THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF SUPPLY CHAIN AND INFORMATION SYSTEMS

THE IMPACT OF 2018 STEEL AND ALUMINUM TARIFFS ON THE AMERICAN AUTOMOBILE INDUSTRY

HUNTER B. DAVEY
SPRING 2019

A thesis
submitted in partial fulfillment
of the requirements of
for a baccalaureate degree
in Chemical Engineering
with honors in Supply Chain and Information Systems

Reviewed and approved* by the following:

Robert A. Novack
Associate Professor of Supply Chain Management
Thesis Supervisor

John C. Spychalski
Professor Emeritus of Supply Chain Management
Reader

* Signatures acquired and on file in the Schreyer Honors College

ABSTRACT

The objective of this thesis will be to examine the automotive supply chain from procurement of raw materials to assembly, to determine the impacts of the March 23rd Section 232 steel and aluminum tariffs on auto makers and their suppliers, and to provide recommendations to auto makers on how to reduce costs and remain profitable.

The result of the Section 232 steel and aluminum tariffs was a significant increase in domestic production of both steel and aluminum, as well as a market-wide increase in the real prices of these raw materials. Due to the long lead time of steel and aluminum products, auto makers and their suppliers have not had the time to make a significant adjustment to their supply chains and avoid the tariffs. Instead, auto makers have instituted automobile price increases and elimination of low-profit lines in order to cut their losses as they struggle to find domestic suppliers of raw materials.

Recommendations to auto makers include continuing to modestly raise prices of automobiles and eliminate low-profit lines and invest in high profit lines, while considering more local sources of both domestically produced and recycled steel and aluminum.

TABLE OF CONTENTS

LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to thank my Mom and Dad for supporting me throughout my time at the Pennsylvania State University, as well as Doctor Novack for supervising this thesis and opening my eyes to the world of Supply Chain Management.

Chapter 1

Introduction

Without question, one of the most iconic symbols of the United States is the American automobile. From Ford's Model-T, the first car produced via assembly line, to popularized services such as the drive-in movie and drive through pickup window, there are few items more culturally representative of the United States than the American car.

During the early days of automobile production, the American car was just that – fully, truly, one hundred percent American. For example, Ford sourced domestically for all of the components of the car, notably wood, coal, and iron ore (used to make steel), and relied heavily upon a network of roads, rails, and shipping channels through the Great Lakes to acquire raw materials (Rubenstein, 1992). However, as time passed some countries were able to produce raw materials at a cheaper rate than the U.S. (known as a competitive advantage), and the need for international trade expanded. Throughout this period of increased international trade, the production of raw materials needed in automobiles gradually has slid from the United States to other countries, most notably Canada and Mexico.

Of the many components in a car, steel and aluminum are by and large the biggest portion of the vehicle, and among the least likely to be American. Steel makes up about fifty-five percent of the average car's weight, of which approximately thirty percent is imported (Worldsteel Association, 2018. International Trade Administration, 2019). Similarly, Aluminum makes up about ten percent of a car's weight, of which about ninety percent is imported (Ducker, 2017).

Recently, the United States government has made an effort to reinvigorate the steel and aluminum manufacturing industries in the United States, and make American cars truly "American-made," once again by imposing a duty, or tariff, on foreign steel and Aluminum. As of March 23rd, 2018, tariffs on these two products came into effect, which imposed a twenty-five percent duty on steel and a ten percent duty on aluminum from nearly every country in the world (Trump, 2018). These tariffs have caused a significant change in the automobile industry, and are sure to have impacts on international suppliers, automakers, and consumers. The purpose of this thesis is to investigate the impact of these steel and aluminum tariffs on the American auto industry.

Chapter 2

Methods

This paper will begin by providing background on the supply chain of automobiles in the United States, starting from raw materials and ending at the dealership. Next, it will seek to evaluate the short-term impact of the March 2018 steel and aluminum tariffs on the industry by the following methodology; by comparing the 2017 and 2018 steel and aluminum production in the United States from the International Trade Administration's Steel Imports report; by using data from the Department of Commerce to evaluate the sources from which the United States imports the most steel, aluminum, and finished automobile parts; and by determining the trends in price of steel and aluminum both domestically and internationally. Next, it will determine how automakers have reacted to these price increases by comparing imports from the top ten steel and aluminum importing counties before and after tariffs. Finally, it will analyze long-term trends in the market in order to present a list of recommendations to remain profitable to any of the "Big Three," American automobile manufacturers: General Motors (GM), Ford, and Fiat Chrysler. Secondary sources will be used.

Chapter 3

Overview of the Steel and Aluminum Supply Chain

There is an incredible amount of planning and coordination that goes into getting a car from raw materials to the dealership. The average automobile has over 30,000 different parts, many of which exchange hands upwards of five times on their way from raw materials such as steel and aluminum to the frame of a GM vehicle (Terrarosa, 2018). This section is dedicated to describing the various possible routes that automobile parts can take to their final location assembled as part of a vehicle in a dealership lot.

The raw materials for steel and aluminum come from the earth, in the form of iron ore and alumina, respectively (International Trade Administration, 2019). These materials are mined from the ground and refined in a series of steps to make them stronger, lighter, and longer lasting. Depending on the methods used to refine the materials, many forms of steel and aluminum are commercially available and used in automobiles, most of which are used to form the chassis, or frame of a vehicle, which makes up about sixty percent the car's total weight (D. W., 2017). Groups that undergo the initial refining process are known as tier three suppliers.

