“To what extent does the US-China trade war detrimentally impact multifarious stakeholders of the semiconductor industry?”

By - Manya Khemka

Abstract

International relations between the US and China have always been tense. As early as the years after World War II, the US has been running a trade deficit with their biggest deficit being with China. The aforementioned combined with alleged security concerns regarding the operations of Chinese companies, led to the start of the US-China trade war with the Trump Administration making the first move in July 2018. Since then, the war has continued with restrictions worsening. Whilst all industries have been hit, the hardest hit is the semiconductor industry as many of the restrictions apply directly to it. In line with this, this research paper aimed to conduct a thorough analysis of the US-China trade war and uncover the manner in which the semiconductor industry has been impacted. The latter end of the paper presents an evaluation on how the restrictions and impacts to the semiconductor industry have affected its stakeholders - namely, but not limited to, the domestic American semiconductor manufacturers, the Chinese consumer electronics and telecommunication producers and some global players.

Key Words: USA, China, Trade War, Semiconductor Industry, Consumer Electronics, Telecommunication manufacturers

Introduction

Trade wars are economic conflicts between countries that lead to both countries imposing trade protectionist measures against one another. This trade protectionism comes in the form of trade barriers that could include tariffs, quotas, subsidies, currency devaluation and even embargos in extreme cases. The warring concept arises when one country imposes a trade barrier that is then countered with another trade barrier from the other country. One of the main reasons for a trade war to arise is when the government of a country believes that another country is engaging in what is considered to be unfair trading practices that are hurting the markets of the first country (CFI, 2023).

Whether trade wars are good or bad is something that has been debated greatly. However, the overall consensus is that whilst in the short term, trade protectionist measures can help a country's domestic industry, in the long term, retaliation against these measures by the other country will lead to adverse impacts on the economy, including slowing down economic growth and triggering inflation (Amadeo , 2022). A prime example of this in the real world was witnessed during the 1930 Smoot-Hawley Tariff that was implemented to support U.S farmers' recovery from the damages caused by the Dust Bowl but eventually led to the worsening of the Great Depression as a result of other countries retaliating with their own tariffs. It was estimated that this trade war caused a 65% reduction in international trade and contributed to the beginning of World War 2 (Leonard and Foster , 2017).

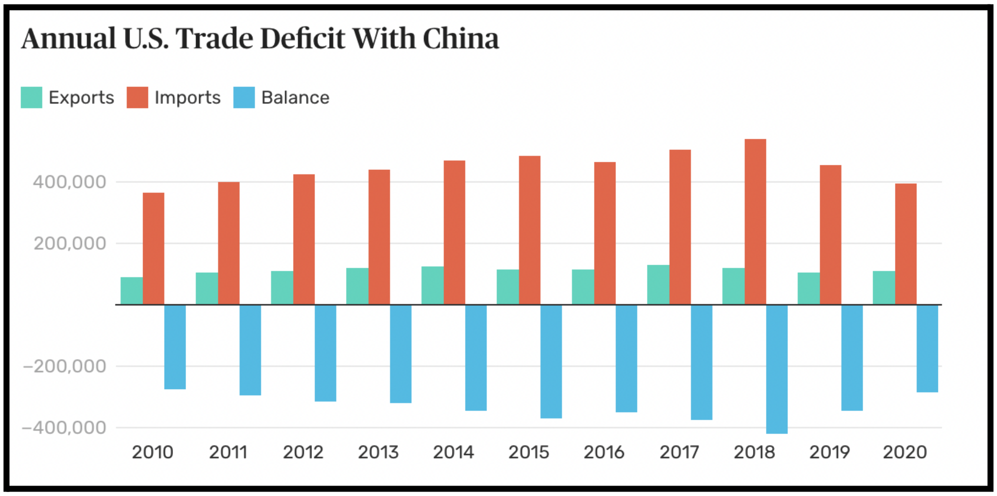
The severity of the long-term impacts of a trade war could also greatly depend on the countries engaging in the war. Taking a more recent and ongoing example, the US-China trade war is one of the most impactful given that both countries are considered to be in the top 2 biggest economies measured by gross domestic product (GDP) (Silver, 2022). Since its start in 2018 as a result of the Trump Administration placing tariffs on around US$34 billion worth of imports from China (Mullen, 2022), this trade war has only escalated and found itself having profound implications for several industries and stakeholders, globally. Looking more closely at the impacted industries, the semiconductor industry is recognized as one of the hardest hit with a great percentage of the US semiconductor industry's revenues having historically come from sales in China. The trade war, therefore, presents myriad challenges not only for the domestic companies operating in the American semiconductor industry but also for several Chinese consumer electronics and telecommunications companies that may have or are at risk of losing access to the tiny chips that power modern electronics. In line with the aforementioned, this research paper aims to answer the question **"To what extent does the US-China trade war detrimentally impact multifarious stakeholders of the semiconductor industry?"**

