Security or Supremacy? The Logic of the US-China Technology Competition

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Abstract

Technology enhances a state's national power, especially economic and military power, driving the pursuit of technology power. Semiconductor plays a crucial role in modern technology, which enhances technology power. Therefore, states look to dominate or play a part in its production. The US-China technology is an instance of a quest to dominate technology power, especially in semiconductors. Using the US-China technology competition, this article explores why states seek technology power and engage in a technology competition. This study explores the topic by studying various policies implemented by the US and China, especially the Made in China 2025 and the US CHIPS and Science Act. It is hypothesized that states seek technological supremacy to keep or obtain their status as a great power. Further, China's growing ability in technological manufacturing undermined US's technological leadership and security, leading to the technology competition. The preliminary findings are as follows: First, China is overtaking the US gradually in the semiconductor supply chain. Second, due to the structural changes in the semiconductor supply chain, the US engages in a technology competition with China. Third, technological supremacy is crucial for security and global leadership; therefore, the US and China compete to gain an advantage in the semiconductor supply chain. This study hopes to deepen the understanding of technology on national power and great power competition.

Keywords: Technology Power, Semiconductor, Neorealism, US-China Technology Competition.

Introduction

Technology plays a significant role in enhancing national power. A state that controls leading technology has a hegemonic potential. Most literature highlighted the importance of technology for improving national power, especially for military power and economic capabilities. However, technological power is underappreciated due to continuous technological evolution and lack of clear definition, making measurement of technology power challenging. Therefore, there is a need for a deeper understanding of technological power, especially when the US and China are engaged in a technology competition.

The US-China technology competition piqued the interest of international relations scholars to delve into technology power. China enjoyed strong economic growth after it opened its market to foreign access. The strong economic growth allowed China to set up its indigenous technology companies and modernize the People's Liberation Army. Further, since Xi Jinping implemented the Made in China 2025 policy, China has become a leader in supercomputing and artificial intelligence, threatening US's technological leadership. In response, Donald Trump started a trade war against China, although the main target is trade disparity. The US-China technology competition intensified after Joe Biden took office, implementing the CHIPS and Science Act to restore US technological leadership and constrain China's technological growth.

This paper explores the rationale of the US-China technological competition using semiconductors as a case study. Most studies focused on the competition in cyberspace, artificial intelligence (AI), or the fifth-generation telecommunication network (5G). However, semiconductors are the backbone of these modern technologies, it is crucial for a great power to control semiconductor production. Therefore, states that want to improve or keep their technology power must control the key chokepoints of the semiconductor production chain. It also illustrates the case of the current US-China technology war.

With the competition over semiconductor supply as a background, this paper looks to explore the rationale of the US-China competition using neorealism as a research framework. The core research question is: Why do US and China compete over technology power? The author posits that internal and external threats in the technology sector drive the US-China technology competition. Based on the structural distribution of technological power, the US competes with China over the dominance of the semiconductor chain after realizing the latter is catching up quickly. Second, internal and external threats endangered the semiconductor supply chain, damaging the US and

China's technological power. Therefore, the US and China look to reinforce their control over semiconductor production. Further, the author would like to explore how the US and China reinforce their control over the semiconductor chain. The author expects that the US and China will use both coercive and alliance means to secure their semiconductor industry.

This paper proceeds as follows. First, the author conducts a literature review on technology and great power competition. Second, the author justifies using semiconductors as a case study in the US-China great power competition and explores the background of the US-China technology competition. Third, the author examines the means the US and China employ to control the semiconductor supply chain before concluding the paper.

Technology Power and Great Power Competition

A general definition of technology is the application of scientific knowledge into practical utilization in human life and change in their environment (Britannica 2022, 68). As a component of national power, technology is a country's ability to produce the most sophisticated "critical technologies" identified today and the capability to create new inventions (Tellis et al. 2000, 53-54). Another characteristic of technology is its disruptive nature which can make previous inventions or innovations obsolete (Diesen 2021). State actors have the motive to improve their technology capability because it will amplify other elements of national power and even change the international order.

Technology allows a state to reform the international order, specifically assuming leadership in the economic order. Modelski and Thompson's long cycle theory theorized that a state controlling the leading sector or technology would resume global leadership (Modelski and Thompson 1996). Various pieces of literature found that growth in the leading sector or technology propels a leading state's economic growth, guiding global economic growth and changing the global division of labor (Reuveny and Thompson 2001, 707-708; Weiss 2005; Hahn 2020, 2-3; Tellis et al. 2000, 40-41; Drezner 2019, 286-303; Wu 2020, 103-108). Further, great power or hegemon will lose its global influence once it loses the monopoly over leading technology (Reuveny and Thompson 2001, 709; Drezner 2001, 24). Therefore, states wishing to pursue great power or hegemonic status must achieve technological dominance.

However, economic prowess alone is not enough to guarantee a state's great power status. A state must be able to translate its technological advantage and economic power into effective military power. Great power must also maintain superiority in technology, economic, and military capabilities because, in the end, military power is the final

arbiter in a great power war (Tellis et al. 2000, 41-42; Knorr 1975). States have the motive to develop technologies for military and defense. Innovative technologies can improve a state's offense and defense capabilities to gain the upper hand over its adversaries (Caverley 2007; Geis and Hailes 2016; Talmadge 2019). In fact, governments incentivized the public sector to secure or create critical technologies to modernize the state's military (Miller 2022; Schreiber 2022). However, military power growth will result in a security dilemma, causing other states to seek technological growth to improve their security as well.