After these raw materials are mined and refined, they are shipped to a tier two supplier for primary manufacturing. This primary manufacturing will usually result in commodities such as nuts and bolts which may be used for either automotive or non-automotive purposes. Usually, raw materials coming from international sources will be shipped by ocean, and then motor carrier or rail to the final destination, whereas domestic raw materials will simply be shipped by motor carrier or rail from the site of production.

Next, these materials will be shipped by rail or motor carrier to a tier one supplier, who will put these pieces together to form automotive-grade hardware. These tier one suppliers are the ones that ship their products directly to Original Equipment Manufacturers such as General Motors. Usually, tier one suppliers will have a tight-knit relationship with one OEM in particular, but will often sell in lower quantities to other OEMs. For example, one tier-one company called American Axle and Manufacturing Holdings Inc. (AXL) makes axles, transmissions, and drive wheels for General Motors, their largest customer (O'Connor, T., 2016). However, they also make these same products for a number of companies, including GM, Ford, and Chrysler (O'Connor, T., 2016).

Following manufacturing, the fully-formed parts are brought to the OEM's assembly facility by trailer or rail, where they are assembled into a vehicle. The vehicle is assembled from the ground up, beginning with the chassis of the vehicle and ending with the body, doors, and paint (O'Connor, T., 2016). Robots will do the majority of the work, but typically workers will be responsible for performing the mate (bolting the chassis to the frame) and ensuring quality through a series of tests (O'Connor, T., 2016). Finally, after the car is completed, it is loaded onto an auto transport trailer, which brings the vehicles to the final destination, one of over 16,000 dealerships across the U.S. (NADA, 2018).

With over 30,000 parts per vehicle including every nut and bolt, it is easy to see how the supply chain for automobiles can become challenging to understand and manipulate. There are many factors to consider which may sway an OEM's decision to go with a particular tier-one supplier. For example, one factor to consider is the trade-off between the low cost of products from international suppliers (due to low labor costs or low overhead) and the transportation cost of international shipping. On top of the cost of shipping, a tariff established by the U.S. Department of Commerce may also be added to the cost of the finished part or raw material.

Another factor that companies need to consider when establishing their supply chain is the order cycle of materials at each step of the process. For the OEM, the order cycle for products delivered by the tier one supplier ready for assembly is typically between ninety and one-hundred twenty days, as products must go through each of the three tiers of manufacturing. This lends itself to a relatively inflexible supply chain, in which OEMs typically have to have a production schedule planned at a bare minimum between three and four months in advance, requiring a long time frame in order to change suppliers (Miller, M., 2018). This order cycle is a stark contrast to that of the dealership, which implements a pull inventory control system, and keeps very little extra inventory on hand, expecting new cars from the dealership on the lot within a matter of days. Due to this short lead time, the OEM must keep a significant amount of inventory on hand. Typically, auto manufacturers will keep approximately two months' worth of inventory to avoid stock outs, which is a trend that has stayed consistent since the 1960s (Dunn, W., and Vine, D., 2016).

To meet the demand for a wide variety of products, a large-scale manufacturer like Ford, GM, or Chrysler will typically have hundreds if not thousands of suppliers from different locations around the world. GM, for example, included a list of 489 tier one suppliers, only 147 of which resided in the United States (Terrarosa, T., 2018).

Some trends have emerged which establish a positive correlation between international content of vehicles and their price, broken down by market segment (Lovely, M, 2018). One study conducted by Peterson Institute for International Economics segments automobiles into three categories (compact cars, compact SUVs/crossovers, and luxury SUVs/crossovers) and compares the percentage of foreign material by a sales-weighted average of the five most popular models. Data acquired from analyzing the price and foreign content of popular car brands in the U.S. found that compact cars are made up of fifty-one percent foreign parts, and are purchased by families with a median household income of $74,387; compact SUVs/crossovers made up of fifty-six percent foreign parts, and are purchased by families with a median household income of $88,094; and luxury SUVs/crossovers are made of eight-four percent foreign parts, and are purchased by families with a median household income of $157,767 (Lovely, M, 2018). While this is certainly not a linear trend, it does appear to convey that the higher percentage of foreign content in the car, the greater the price will be.

Although many domestic auto manufacturers do source their parts from international partners, it is important to determine if this trend is out of necessity or logistics: that is, does the U.S. produce enough steel and aluminum to satisfy the demand of its U.S. auto manufacturers? And if not, which countries do the United States get their steel and steel products from?

According to the International Trade Administration, the United States was the world's largest steel importer in 2017, and imported more than twenty-five percent more than the next largest importer of steel (Germany) (International Trade Administration, 2019). The countries that provided the most steel to the U.S. were Canada, Brazil, and Mexico (International Trade Administration, 2019). In 2017, the United States produced approximately 81.6 million metric tons of steel, and imported over 30.8 million tons of steel, while only exporting 6.4 million metric tons, resulting in a steel trade deficit of 24.4 million metric tons (International Trade Administration, 2019). Clearly, in 2017 the United States did not produce enough steel to satisfy all of its industries, most notably construction companies and automakers (International Trade Administration, 2019). Similarly, according to the Economic Policy Institute, the U.S. also did not produce nearly enough aluminum to supply its industries. The U.S. consumed approximately 5.3 million tons of primary aluminum in 2016, of which nearly eighty percent was the result of importation from other countries, most notably Canada and China (Bray, 2018. U.S. Department of Commerce, 2018).

It is evident that the United States is dependent on foreign sources of steel and aluminum for more than fifty percent of the aggregate need, which is corroborated by the high percentage of foreign content (especially steel and aluminum) in American-made cars.