This research paper aims to conduct a thorough analysis on the US-China trade war and uncover how it is affecting the semiconductor industry. The latter part of the paper conducts a stakeholder evaluation to understand how companies operating in the semiconductor industry and other related industries that make use of semiconductors, including but not limited to consumer electronics and telecommunication equipment, are suffering greatly at the hands of the US-China trade war with implications extending beyond the stakeholders and economies of the two countries to the global domain.

The US-China trade deficit and trade war

The trade balance is represented as the difference between what a country exports and imports both as the aggregate across all trading partners and also within each of the bilateral trading relationships. A deficit occurs when the country in question imports more than it exports or in simpler terms a nation consumes more than it is able to produce (WITA, 2022). In the years post World War II era, the United States has been running a trade deficit. Since 2000, the deficit has been an average of $535 billion which is significantly higher than in previous decades (McBride and Chatzky, 2019). In the context of the US, many economists have suggested that the prime reason for the trade deficit is the low rate of domestic savings by the firms, households and governments relative to the investment needs of the country. To make up for this shortfall and to enjoy a higher rate of economic growth, Americans have had to repeatedly borrow from other countries that have excess savings. The aforementioned drives up the US consumption and demand for imports ultimately resulting in the trade deficit (WITA, 2022).

That being said, the largest trade imbalance that the US has had has been in its bilateral trade with China. As seen in the graph below, the deficit with China peaked in 2018 at $418.9 billion.



The reason that America's trade deficit with China has been so large, particularly with regard to manufactured goods, is that the latter has always been able to produce the majority of consumer goods at relatively lower costs (Amadeo, 2021). Porter's diamond framework - a framework that considers how related supporting industries, the government, factor conditions, demand conditions and firm strategy, structure, and rivalry give rise to a country's competitive advantage in a specific industry - can be used to further understand China's competitive advantage in manufacturing.

More specifically, in the category of *factor conditions (those factors that according to Porter, a country may create for themselves)*, China has always benefited greatly from low labour costs. Whilst several studies conclude that in the present year, China may not be deemed a low-cost labour country, when its labour costs are compared to those of the US, they are still drastically low. Furthermore, Porter's framework also looks closely at the role that the *government* plays in enabling the country's competitive advantage. Chinese companies have been suscept to much lower levels of compliance with international laws and regulations with many being notorious for making use of unethical practices such as child labour (Bajpai , 2022). The government also initiated the export tax rebate policy in 1985 as part of which Chinese exports gain a competitive advantage due to the abolishment of double taxation on exported goods - not only are many exported goods subject to zero value added tax (VAT) but a majority of consumers products from China are also exempt from any import taxes (a certain portion of the government's budget has been allocated towards enabling the aforementioned) (Li and Whalley, 2012). Since most rational consumers would prefer to pay the lowest price for the products they are purchasing, the competitive advantage of China has meant that the U.S. has always imported more from China than it has exported to the country. Moreover, even American businesses have commonly made use of Chinese labour to manufacture a range of products in their endeavours to reduce production costs.

Whilst some economists and experts argue that bilateral trade deficits are not bad but instead an indication of the growth of the U.S. economy and the increasing ability of Americans to be able to purchase foreign goods and services, many have also shown great concern regarding the detrimental impacts that this might have for the domestic economy. The deficit with China, particularly, has received substantial criticism as many believe that the country has made use of unfair practices including wage suppression, currency manipulation and government subsidies to boost their exports whilst blocking U.S. imports. For instance, research by C. Fred Bergsten and Joseph E. Gagnon (2017) blames China's "massive and sustained" currency manipulation from 2000 to 2010 for widening the trade deficit to historic levels. This currency manipulation was greatly enabled by China's policy of keeping its currency artificially undervalued against the U.S. dollar. As per some experts, the American economy has suffered even further in its relationship with China as a result of what Robert E. Lighthizer, U.S. Trade Representative, recognises as China's 'forced technology transfer - resulting from a requirement by the Chinese government for any foreign companies wanting to sell their products in the country to share their trade secrets (Congress, 2019). According to the report investigating Chinese economic policy, issued by the Office of the United States Trade Representative (USTR) in March 2018, the alleged technology transfer cost the US economy between $225 billion and $600 billion annually (Pham, 2018).

