see the impact of time after imposing a duty. It would be interesting to see if these effects continue in the long-run.
Lastly, there is the idea of a domino effect for U.S. imports related to expectations. If U.S. importers can have some type of expectation of which foreign companies/countries will be imposed with a duty in the near future, then it is possible that their import decisions could be impacted by those expectations. They may not import from a relatively cheap foreign exporter since they believe that it will be imposed with an antidumping duty soon, and instead they will import from another more expensive exporter that is not at risk of being imposed with an antidumping duty, according to their expectations. Being able to formulate a variable to account for those expectations could be an extension to this paper.
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