Because steel and aluminum are non-substitutable products, some officials in the United States government have expressed concern that in times of war and potentially unreliable trading partners, the United States should be able to produce a higher percentage of the steel and Aluminum needed for defense.

On April 20th, 2017, President Donald J. Trump ordered the Commerce Department to conduct an investigation on the global production of steel and aluminum, which was to conclude in no more than two-hundred seventy days. These reports were completed on January 11th, and January 22nd, 2018, respectively, and recommended a twenty-five percent increase in tariffs on steel imports, and at least seven percent increase in tariffs on all aluminum imports (U.S. Department of Commerce, 2018). After the reports were concluded and published, the President was given ninety days to make a decision on a possible course of action (U.S. Department of Commerce, 2018). Based on his past attitudes about American manufacturing, Donald Trump was favored to enact legislation following the recommendations of the Commerce Department.

On March 8th, 2018, the president issued two proclamations, which would put in motion the adjustment of duties on imports of steel and aluminum into the United States, in order to secure "the national security of the United States" (Trump, 2018). These two proclamations under section 232 of the Trade Expansion Act of 1962 imposed a twenty-five percent ad valorem tariff on steel articles and ten percent tariff on aluminum imported from most countries, effective on March 23rd of that same year, just fifteen days later (Trump, 2018). The next chapter will discuss the short-term impact of the Section 232 steel and aluminum tariffs on the American Auto industry, from customers to tier three suppliers and production, as well as analyze the short-term impact of these tariffs on the American automobile industry.

Chapter 4

Impact of Tariffs on American Auto Manufacturers

There were several changes that occurred in the year following the Section 232 tariffs on steel and aluminum, including an increase of domestic production of steel and aluminum, as well as price increase of both imported and domestic steel and aluminum. This price increase lead to decreased profit margins form Original Equipment Manufacturers (OEMs) like Ford, General Motors (G.M.) and Fiat-Chrysler. Further down the supply chain, tier one, tier two, and tier three manufacturers absorbed the rest of the costs not offset by the OEMs, which disproportionately impacted smaller firms operating on low margins, sending many toward bankruptcy. The industry has responded to these sudden price increases by importing more finished materials (not subject to tariffs), as well as reducing imports of steel while increasing imports of aluminum.

According to the U.S. Department of Commerce, each of the three main types of steel produced in the United States increased in price by almost one-third between March 2018 and June 2018. At this point, domestic prices reached an all-time high, which lasted throughout the summer. It was not until September 2018 that domestic steel prices began to fall, and when they did, they still remained above pre-tariff levels (Fuller, 2019). This is contrary to the prices to the largest international exporter of steel, China, whose prices remained relatively constant, and then dipped to below pre-tariff levels as U.S. prices fell in September 2018 (Fuller, 2019).

Figure 1. Average prices of steel, U.S. vs. China: April 2013 – Feb 2019

Similarly, domestic aluminum prices experienced a peak when tariffs were announced, then went through a several month period of high prices, and finally began to fall toward the end of 2018 (Aluminum Price Charts, 2019). The prices of Chinese aluminum (which are fairly representative of the competitive global market) also rose slightly, yet continued to undercut U.S. prices, resulting in an increase in aluminum imports in 2018. (Djukanovic, 2018).

Figure 2. Price of Aluminum, U.S. Jan 2014 - December 2018

In addition to price increases on domestic and international steel and aluminum, the level of production of these materials also increased both domestically and internationally. From 2017 to 2018, U.S. steel production increased approximately six percent, from 81.6 million tons to 86.6 million tons in 2018, just ahead of the world of average of about 4.5 percent (International Trade Administration, 2019). Similarly, Aluminum production increased significantly, from approximately one million tons in 2017 to 1.51 million tons in 2018 (Scott, 2018), an increase of sixty-seven percent, compared to the global aluminum production growth of only 1.5 percent (Home, 2019).

In order to compensate for the increased price of steel and aluminum, the Big Three auto manufacturers and their suppliers responded to the steel and aluminum tariffs by taking the following actions regarding steel and aluminum as raw materials: by importing less steel from international sources while relying more on domestic sources, as well as importing more aluminum from international sources and purchasing more aluminum from domestic sources.

In 2018, the United States imported 30.8 million metric tons of steel, an eleven percent decrease from 34.5 million tons in 2017 (International Trade Administration, 2019). Conversely, aluminum imports increased by 3.7 percent, (Workman, 2019), and aluminum automobile parts imports increased by 11.1 percent from 2017 to 2018 (Department of Commerce, 2018). These opposite impacts were likely a result of a lower tariff on aluminum than steel, and relatively more competitive prices for aluminum than steel in countries like China.

In addition to changing its importation and production of raw steel and aluminum, the U.S. auto industry suppliers also altered their levels of importation of finished automobile parts

(Department of Commerce, 2018). Using information provided by the U.S. Department of Commerce, Figures 3 and 4 were developed comparing the U.S. imports of automotive parts from the top ten sources in 2017 to those same countries in 2018.