In light of the US's growing trade deficit with China and what may be deemed national security concerns over China's alleged access to American technology, Trump decided to initiate a trade war with the country in 2018 by placing several tariffs on their imports. In 2018, a total of three tariffs were placed on Chinese imports and almost each of these was met with some form of retaliation. For instance, the first measure was placed in July 2018 and represented a 25 percent tariff on about US$34 billion worth of imports from China, including cars, hard disks and aircraft parts (Lynch, Paquette and Rauhala, 2018). China then retaliated by imposing a 25 percent tariff on 545 goods originating from the US worth US$34 billion, including agricultural products, automobiles and aquatic products (Leng, 2018). Shortly after, in August, there was a 25 percent tariff imposed on another US$16 billion of Chinese goods including electrical machinery, railway products, iron and steel products etc. (Tan, 2018). Once again, China retaliated by applying a 25 percent tariff on US$16 billion of US goods such as Harley-Davidson motorcycles, orange juice and bourbon (Mullen, 2022). Another move in the trade war was witnessed in September of the same year when the US decided to place a further 10 percent tariff on US$200 billion of Chinese imports (Bloomberg, 2018). This too was met with a customs duty of 10% being placed by China on US$60 billion worth of American goods (BBC, 2018). Whilst in December 2018, the two governments agreed on a 90-day trade truce (Xin and Carter, 2018), the trade war only became increasingly dangerous post-May 2019 with many further increases to the tariffs, failed trade deals, the addition of several Chinese brands to the American entity list preventing US companies from selling to Chinese companies without approvals and China's retaliation in the form of their own creation of an unreliable entity list.

The semiconductor industry

So, where does the semiconductor industry, the prime focus of this research paper, come up in this trade war? Well, one of the triggering factors of this trade war was concern over the technology transfers from America to China. In order to analyse this, it is essential to understand what semiconductors are. Semiconductors, otherwise commonly referred to as integrated circuits (ICs), microelectronic chips or even computer chips are defined as tiny electronic devices that are composed of billions of components that make it possible to store move and process data (Panzeri, 2022). They are often attributed as the backbone of modern electronics with their varied uses across several types of products ranging from smartphones and digital cameras through to televisions and refrigerators. Furthermore, the use of semiconductors extends even further into products that find their roots in mechanical systems such as manufacturing equipment and those required in the production of modern automobiles. Whilst the explanation of semiconductors might sound simple, the semiconductor industry, on the other hand, is not as simple because the materials and equipment required in its production are complex and extremely varied. To understand the semiconductor supply chain better, the explanation by Calhoun (2021), professor at Stevens Institute of Technology, may be referred to. As part of the aforementioned, the first step in the creation of an IC is its design. This is followed by the process of fabrication that entails the design being converted into a physical product or more specifically a chip in this case. The next step in the supply chain is the assembly and packaging of this chip in a manner that it can be connected to the external environment and at the same time effectively protected from it. The fourth and final stage of the semiconductor supply chain deals with the production of the semiconductor manufacturing equipment as opposed to the semiconductor itself.

Historically, companies termed integrated device manufacturers (IDMs) would directly perform all stages of the creation of the ICs. However, as a result of a strong trend towards differentiation and specialisation, the world has seen IDM split into design companies and foundries. This implies that at today's date, most semiconductor companies would deal exclusively with a single segment of the supply chain. For instance, Fabless IC companies are design companies responsible for the development of software and intellectual property (Fernando, 2023); Foundries are manufacturing companies that perform contract manufacturing on the product designed by the Fabless IC companies (Bajpai, 2021); APT or assembly/packaging/testing firms package the IC into a chip which is suitable for incorporation into several tech products (Calhoun, 2021); equipment manufacturing companies stand entirely separate from the other segments.