Drezner gave a rationalist account of the effects of technological change on world politics. Technology can be classified into prestige technology, strategic technology, public technology, and general-purpose technology (Drezner 2019, 292). Each classification has high or low fixed costs, is dominated by the public or private sectors, and has a different degree of diffusion (Drezner 2019, 292-293). Drezner compares how technology changes world politics (power, interest, and norms) using nuclear weapons (prestige technology with a high fixed cost, public sector dominance, and low diffusion rate) and the internet (general purpose technology with low fixed costs, private sector dominance, and high diffusion rate) as examples. Drezner concludes that general prestige technology has a greater leveling effect than prestige tech, states prefer to cooperate to limit the proliferation of destructive prestige tech, and prestige technology creates norms that are self-reinforcing over time (2019, 300).

Given the importance of technology in enhancing national power, states will compete for technological power. The US-China technology competition is not the first instance of technology competition. During the Cold War, the US and Soviet Union have a space and arms race to prove their technological superiority. In the 1980s, the US competes with Japan over the dominance of semiconductor production. The US once again finds itself in a technology competition, with China as its main rival. This section aims to understand the logic of technology competition or the race to dominate technology power from the neorealist lens.

The basic tenets of neorealism are that the world lacks an ordering principle, all actors have some offensive military capability, states are skeptical of the intentions of other actors, survival is the ultimate goal for a state, and therefore, states will do everything to ensure their survival in the international system. Neorealism is further divided into the branches of defensive realism and offensive realism as their survival strategy. The former increases its capability to maintain its status quo, while the latter seeks power maximization to achieve hegemony as it is the best way to survive (Waltz 2010; Mearsheimer 2003). However, when actors increase their power, they will create

a security dilemma due to mistrust of each other, resulting in a balance of power.

Most studies approached the question of technology and great power competition from the perspective of security (Eriksson and Giacomello 2016; Schmidt 2022; Schreiber 2022; Akdag 2018; Diesen 2021; Wu 2020). In particular, Schreiber (2022) examined Russia-US competition in space technology, Wu (2020) studied the US-China technology competition during the Trump administration, and Schmidt (2022) explored great power competition in the AI realm. Further, there are other studies that explore competition in military technologies through the lens of balance of power. These are the instances of exploring technology competition from the perspective of a neorealist. There are also studies that use theories contending to neorealism. Akdag (2018) uses the power transition theory to justify the lack of cyber war between the US and China despite the latter being unsatisfied with its status in the cyber realm. Rovner and Moore (2017) applied the hegemonic stability theory to explore whether the cyber realm needs the US as a leader.

In sum, a state's technological power lies in its ability to control the output of leading innovation. A state can generate technology power through innovation capacity, manufacturing capability, or both. Technology is crucial for the economic growth and military growth of a state. A state that dominates leading technology also has a hegemonic potential and can dictate the international order, which becomes a cause for technology competition. There are many leading technologies in the fourth industrial revolution, with an emphasis on 5th-generation telecommunication networks (5G) and artificial intelligence (AI). Although the first semiconductors were invented in the 1950s, it was constantly improvised until they reached a dimension of 2 nanometers currently. Semiconductors are the backbone of these leading technologies because they need high computational power. The smaller the size of the chip, the more computing task it can perform. Therefore, this paper will focus on the great power competition in the semiconductor industry using neorealism.

The Battle over Semiconductor

The US-China technology competition mainly revolves around the domination of the semiconductor supply chain. This section aims to unravel the importance of the semiconductor supply chain, then explore the US-China technology competition briefly to understand the threats that they face before looking into the structural changes in the semiconductor supply chain.

The Semiconductor Supply Chain in Brief

The semiconductor supply chain is extraordinarily complex and diversified. Figure 1 depicts the main actors and their roles in the semiconductor supply chain. The US specializes in chip designing and production automation of advanced processors, sensors, and other logic chips, putting them at the top of the production chain. China specializes in the fabrication of mature logic chips (10 nanometers and above) and back-end manufacturing (assembly and testing). Like China, Taiwan specializes in fabrication and back-end manufacturing, but it also specializes in fabricating advanced logic advanced chips (less than 10 nanometers). Currently, there is no country that has an end-to-end capacity for semiconductor design and manufacturing (Bauer et al. 2020).