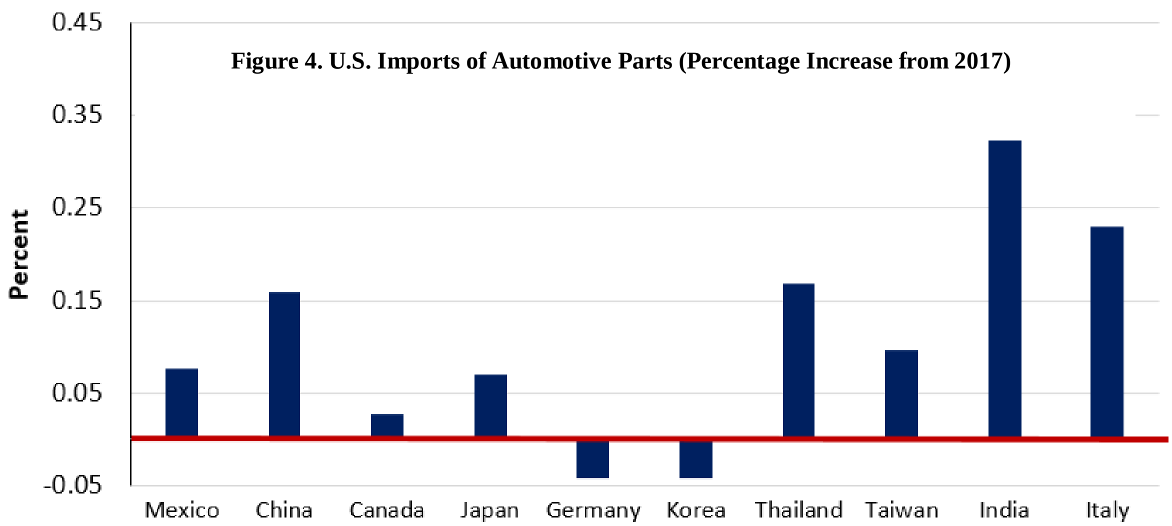


Figure 4. U.S. Imports of Automotive Parts (Percentage Increase from 2017)

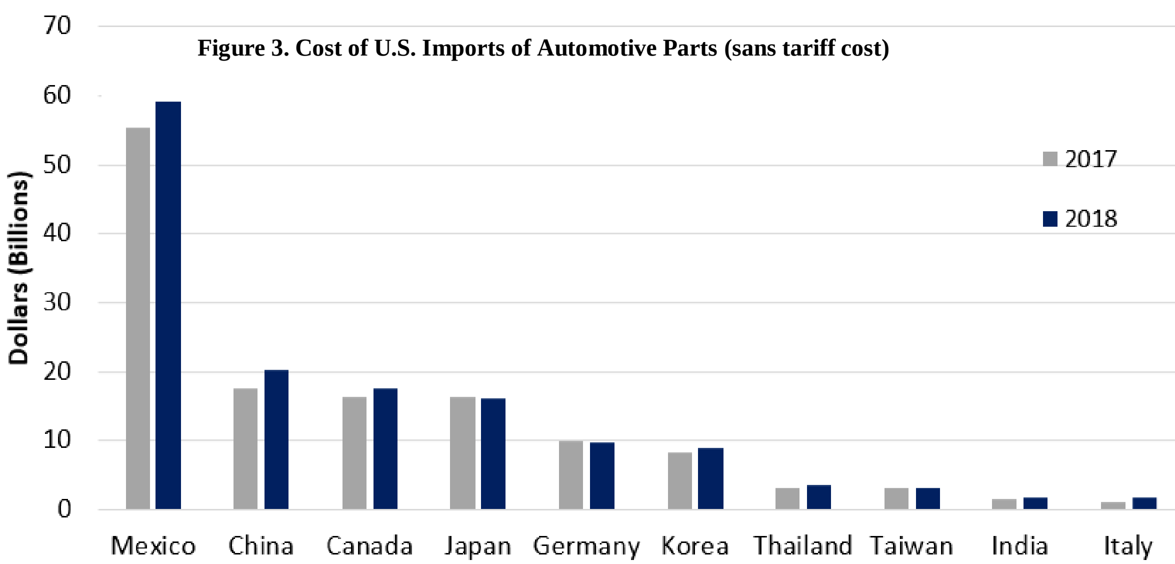
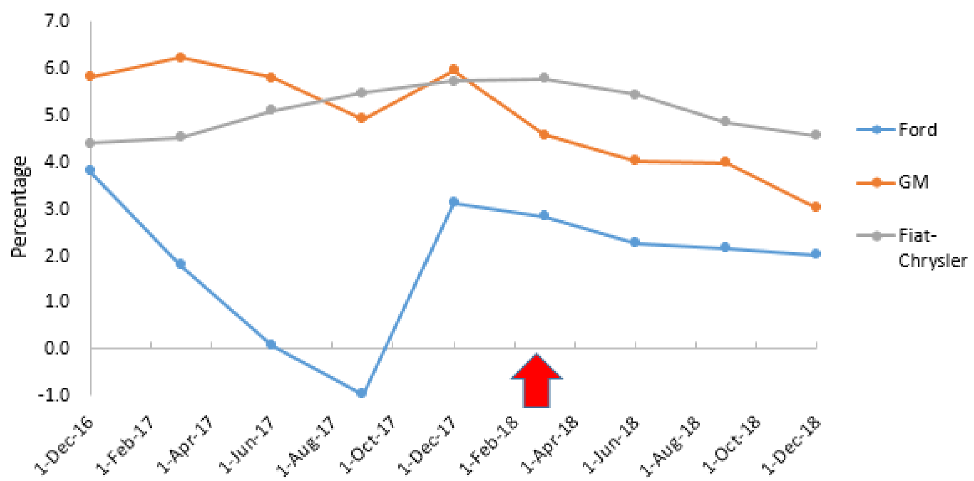


Figure 3. Cost of U.S. Imports of Automotive Parts (sans tariff cost)