The leading countries in the semiconductor global supply chain have consistently been recognised as the US, Taiwan, Japan and South Korea. More specifically, the US leads in advanced chip design and the production of semiconductor manufacturing equipment (SME), holding more than 40% market share in both areas. The Japanese SME industry is the second largest with the country’s companies holding 29% of the market share (Thadani and Allen, 2023). That being said, many wonder where China stands in the talks of the semiconductor industry. While the country has never been a leading player in any stage of the semiconductor supply chain, it is one of the biggest consumers of these devices as it is the main global producer of technological devices - all of which make use of these chips. However, in the endeavour to decrease the reliance of China on foreign suppliers of semiconductors, the "Guidelines for the Promotion and Development of the National Integrated Circuit Industry" was promulgated in 2014 and then integrated into the "Made in China 2025" plan of 2015 (Siddiqui, 2022). In order to achieve this goal, other than several investments made by the Chinese government, Chinese corporations were prompted to acquire technology and experts from foreign firms through a variety of means. The aforementioned was of great concern for the US as technology relating to the chips, in particular, could be of great application in the fields of supercomputers, artificial intelligence and military hardware. Therefore, as the trade war started and progressed, the US imposed more drastic measures to ensure that their national security was not being compromised at the hands of the Chinese.

As part of the aforementioned, one of the most significant moves that came from the US was witnessed in October 2022 when the country placed new export controls that blocked US companies and foreign companies using American equipment from selling any advanced semiconductors as well as the equipment used in their production to certain Chinese manufacturers unless a special license was obtained - one that was incredibly difficult to receive approval for. As per Alan Estevez, undersecretary at the US Commerce Department, this move was to ensure that the US was doing everything it could to prevent "sensitive technologies with military applications" from being acquired by China (BBC, 2022). As expected, China did not take this news well and demanded that the US stop treating Chinese firms unfairly. However, the US did not stop at this. Instead, in December 2022, the restrictions were expanded even further by restricting 36 additional Chinese chip makers from accessing US chip technology (Tewari and Josephs, 2022). This included Yangtze Memory Technologies Corporation (YMTC) - the largest contract chip maker in the world. Recognising that in order for the restrictions to be effective, it would be essential for the Netherlands and Japan, home to two of the biggest chip makers to be on board, the commerce department closely coordinated with its foreign allies. Towards the end of January 2023, it was announced that the United States has successfully secured a deal with the Netherlands and Japan to restrict exports of some advanced chip-making machinery to China.

Stakeholder evaluation - the impacts of the restrictions on the domestic and global stakeholders of the semiconductor industry and other related industries

These restrictions have previously had and continue to have drastic impacts on stakeholders in both the American and Chinese economies as well as in the global economy. On a domestic level, for instance, in late 2022, Apple was looking to work with YMTC - a Chinese semiconductor IDM - to source their 128-layer 3D NAND flash memory chips required for the iPhone 14. Apple was keen on pursuing this decision as YMTC's chips are government funded and reportedly at least 20% cheaper than those of its rivals. However, regardless of completing the lengthy process of certifying the company as one of its suppliers, the US's imposition of the restrictions against working with YMTC meant that Apple had to change course (Ting-Fang, Li and Yu, 2022). With the American multinational technology company working hard to find an alternative, the production of their latest version of the iPhone was slowed and resulted in consumers in many markets, including India, facing delays in receiving their pre-orders (Livemint, 2022).

Other American companies drastically impacted include Nvidia and AMD - companies making GPUs and selling large quantities to Chinese companies. Nvidia's Chief Executive, Jensen Huang, in a recent interview with Financial Times (Waters, Bradshaw and Murgia, 2023), stated that there is "enormous damage" to US companies if the chip war with China escalates any further. He further highlighted how there is only one China and the loss of the Chinese market would cause the company's capacity needs to fall by a third. In light of this, he has emphasized the need for U.S. policymakers to be more cautious in their policies as he believes that these restrictions are only likely to further China's agenda to amp up their domestic chip production and become potential market leaders.

Shifting the focus to the impacts on the Chinese stakeholders, with the restrictions placed on several US and foreign firms engaged in the semiconductor supply chain, several Chinese tech vendors including the likes of Alibaba, Baidu and Huawei will face a hurdle in the form of having to source the advanced chips to run their artificial intelligence workloads from alternative sources. This was highlighted by the research director for thematic intelligence at analytics and consulting company GlobalData, Josep Bori, who stated that “They (the Chinese companies) won’t be able to buy them (the chips) from Nvidia or AMD any longer, and Chinese AI chip vendors like HiSilicon, Cambricon, Horizon Robotics or Biren Technology will not be able to manufacture their own AI chips because foundries like Taiwan Semiconductor Manufacturing Company (TSMC) are also obeying the US ban and the Chinese foundries (mainly SMIC) are not yet capable of manufacturing anything smaller than 14 nanometers" (Aggarwal, 2022).