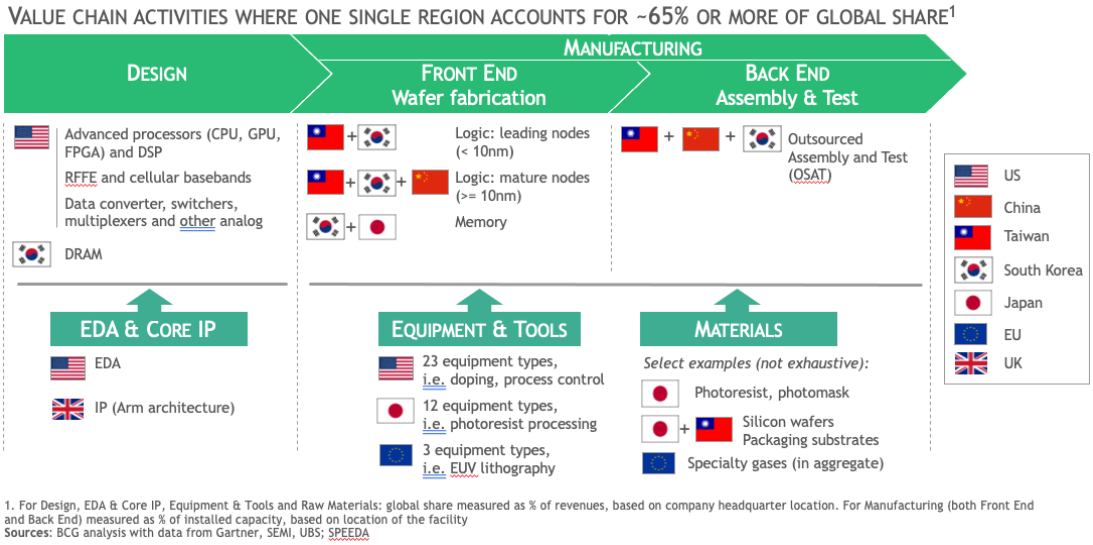

Figure 1: Geographical Depiction of Semiconductor Supply Chain. Source: "Strengthening the Global Semiconductor Supply Chain in An Uncertain Era," Semiconductor Industry Association, April 2021, accessed May 10, 2023, https://www.semiconductors.org/strengthening-the-global-semiconductor-supply-chain-in-an-uncertain-era/.

The US dominated the semiconductor supply chain in the 1990s but gradually shifted its production to East Asia due to lower labor and production costs (Whalen 2021; Miller 2022). Further, although it is costly, the Taiwanese and Chinese governments are willing to subsidize private companies to maintain chip production in their country (Whalen 2021). Since modern equipment, from smartphones to satellites, continuously generate demand for more semiconductors, governments are incentivized to expand semiconductor foundries.

Although semiconductors can be found in various electronic appliances, its industry is considered a strategic tech. Private company dominates the semiconductor supply chain, but it requires large investment to build a fabrication plant, especially for advanced chips. Therefore, state actors will intervene to support their local companies

and reduce reliance on foreign technologies (Drezner 2019).

Many countries, including the US, hope to build or improve their semiconductor production facilities, but it is daunting. First, investing in the semiconductor business is risky because it requires extensive R&D programs, large investments, and tight operation controls to produce high-quality chips (Bauer et al. 2020). Second, only a small number of companies produce photolithographic machines to produce semiconductors, and only ASML from the Netherlands manufactures the machinery for advanced semiconductors (O'Grady and Kenyon 2023). Third, the production of modern chips involve hundreds or even thousands of steps to produce and require raw materials with high purity (Mochizuki and Furukawa 2023; Hope 2023). Given its complexity, chip design companies prefer to rely on established foundries, such as Taiwan Semiconductor Manufacturing Company (TSMC) or South Korea's SK Hynix and Samsung, to produce their products.

Unraveling the US-China Technology Competition

Most experts agree that Made in China 2025 (MIC2025), which was announced by the Beijing government in 2015, started the US-China technology competition. The MIC2025 blueprint aims to transform China into a high-tech manufacturing superpower (McBride and Chatzky 2019). The ulterior motive of the MIC2025 is to reduce China's dependence on foreign technology and promote the use of Chinese-made technologies worldwide (McBride and Chatzky 2019). As of 2020, China still depends on foreign sources for semiconductors but has replaced the US as one of the top semiconductor exporters.

China has an advantage in manufacturing technological products. While China still relies on the West on advanced production equipment, China made rapid growth in the production of advanced machine tools, electronic products, and telecommunication infrastructure (Wang 2023; Lee 2020; Ghiasy and Krishnamurthy 2021). Further, China is leading in the production of solar panels and large-capacity batteries for green vehicles (Wang 2023). China obtained its manufacturing power through heavy government subsidies and vast labor experience from Western companies that offshored their production (Wang 2023, 70-73). China's manufacturing power allows it to optimize and coordinate all steps of innovation process (Allen 2023) from its labor experience (Wang 2023), which contributes to its innovative capability. Although the process is slow, the Chinese government is dedicated in improving its research and manufacturing capabilities.

The US dominates the world with innovative power: the capability to invent, adopt,

and adapt new technologies (Schmidt 2023). The ability to innovate faster and better gives a state an upper hand in enhancing its military and economic hard power. It also enhances a state's global appeal due to success in the research and development of leading technologies (Schmidt 2023). Although the US is still in the lead in innovation power, China is gradually catching up in artificial intelligence (AI) and quantum computing.

Donald Trump declared a trade war against China and ordered an investigation into China's unfair trade practices following his ascension as the 45th president of the United States. Although Trump targeted overall trade imbalances as his primary concern, the United States Trade Representative Section 301 found that China targeted forced technology transfer and intellectual property theft which undermined US's technology sector (Rogin 2018). Consequently, the US government imposed additional tariffs on Chinese products and restricted US foreign investments in China as defensive measures (Rogin 2018).

There are a few incidents that intensified the US-China technology competition. First, the US government found out about Chinese telecommunication companies ZTE and Huawei secretly supplied Iran with telecommunication equipment (Shepardson 2019). Further, ZTE and Huawei products pose espionage threats to the US government and businesses (Demarais 2022). Finally, the COVID-19 pandemic greatly disrupted the semiconductor supply chain, causing shortages of technological goods worldwide (Simchi-Levi, Zhu, and Loy 2022).

President Joe Biden introduced the CHIPS and Science Act to address the above concerns. The act aims to reinforce the US semiconductor industry, bolster the semiconductor supply chain resilience, and counter Chinese threats (Antsey 2022; Simchi-Levi, Zhu, and Loy 2022). Rubbing salt to the Chinese wound, Biden implemented export control measures to limit China's access to advanced semiconductor and chipmaking equipment (Iyengar 2022). The US proposed an alliance with Taiwan, Japan, and South Korea to strengthen the semiconductor supply chain after serious disruption caused by the COVID-19 pandemic (Blanchard 2023).