One of the most notable changes in imports to note is the *influx* in foreign automotive parts (especially China, Canada and Mexico), rather than a decrease, as economic theory might predict. This influx is likely due to another set of policy changes that were announced in quick succession on September 17th, 2018, and November 30th, 2018. The first of these policy changes was an additional $200B in tariffs on Chinese products (fifty percent of which were auto parts), set to come into effect on January 1, 2019 (Brown, 2018). American suppliers noted that it would be more economical to over order from China, or keep safety stock on hand, rather than receive the normal order size and have to pay additional tariffs several months later. The second piece of legislation, known as the United States Mexico Canada Agreement (USMCA), exempted Mexico and Canada from the auto parts (not raw materials) tariffs, given that automobiles assembled in the U.S. be made of seventy five percent or more USMCA components by 2020 (Office of the U.S. Trade Representative, 2018). This resulted in U.S. automakers and their suppliers to begin developing Mexican and Canadian supply chains by purchasing more finished parts from the two countries.

This spike in both domestic and international cost of steel and aluminum, as well as global increases in production of these materials as a result of section 232 tariffs, had a number of significant effects on U.S. auto manufacturers. One result of the tariffs was a negative impact on each of the Big Three's operating margins, which compare profit per vehicle to variable costs of production, such as wages and raw materials. The operating margins of the Big Three auto manufacturers are shown below in Figure 5, ranging from December 31st, 2017 until December 31st, 2019 (Ford, G.M., Fiat Chrysler Operating Margin, 2018). The red arrow in the diagram points to March 23rd, 2018, when the tariffs went into effect. As depicted in Figure 5, each of the big three U.S. OEMs saw a negative impact on their operating margins, indicating a higher cost to produce each vehicle by between one and three percent (Ford, G.M., Fiat Chrysler Operating Margin, 2018).

Figure 5. Operating Margins of the Big Three U.S. Automakers



This drop in operating margins does not necessarily mean that the Big Three auto companies stopped making a profit. Rather, it means that these companies noticed a decreased *margin* of return from each vehicle. The vast majority of these new costs come from price changes from their tier one suppliers.

Generally speaking, OEMs have a high level of control over their suppliers, and suffer the least of all levels of the supply chain as a result of tariffs. Contracts between OEMs and tier one suppliers are the result of bidding between tier one suppliers and as a result are very one-sided, offering OEMs the right to terminate a contract at any time and for any reason, whether it be a price change or for no reason at all (White, 2007). Some contracts between OEMs and suppliers provide suppliers with short-term cancellation inconvenience payments. However, by no means is this the industry standard (White, 2007). Additionally, these contracts between

OEMs and suppliers often give OEMs the right to the intellectual property and tooling devices that a tier one supplier uses to manufacture the finished parts (White, 2007). This means that at the OEM's discretion, they may not only cancel a contract for a finished product on short notice, but also remove the equipment from the tier one supplier's manufacturing facilities. This combination of high competition between tier one suppliers and high risk and costs of cancellation deter most tier-one suppliers from negotiating higher prices with the OEM.

However, despite holding the power in the relationship, often times OEMs choose to absorb some of the added cost to maintain the relationship with their tier one supplier. There has been a trend in the last ten years of increasing the closeness of the relationship between the tier one supplier and the OEM, so much so that nearly seventy percent of tier one suppliers actually work on the design of the vehicle (Kapadia, 2018). Because of this developing closeness between OEM and tier one supplier as well as the economic interest of the OEM to keep the tier one supplier's business afloat, many OEMs will absorb some of the costs associated with raw material price increases, while passing the rest on to suppliers down the supply chain.

In the case of the Section 232 steel and aluminum tariffs, most auto makers absorbed some of the costs through increasing their prices as well as reducing their profit margins with the hope of future steel and aluminum price changes. Since March 2018, OEMs have increased the prices of their automobiles by an average of 4.2 percent, and seen their operating efficiencies become reduced by approximately two percent (Kelley Blue Book, 2019; Ford, G.M., Fiat Chrysler Operating Margin, 2018). While this was a significant change in cost for OEMs, much of the remaining costs of the tariffs were left to fall onto the tier one suppliers and others farther down the supply chain (Ford, G.M., Fiat Chrysler Operating Margin, 2018).

Despite being put under economic stress from OEMs, tier one suppliers did not absorb the majority of the costs of the tariffs. Rather, it was their suppliers (tier two) that were impacted most. Generally, tier one suppliers, being subject to the terms of OEMs, turn around and offer similar terms to other suppliers in lower tiers. While tier two suppliers have a bit more influence over the terms of their contracts than tier one suppliers (due to a greater number of potential customers), they were still subject to the short timeline imposed by the section 232 steel and aluminum tariffs. When the tariffs were announced, tier two suppliers were still locked into contracts with tier one suppliers and were contractually forced to keep providing the same services at the same costs. However, when costs increased due to tariffs, tier two suppliers ended up absorbing most of the costs associated with the tariffs.

The new higher costs associated with raw materials procurement were exacerbated in tier two suppliers by the fact that they already operate on slim profit margins. Tier two suppliers are generally local suppliers with older technology and fewer than one hundred employees, contrary to that of tier one suppliers, which are typically larger and have more advanced technology (Durden, 2019). These low profit margins, in coordination with lower-tier suppliers' unwillingness to negotiate prices, puts suppliers in difficult financial situations (Walsh, 2018).