On a global scale, the trade restrictions are likely to cause other long-term changes in global manufacturing and trade. Pareekh Jain, CEO of Pareekh Consulting, notes that “these sanctions will encourage more manufacturing investment in the production of phones, cars, electronics, other white goods, machines, telecom equipment, etc., outside China including India, Vietnam, and other countries” (Aggarwal, 2022). Taking the example of India specifically, since 2020, several companies including Cisco and Apple have shifted their manufacturing to the country as a result of the prosperous local market as well as the ongoing supply chain disruptions in China. That being said, the chip restrictions, arising from the US-China trade war, are likely to act as additional incentives for companies in the consumer electronics and telecommunications business to amp up their manufacturing capabilities in India - presenting great developmental and economic opportunities for a developing country like India.

All that being considered, China and several of the country’s companies are not backing off in their efforts to pursue independence in light of the restricted access to high-end technologies. For instance, Huawei has doubled its smartphone chip development since being put on the export blacklist over national security concerns by the US in 2019. Furthermore, the Chinese market has seen a large influx of domestic semiconductor start-ups all of which are gaining access to large investments from government-guided funds as well as venture capitalists (Liao, 2022). Other than the increasing strength of the domestic industry, China has also recently, still part of the trade war, placed curbs on the exports of geranium and gallium, two of the niche metals that are used in the manufacturing of semiconductors and electronics (Chauhan , 2023). As per the country’s commerce ministry, these export controls will come into play on August 1st in a bid “to protect national security and interests” whereby exporters of these raw materials will need to apply for “special permission from the state” to ship them out the country (Ziady and Xu, 2023). With this representing another form of retaliation from China in the ongoing chip war, the future of the semiconductor industry and its supply chain remain uncertain. However, what is certain is that the back and forth between the US and China has had and is likely to continue to have impacts on the domestic companies and customers with far reaching effects on global stakeholders as well.

Conclusion

The US-China trade started in 2018 and since then, there have been several developments in the restrictions both countries have placed on one another. In some instances, the USA has also gone as far to place restrictions on other countries, preventing them from dealing with Chinese companies. At the center of this trade war lies the semiconductor industry - an industry which is complex but provides the technology that drives modern electronics and telecommunication technologies. This research paper aimed to provide an insight into how the impacts of the trade war on the semiconductor industry have translated to the American semiconductor manufacturers, Chinese consumer electronics and telecommunication technology producers as well as some stakeholders in the global economy.

As mentioned in the paper, America is one of the top players in the semiconductor industry , holding the greatest market share in not only the design but also semiconductor manufacturing equipment market. China, on the other hand, is not a prominent player in the manufacturing of semiconductors but instead is the largest consumer of semiconductors being a big producer of consumer electronics and other products which require such chips. The restrictions which have been placed on the use of American produced semiconductors and semiconductor technology by Chinese companies has far reaching impacts. Firstly, it represents a large loss to American semiconductor manufacturers who once used to generate a large chunk of their revenue, if not the majority of it, by supplying to Chinese companies. Secondly, Chinese stakeholders who have been using these chips for years have been left to look for alternatives from manufacturers that are able to and not restricted to supply to them. Consequently, there has been an uprising in the number of domestic Chinese semiconductor manufacturers and the aim is for such companies to start providing the Chinese consumer electronics and telecommunication technology producers with the chips so reliance on any foreign markets are minimized. Lastly, with the US and China being such large economies, the impacts in their domestic markets inevitably find a way into the global domain. These impacts are both negative and positive - whilst some consumers have had to suffer delays in consumer electronic production due to companies like Apple seeking production alternatives, developing countries like India are set to benefit from the manufacturing shifts that are expected to come from the restrictions being placed on chip production and supply in the US and China.

Overall, considering the above, it can be concluded that the US-China trade war detrimentally impacts the several stakeholders of the semiconductor industry to a somewhat great extent. Whilst this war may lead to some beneficial impacts in the long run, the short run is expected to be filled with hurdles that the stakeholders will have to overcome.

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