In short, the following causes the intensified state of the US-China technology war. First, China aims to achieve technology self-sufficiency and increase the dependence of other countries on Chinese technology. Second, Chinese technology's proliferation ability undermines US technological leadership. Third, Chinese technologies pose a national security threat to the US and its close allies. Fourth, the US seeks to protect its high-technology industry from further deterioration. Fifth, the US hopes to avoid another semiconductor supply disruption due to major international incidents such as a

pandemic.

Structural Changes in Semiconductor Supply Chain

China has a strong ambition in controlling the technology supply chain, especially in semiconductor production. The US, understanding China's ambitions, look to control its rise. However, it is important to understand the current trend that leads to the US-China technological competition.

In terms of innovative capability, the US still has the edge over China. The author used the research and development (R&D) percentage of annual GDP and the number of patent applications. The R&D percentage of annual GDP shows the incentives put in by governments to improve their innovation capacity. Patents are the exclusive rights of an innovation that can be disseminated for further improvements. When combined, they are a rough indicator of how much innovation power a country has.

From Figure 2, although China's investment in R&D increases yearly, its magnitude is smaller compared to the US. Therefore, the US still invests more in research development compared to China. Further, since 2018, both the US and China have poured more resources into research and development, but the US surpassed 3% of its GDP, while China is still below 2.5%.

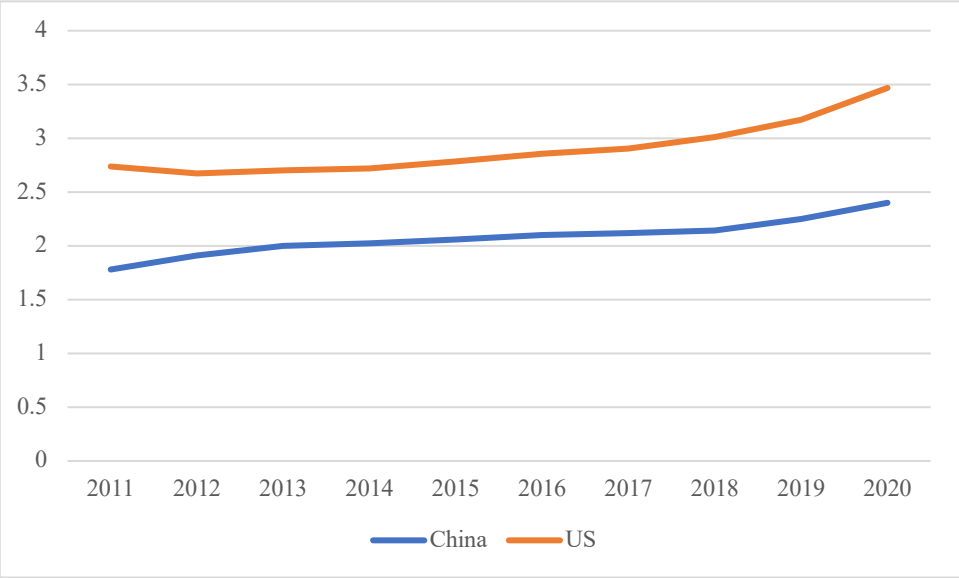

Figure 2: Research and Development Budget percentage of GDP. Source: Author's own elaboration.[1]

However, the remaining metrics gives a clear picture of Chinese threat to the US

[1] The author obtained the data from OECD Stats, https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm#indicator-chart, except for China in 2019 and 2020, which is obtained from Trading Economics, https://tradingeconomics.com/china/research-and-development-expenditure-percent-of-gdp-wb-data.html.

technological leadership. In terms of semiconductor patent applications, the US has a clear lead over China before 2015 but was surpassed from 2016 onwards. Further, US's patents in semiconductors constantly fluctuated in between 13,000 and 15,000 but China has seen constant growth, especially from 2017 onwards. In 2020 and 2021, China's patent application for semiconductors is double of the US.

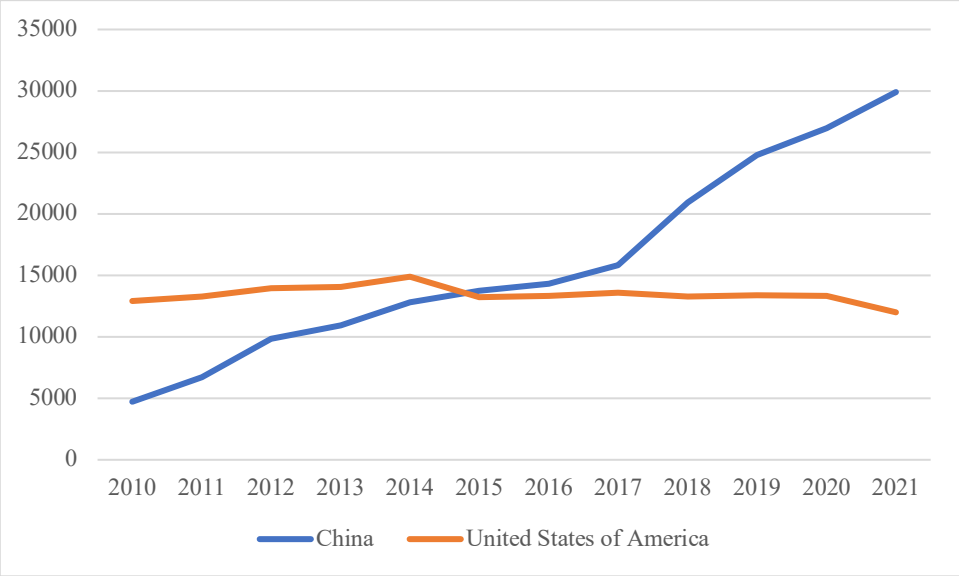

Figure 3: Total semiconductor patent applications count by applicant's origin from 2010 to 2021. Source: WIPO IP Statistics Data Center, accessed June 5, 2023, https://www3.wipo.int/ipstats/IpsStatsResultvalue.