In an effort to reduce the impact of these tariffs, tier two and three suppliers petitioned the U.S. Department of Commerce to grant exemptions on certain types of steel and aluminum. Due to the fact that some specialty steel and aluminum products are simply not produced commercially in the United States, the U.S. Department of Commerce released a form to be filled out for every type of steel and aluminum on which tariff exemptions were requested (McDaniel and Parks, 2019). In the time the tariffs went into legislation (March 25th 2018) until

December 20th, 2018, over 44,000 independent steel tariff exemption requests were filed, of which sixty eight percent were rejected. Similarly, over 6,000 aluminum requests were filed, of which eighty-four percent were rejected (McDaniel and Parks, 2019). By and large, the attempt of tier one and two suppliers to take advantage of exemptions failed, which lends itself to alternate long term solutions.

Regardless, each of the Big Three automakers (and their suppliers) have felt the pain from the section 232 steel and aluminum tariffs, most notably Ford and General Motors. Ford's CEO James Hacket said at a Bloomberg conference in New York that the tariffs took, "about $1 Billion in profits," from the company (Naughton, 2018). Additionally, G.M. has laid off approximately 7,000 employees, a reduction of four percent of its workforce as a result of closing assembly plants (Huston-Rough, 2018). While some may argue that this closure of assembly plants reflects American's shifting preference from sedan's to S.U.V.'s the timing of this reorganization effort is so close to that of the steel and aluminum tariffs that it is very likely inexorably related.

Fiat Chrysler, on the other hand, has managed to stay afloat and even exceed in these uncertain steel and aluminum markets. In 2018, the company hired 2,034 new employees, an increase of about one percent of its workforce, and increased its annual sales by 8.5 percent (Rosevear, 2019). Most experts attribute this success to increased presence in the S.U.V. market, and the high performing Jeep Wrangler and Cherokee models (Rosevear, 2019). However, in order to maximize their profits, Fiat Chrysler will need to adjust their supply chains to deal with variability in customer preferences.

In summary, the Section 232 steel and aluminum tariffs implemented on March 23rd, 2018 have significantly altered the supply chain of U.S. OEMs. These tariffs caused greater levels of domestic and global production of steel and aluminum, as well as higher prices of these materials both domestically and globally. United States steel manufacturers responded to these tariffs by producing more steel and aluminum, making these commodities more available domestically. In response, auto manufacturers and their suppliers increased their domestic consumption of steel and aluminum, while decreasing importation of steel, while simultaneously increasing importation of aluminum due to a temporary Chinese competitive advantage. Despite significantly altering their supply chains, OEMs and their tier two suppliers have suffered, resulting in decreased profit margins and job loss for two of the Big Three auto manufacturers. In the next chapter, the recommendations for American OEMs will be provided.

Chapter 5

Recommendations to the American Auto Manufacturer

As discussed in chapter 4, American auto manufacturers and their suppliers have already begun responding to changes in the steel and aluminum market due to Section 232 steel and aluminum tariffs. However, many of these changes were short-term solutions, and will not be effective long-term due to additional legislation, such as is scheduled to be ratified by the United States Mexico Canada Agreement (USMCA). This agreement imposes the conditions of the section 232 tariffs, but also imposes limiting quotas on countries such as Brazil, Argentina, and South Korea, who export finished and semi-finished steel products to the United States (USMCA, 2019). Operating under the assumption that this agreement (or a similar one for automotive tariffs) will be ratified, the following actions are recommended.

One recommendation for U.S. auto makers is to cut overhead as much as possible, and reduce or eliminate supply chains for car models that do not sell well, while boosting production and procurement of materials for popular models. In 2019, General Motors plans to close five plants that produced six popular models of vehicles, such as sedans like the Buick LaCrosse, Chevrolet Impala, and the Chevrolet Cruze, which each saw sales drop more than thirteen percent (Veldes,-Dapena, 2018). These savings of upwards of six billion dollars have been allocated to investing in more popular models such as the Chevrolet Equinox, which sold nearly 300,000 vehicles last year, an increase of twenty percent from 2018 (Tyler, 2018). If each of the Big Three auto manufacturers eliminated or reduced production of unpopular models and invested in the production of models on the rise such as S.U.V.'s, they would likely save billions.

Another strategy for U.S. auto makers is to influence their suppliers to adapt where and how they procure their raw materials, most notably to increase recycling of steel and aluminum. Approximately sixty-eight percent of the American steel market is using recycled steel, rather than mining or importing “virgin,” steel from iron ore (GLE Scrap Metal, 2018). However, about thirty percent of this new steel on the market is never recycled (GLE Scrap Metal, 2018). If auto manufacturers can influence their suppliers to put more effort into buying back recycled steel (and aluminum), they can avoid the brunt of the Section 232 tariffs.

A third recommendation to American auto manufacturers is to increase the percentage of finished and semi-finished products from Canada and Mexico. With section 232 Tariffs and USMCA, quotas have been imposed on several countries that import finished or semi-finished products (USMCA, 2019). However, USMCA eliminates those tariffs on Canadian and Mexican products (USMCA, 2019). Therefore, U.S. manufacturers should attempt to contact manufacturers in Canada and Mexico to compensate for the reduced parts they are able to import from Brazil, Argentina, and South Korea.

Finally, the last option (but one that will have to be employed) is raising prices modestly, and communicating these price changes with customers. Most people understand that steel and aluminum tariffs have come into effect, and that an increase in prices is to be expected, and indeed, already occurred in 2019 with a price increase of 4.2 percent from the year prior (Kelly Blue Book, 2019). However, the way that U.S. auto manufacturers go about informing customers is critical. Customer’s negative reactions to price increases are driven by two factors: the magnitude of the price increase and the perceived fairness of the motive of the price increase (Hornburg, 2005). If companies are clear about the reasoning for price increases, and include information about bringing American steel production back to the United States as well as supporting local industries, individuals will be much more likely to continue buying vehicles despite the increased price.