China's manufacturing capability is also a cause of concern for the US. From Figure 4, China and US has kept similar levels from 2011 to 2013, but China surpassed the US from 2014 onwards while the US still is in the region of US$40 billion. Since 2016, China semiconductor exports increased rapidly and is at least twice of the US since 2018. China's percentage of semiconductor exports over overall exports also surpassed the US in 2016, while the US stays in similar levels.

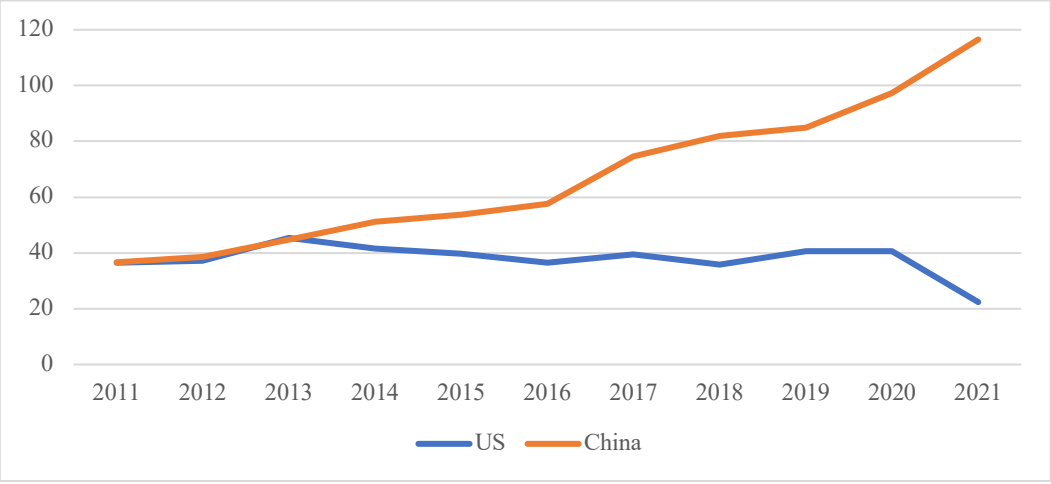

Figure 4: Semiconductor exports (in US$ billion). Source: WTO Stats, https://stats.wto.org/.[2]

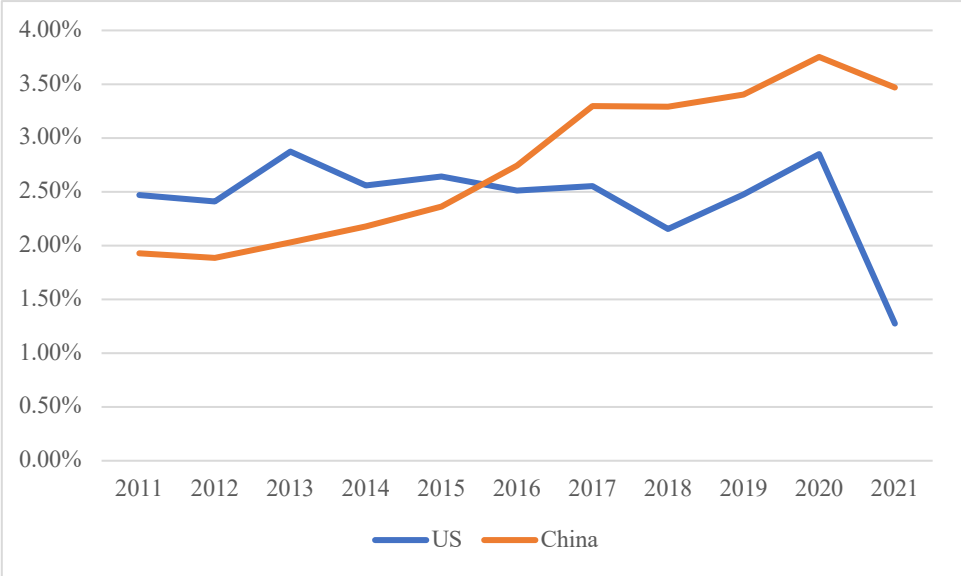

Figure 5: Percentage of semiconductor exports as percentage of overall exports. Source: WTO Stats, https://stats.wto.org/.

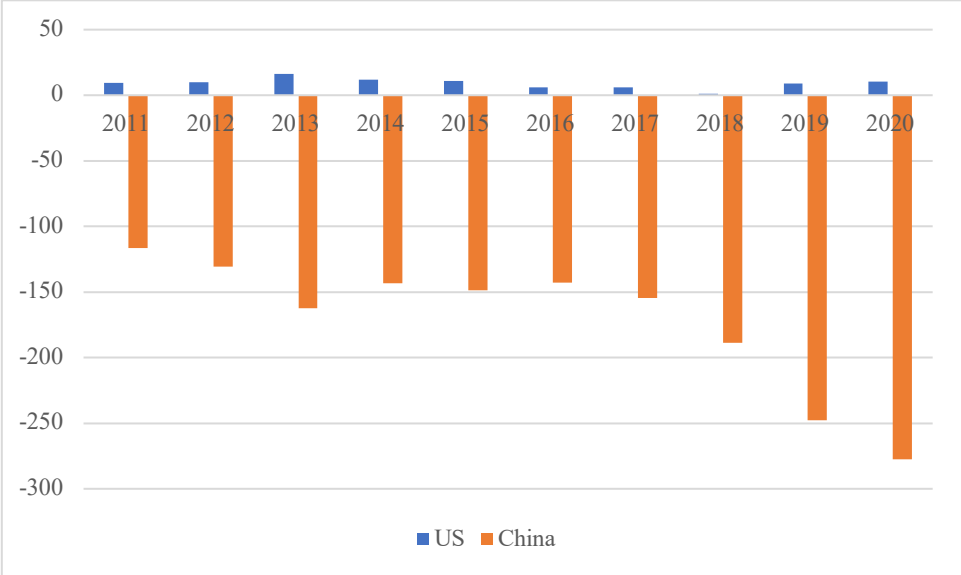

Figure 6: Surplus of Semiconductor (US$ billion). Source: WTO Stats, https://stats.wto.org/.

However, from the perspective of semiconductor surplus (Figure 6), the US constantly supported a surplus while China is constantly in a deficit. China's appetite for semiconductors increased rapidly since 2017, despite the implementation of the Made in China 2025.

The figures give a rough outlook on the structural changes in the semiconductor

[2] The author used HS Code 8542 as a reference.

supply chain. In terms of innovative power, although the US still has the upper hand in terms of R&D funding, China is catching up quickly. As for semiconductor patents application, China took over the US since 2015 and grown rapidly. It shows that China is strengthening its innovative power, especially in the semiconductor sectors, while the US stagnates.

In terms of manufacturing power in semiconductor, the US was on par with China before 2013 but lost its lead to China soon. The value of semiconductor exports in the US is at a constant level, but China's percentage had increased since 2016. However, since China must import advanced chips from Taiwan and South Korea for its manufacturing industry, it became a net importer of semiconductors with a growing gap.

However, further exploration is needed to further understand the US and China's innovation and manufacturing power for semiconductors. First, these data measures only the semiconductor input and output for the US and China, a closer inspection into various phase of semiconductors must be conducted to get a full picture. Second, the data measures only overall semiconductor values but not the types of semiconductors (mature or advanced). Future explorations will examine the actors that control the various parts of semiconductor manufacturing from the design phase to the end phase and if possible, the author would like to explore the type of semiconductors that various actors specialize in.

Summary

The US engages in technology competition with China due to internal security concerns and structural changes in the semiconductor supply chain. First, the US government has serious doubt whether China manufactured chips or high-technological products, such as the Huawei 5G telecommunication infrastructure, has a backdoor that allows Beijing to conduct espionage operations in US grounds. Second, the COVID-19 pandemic caused massive chips shortages that badly hurt the US automobile industry. Third, the US is losing its supremacy over the global semiconductor industry to China. The US acted more from a security perspective and seek to rebalance its technological capacity against China.

China's ambition to achieve technological self-sufficiency and global supremacy through the Made in China 2025 initiative drives suspicion from the US and led to a security dilemma. China hopes to rely on itself to manufacture advanced chips and sustain its high-technological sector without depending on foreign sources to protect its economy. Further, China hopes to dominate the semiconductor supply chain completely and increase other's reliance on it. Although China has a clear manufacturing advantage

over the US in semiconductor production and a slight advantage in innovative power, China must rely on external sources of chips to sustain its manufacturing sector. While China may secure its economy for the short term, it cannot achieve technological supremacy under current circumstances.

According to the Semiconductor Industry Association (SIA), the US still accounts for nearly half of the global market share, followed by South Korea. China places sixth, behind Taiwan, the EU, and Japan (Figure 7). Although China shows improvement in its global market share, it is still outsized by the US and South Korea. It shows that China still has a long way to go in order to be a top player in the semiconductor industry.

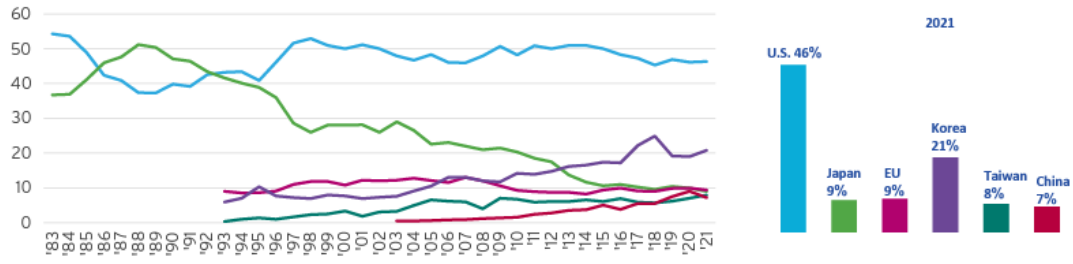

Figure 7: Global Market Share of Semiconductors for Major Actors.

Source: Semiconductor Industry Association 2022 Factbook, available at: https://www.semiconductors.org/wp-content/uploads/2022/05/SIA-2022-Factbook_May-2022.pdf.

In short, both China and the US are maximizing their technological power, especially in their capacity to produce semiconductors, but with different motives. The US acted on security grounds and to preserve its global technological leadership. China also has economic security concerns in pursuing semiconductor leadership. Simultaneously, China is trying to revise the global technological order by seeking supremacy in the semiconductor supply chain.