BIBLIOGRAPHY

5 Year Aluminum Prices and Price Charts. (2019, April 01). Retrieved from http://www.infomine.com/investment/metal-prices/aluminum/5-year/

Bray, E. L. (2017). *Mineral Industry Surveys: Aluminum*(Rep.). Reston, VA: National Minerals Information Survey.

Brown, C. P. (2018). Trump and China Formalize Tariffs on $260 Billion of Imports and Look Ahead to Next Phase. *Peterson Institute for International Economics*.

D. W. (2017). *Aluminum Content in North American Light Vehicles 2016 to 2028*(Rep.). Troy, MI.

Department of Commerce. (2018). U.S. Exports of Automotive Parts. Retrieved from https://www.trade.gov/td/otm/assets/auto/AP_Trade.pdf

Djukanovic, G. (2018, December 17). Aluminium: Year in Review and What to Expect in 2019. *Aluminum Insider*. Retrieved from https://aluminiuminsider.com/aluminium-year-in-review-and-what-to-expect-in-2019/

Dunn, Wendy E. and Daniel J. Vine (2016). “Why are Inventory-Sales Ratios at U.S. Auto Dealerships so High?,” Finance and Economics Discussion Series 2016-047. Washington: Board of Governors of the Federal Reserve System, http://dx.doi.org/10.17016/FEDS.2016.047.

Durden, O. (2019, January 31). Difference Between Tier 1 & Tier 2 Companies. Retrieved from https://smallbusiness.chron.com/difference-between-tier-1-tier-2-companies-25430.html

Fiat Chrysler Automobiles Profit Margin 2014-2018 | FCAU. (n.d.). Retrieved March 10, 2019, from https://www.macrotrends.net/stocks/charts/FCAU/fiat-chrysler-automobiles/profit-margins

Ford Motor Profit Margin 2006-2018 | F. (2019, March 10). Retrieved from https://www.macrotrends.net/stocks/charts/F/ford-motor/profit-margins

Fuller, B. (2019, March 21). Steel price Archives - Steel, Aluminum, Copper, Stainless, Rare Earth, Metal Prices, Forecasting. Retrieved from https://agmetalminer.com/tag/steel-price/

General Motors Operating Margin 2009-2018 | GM. (n.d.). Retrieved March 10, 2019, from https://www.macrotrends.net/stocks/charts/GM/general-motors/operating-margin

GLE Scrap Metal. (2018, November 14). Scrap Metal Recycling Outlook 2019 | GLE Scrap Metal Recycling. Retrieved from https://glescrap.com/scrap-metal-recycling-outlook-for-2019

Home, A. (2019, January 24). Global aluminium production growth brakes sharply in 2018. Retrieved from http://www.mining.com/web/global-aluminium-production-growth-brakes-sharply-2018/

Homburg, C. (2005). Customers Reactions to Price Increases: Do Customer Satisfaction and Perceived Motive Fairness Matter? *Journal of the Academy of Marketing Science,33*(1), 36-49. doi:10.1177/0092070304269953

Huston-Rough, J. (2018, November 26). General Motors Accelerates Transformation. Retrieved from https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2018/nov/1126-gm.html

International Trade Administration: *Steel Imports Report March 2019: United State* (pp. 1-8)

Kapadia, S. (2018, February 20). How the auto industry gave rise to the 'Tier 0.5' supplier. *SupplyChainDive*. Retrieved from https://www.supplychaindive.com/news/auto-industry-innovation-electric-autonomous-supplier-tier/517298/

Kelley Blue Book. (2019, January 3). Average New-Car Prices Up More Than 4 Percent Year-Over-Year for January 2019 on Tesla, Full-Size Trucks, According to Kelley Blue Book.

Lovely, M. E., Cohen-Setton, J., & Jun, E. (2018). Vehicular Assault: Proposed Auto Tariffs Will Hit American Car Buyers' Wallets. *Peterson Institute for International Economics*.

McDaniel, C. (2019, January 28). Growing Backlog, Inconsistent Rulings Cast Doubt over Tariff Exclusion Request Process. Retrieved from https://www.mercatus.org/bridge/commentary/growing-backlog-inconsistent-rulings-cast-doubt-over-tariff-exclusion-request

Miller, M. (2018). Auto parts suppliers already experiencing disruption from tariffs. Am*erican Journal of Transportation*,(676). Retrieved from https://www.ajot.com/premium/ajot-auto-parts-suppliers-already-experiencing-disruption-from-tariffs.

National Automobile Dealers Association. (2018). NADA Data. Retrieved from https://www.nada.org/WorkArea/DownloadAsset.aspx?id=21474855962

Naughton, K. (2018, September 26). Ford CEO Says Trump Metals Tariffs Took $1 Billion of Profit. *Bloomberg*.

O'Connor, T. (2016, January 02). American Axle and Manufacturing. Retrieved from http://www.manufacturing-today.com/sections/profiles/1587-american-axle-a-manufacturing

Office of the United States Trade Representitive. (2018, November 30). Agreement between the United States of America, the United Mexican States, and Canada Text. Retrieved from https://ustr.gov/trade-agreements/free-trade-agreements/united-states-mexico-canada-agreement/agreement-between

Panzino, C. (2019, January 16). Auto industry faces rising costs and tariff uncertainty in 2019. Retrieved from https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/49385890

Rosevear, J. (2019, January 03). How Fiat Chrysler Automobiles Pulled Off a Big Sales Gain in 2018. Retrieved from https://www.fool.com/investing/2019/01/03/how-fiat-chrysler-automobiles-pulled-off-a-big-sal.aspx

Rubenstein, J. M. (1992). *Changing u.s. auto industry: A geographical analysis*. Abingdon-on-Thames: Taylor & Francis.