Prospect and Challenges of Semiconductor Statecraft

The earlier section explored the causes of the US-China technology war. This section will discuss the strategies employed by the US and China to secure or dominate the semiconductor supply chain.

Made in China 2025: The Quest for Semiconductor Self-Sufficiency and Dominance

The key aim of MIC2025 is to develop China's manufacturing sector further, move China up the value chain, and transform China into a high-technology production dominion (Kennedy 2015). Experts also argued that increasing domestic innovation is

crucial for China's future. To achieve the aim of MIC2025, the Beijing government provided subsidies to Chinese technology leaders, forced foreign companies operating in China to transfer their technology, and invested in foreign high-technology companies (McBride and Chatzky 2019; Wubbeke et al. 2016).

A key element in the MIC2025 is to achieve semiconductor self-sufficiency because semiconductors are crucial in high-technology products, especially advanced chips. However, the COVID-19 pandemic that broke out in 2020 exacerbated China's demand for semiconductors as China struggled to secure advanced chipmaking equipment (Ji 2023; Yamada 2023). According to reports, China only produces less than 20% of its chips and relies on foreign sources of advanced chips to sustain its manufacturing sector, falling short of its target to achieve 40% self-sufficiency in 2020 (Tabeta 2021; Yamada 2023). Figure 8 depicts the foreign sources of semiconductors for China. China imported its chip mainly from Taiwan and South Korea, which is around or more than 50% in total. Further, China increasingly relied on Taiwan to supply its advanced chips. Interestingly, except for Malaysia, China has geopolitical conflicts with its main semiconductor suppliers. China constantly threatens Taiwan with peaceful or forced reunification, pressures South Korea for its deployment of THAAD, and is in territorial disputes with Japan.

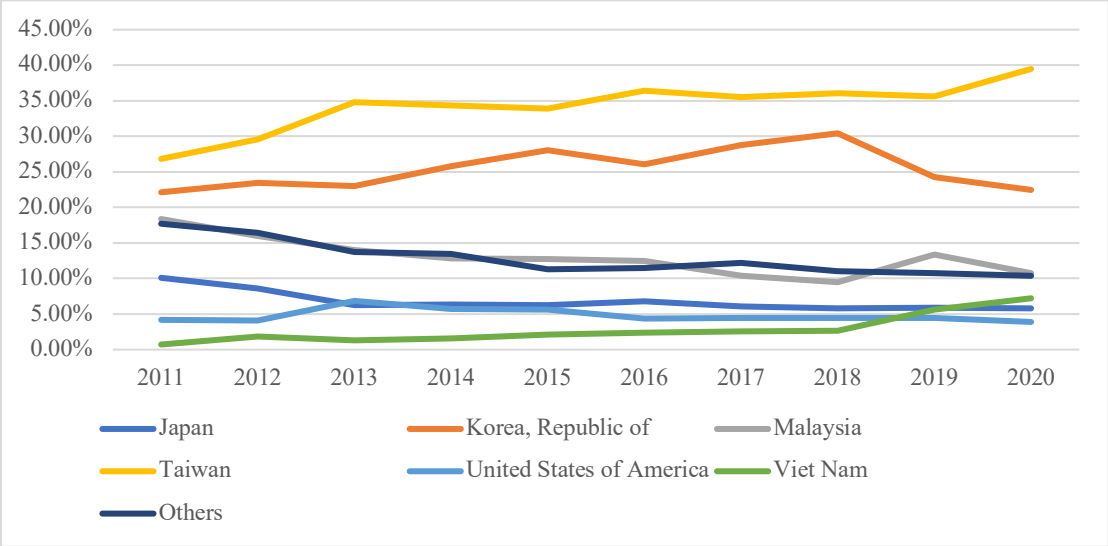

Figure 8: Chinese source of semiconductors from 2011 to 2020. Source: Author's elaboration from WTO Stats.[3]

Another problem with China is the lack of deep ultraviolet (DUV) photolithography machines that are used to manufacture advanced chips. China's

[3] The author used bilateral imports in WTO Stats by detailed HS code 8542 (Tariff Classification: Electronic integrated circuits; parts thereof).

problem started during the COVID-19 pandemic, which severely disrupted the global supply chain. It is further exacerbated by Biden's export control measures in October 2022, in which the Netherlands and Japan followed suit (Petrakakos 2023). Only the Netherlands has the capacity to build DUV photolithography equipment, and the US cut Chinese access to these machines. The lack of access to DUV equipment will set China back for decades in semiconductor manufacturing or limit its ability to produce only mature chips.

The U.S.: Self-Sufficiency, Alliance, and Coercion

Several factors drive the US into a technology competition with China. First, Beijing's forced technology transfer practices, industrial espionage, cybertheft, and investment in critical technology companies threatened US's national security (Demarais 2022). Since technology is a key element in US's economy and defense, Chinese practices will undermine US's national power and security. There are also concerns that Chinese technologies have a backdoor that allows the Chinese government to steal US intelligence (Demarais 2022). Second, China's implementation of the Digital Silk Road will erode US global leadership (Edel and Rapp-Hooper 2020). China outperforms the West in technology exports, especially in 5G technology, because it is affordable. However, China aims to expand its 5G networks and build data centers worldwide, which may be a panopticon to monitor global internet data (Edel and Rapp-Hooper 2020).