Scott, R. E. (2018). Aluminum tariffs have led to a strong recovery in employment, production, and investment in primary aluminum and downstream industries. *Economic Policy Institute*.

Trump, D. J. (n.d.). Presidential Proclamation Adjusting Imports of Steel into the United States. Retrieved from https://www.whitehouse.gov/presidential-actions/presidential-proclamation-adjusting-imports-steel-united-states-6/

Terrarosa, T. (2018, March 2). Why GM's Claim to Use 90% U.S. Steel Might Not Hold Water. *TheStreet*.

The Aluminum Association. (2017, January 12). Primary Production. Retrieved from https://www.aluminum.org/industries/production/primary-production

Tyler, J. (2018, July 11). Americans are obsessed with SUVs — these are the ones everyone is buying. *Business Insider*.

U.S. Department of Commerce. (2018, March 08). Secretary Ross Releases Steel and Aluminum 232 Reports in Coordination with White House. Retrieved from https://www.commerce.gov/news/press-releases/2018/02/secretary-ross-releases-steel-and-aluminum-232-reports-coordination

U.S. Department of Commerce. (2018). *THE EFFECT OF IMPORTS OF STEEL ON THE NATIONAL SECURITY* (pp. 58-59, Rep.). Washington, D.C.: U.S. Department of Commerce. https://www.commerce.gov/sites/default/files/the_effect_of_imports_of_steel_on_the_national_security_-_with_redactions_-_20180111.pdf

U.S. Department of Commerce. (2018). *THE EFFECT OF IMPORTS OF ALUMINUM ON THE NATIONAL SECURITY* (pp. 107, Rep.). Washington, D.C.: U.S. Department of Commerce.

Valdes-Dapena, P. (2018, November 27). GM will no longer make these 6 cars. *CNN Business*.

Walsh, D. (2018, August 12). Suppliers look for ways around tariffs. *Crain's Detroit Business*. Retrieved from https://www.crainsdetroit.com/article/20180812/news/668316/suppliers-look-for-ways-around-tariffs

White, J. J., & Ben-Shahar, O. (2007). *Boilerplate and Economic Power in Auto Manufacturing Contracts*. Ann Arbor, Michigan: University of Michigan Law School.

Workman, D. (2019, March 15). US Aluminum Imports by Supplying Country. Retrieved from http://www.worldstopexports.com/us-aluminum-imports-by-supplying-country/

Worldsteel Association. (2018). Steel in Automotive. Retrieved from https://www.worldsteel.org/steel-by-topic/steel-markets/automotive.html

Academic Vita

Hunter Davey

(908) 902-2324
hbd5053@psu.edu
linkedin.com/in/hunterdavey

EDUCATION:

Bachelor of Science in Chemical Engineering
with **Honors** in **Supply Chain Management** — *Graduation: May 2019*
The Pennsylvania State University, University Park, PA
Schreyer Honors Scholar

WORK EXPERIENCE:

PepsiCo
Frito-Lay Supply Chain Intern — *Summer 2018*

- Collaborated with and influenced warehouse leaders to implement a policy change, reducing our warehouse's most common inbound accuracy error by 20% resulting in an annual savings of $78,000.
- Developed and implemented a new training program aimed at achieving higher performance, job satisfaction, and retention in warehouse hires.
- Shadowed Supply Chain Leaders to learn other aspects of the Frito-Lay supply chain such as manufacturing, packaging, and traffic.

Penn State Summer Translational Cardiovascular Science Institute
Fellow — *Summer 2017*

- Created and characterizing magnetic metallic nanoparticles for use in a new gene delivery system
- Developed heating profiles of nanoparticles using a Magnetherm™ radio frequency machine.
- Synthesized and characterized Malemide Diels Alder heat-sensitive linker molecule
- Created and presented a PowerPoint presentation of results to Penn State students and faculty.

Head Counselor for Age 10 Boys – Camp Coconuts, Middletown, NJ — *Summer 2016*
Swim Instructor – YMCA Camp Arrowhead, Marlboro, NJ — *Summers 2014, 2015*

SKILLS:

Software	Microsoft Excel Analytics – Advanced (i.e. LINEST), Microsoft Office, SolidWorks, HTML
Lab Skills	Nuclear Magnetic Resonance (NMR) imaging, UV-vis Spectroscopy, Fourier Transform Infrared Spectroscopy (FTIR), Polymerase Chain Reaction (PCR), Gel Electrophoresis

ORGANIZATIONS:

Penn State Lion Ambassadors
Selected Member — *Spring 2017 - Present*

- Lead campus tours for accepted students, alumni, and private guests of the University.
- Entertained guests, lead games, and served food at several campus-wide projects.

Committee Director — *Summer 2017 – Spring 2018*

- Lead the effort to recruit the next Class of Lion Ambassadors, resulting in the largest increase in the applicant pool within the past five years.
- Met with committee members on a weekly basis to organize four formal recruitment sessions, establish a weekly email service, and create and distribute marketing materials both digitally and in print.

Penn State THON – *Committee Member* — *Fall 2015 - Present*
Penn State Club Soccer League – *Central Midfielder* — *Fall 2015 – Present*