Other factors, such as the COVID-19 pandemic and Taiwan, also push the US further into the technology competition. COVID-19 exposes the danger of relying on China and East Asia for chip supplies. The disruption in semiconductor supply badly damaged the US economy, particularly the automobile industry (Klayman and Nellis 2023). The US wishes to fortify the semiconductor supply chain to avoid another great disruption. China's continuous aggression on Taiwan, the world's largest semiconductor supplier, made the US commit to technology competition with China. Therefore, the US engages in technology competition mainly due to national security fears.

The US aims to undercut Chinese technological power by controlling the semiconductor supply chain. Figure 9 shows the trend of semiconductor exports of different actors since 2011. Taiwan and South Korea still dominate the world chipmaking industry. Although China's chip exports are growing, it is limited to mature nodes (10 nanometers and above), making them less valuable than Taiwan or South Korea. The US chip industry had a similar output to China before 2013, but China overtook it in 2014, and now it has a clear advantage over the US.

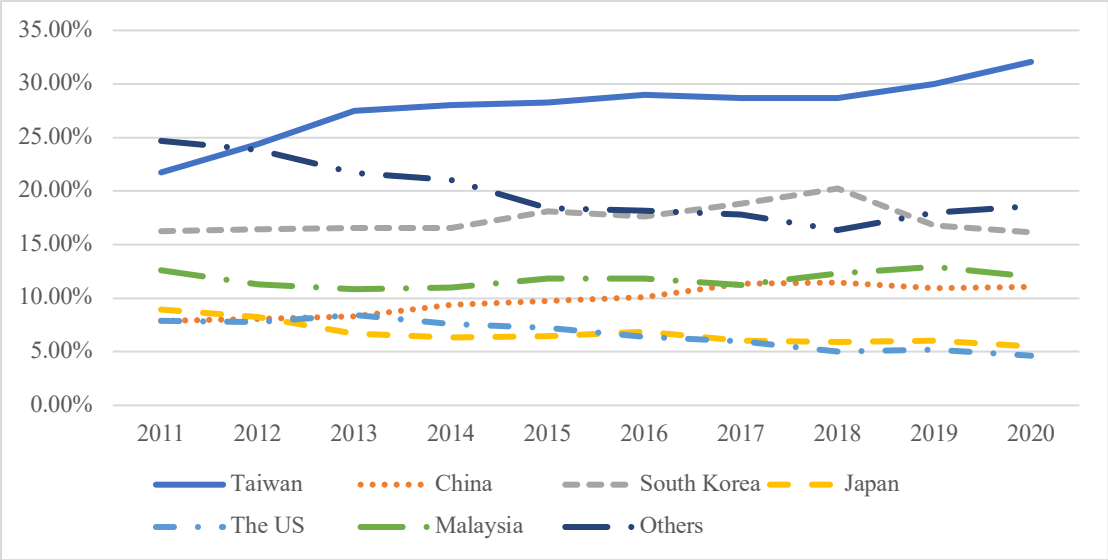

Figure 9: Global trend of semiconductor exports from 2011 to 2020. Source: Author's elaboration from WTO Stats.[4]

The Biden administration introduced the CHIPS and Science Act to promote self-sufficiency in semiconductor production. It gives funds to US chipmakers to expand their manufacturing base in the US and improve US semiconductor research programs (House 2022). This policy is clearly directed at China with an aim to preserve the US's global technological leadership, strengthen the US's semiconductor supply chain, and allow the US to get ahead of China in the research of frontier technologies. Biden's technological policy is clearer compared to his predecessor.

The US also seeks to rebalance the technological power back to the West through alliances. Biden proposed an informal CHIP4 Alliance among Taiwan, Japan, and South Korea, which are the largest semiconductor fabricators (Hsu 2022; Blanchard 2023). Biden also subsidized top fabrication companies such as TSMC, Samsung, and SK Hynix to set up production lines on their soil or vice-versa (Kreps, Clark, and Rao 2022).

The US uses its influence in the design phase and control over the key components of lithography technology to limit China's technological growth and support like-minded allies. The US has top companies specializing in electronic design automation (EDA) and the tool for manufacturing semiconductors. Further, the US also influenced the European Union and Japan to limit sales of certain components to China, which they obliged.

[4] The author used bilateral imports in WTO Stats by detailed HS code 8542 (Tariff Classification: Electronic integrated circuits; parts thereof).

Conclusion

Countries seek technological power to improve their economy and military power. A state that can proliferate its technology can resume global leadership through technology dissemination or controlling the standards. Therefore, states will maximize their technology power for security and supremacy.

The US-China technology competition is an instance of technology power maximization. Although the US still has strong innovation power, China's manufacturing power allowed a higher proliferation of Chinese technological goods. Further, many developing countries use Chinese-manufactured telecommunication goods, and China also leads AI research. Therefore, the US engages in technology competition to constrain Chinese growth in the semiconductor supply chain.

Semiconductors are crucial for today's technology power, and therefore, the US and China look to dominate the semiconductor supply chain and avoid supply disruptions. Through the Made in China 2025 initiative, China hopes to increase its self-reliance in semiconductor production and dominate the chipmaking industry. Despite large investments in the chipmaking industry, China did not improve its chipmaking capacity and had to rely on foreign sources, such as Taiwan and South Korea, for advanced chips. The prospects for China to be a technology dominion is bleak after the US went all out to limit its access to advanced semiconductors and chipmaking equipment.

The US entered the technology competition to protect its national security and interests, especially after finding out that Chinese unfair trade practices undermined US's technology industry. Due to the COVID-19 pandemic, the US realized how important East Asia is to the semiconductor supply chain and tried bolstering its resilience with the CHIPS and Science Act. The US also realized its technological leadership is eroded by China and seeks to rebalance the technological order.

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