The Relationship between US-China Semiconductor Friction and US National Security: A Realism Perspective

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Abstract

In recent years, the US has been escalating sanctions on China's semiconductor industry, attributing these measures to national security concerns in official statements. This study employs a realism theory framework to analyse these sanctions, emphasizing their connection to US national security. US national security aims to achieve global influence in both military and non-military domains, with the semiconductor industry playing a crucial role in US national security and economic stability. The emerging capabilities of China's semiconductor industry pose potential challenges to these critical aspects. In the military domain, China has deployed artificial intelligence and 5G technologies for military purposes, attaining capabilities comparable to the US. These technologies heavily rely on semiconductor chips as hardware support. In response, the US targets China's semiconductor industry, aiming to indirectly impede China's military competition. Additionally, the US position in the global semiconductor manufacturing value chain renders it relatively vulnerable. Given the US dependence on key products manufactured in China, concerns about the security of the semiconductor value chain arise. Therefore, motivated by national security considerations, the US has implemented significant sanctions on China's semiconductor industry to address the military and economic threats posed by China.

Keywords

The US-China Relations; National Security; Realism; Semiconductor Trade Frictions.

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Introduction

The friction between the US and China concerning the semiconductor industry began escalating during the Trump administration, specifically starting in 2018 with the onset of the US-China trade war. The origin of the friction can be traced back to the Obama administration. During the Obama administration (2009-2017), some US officials began expressing concerns about the rapid growth of China’s semiconductor industry. China’s substantial investments, including subsidies and funds amounting to billions of dollars, aimed at developing its domestic semiconductor sector, exerted significant pressure on the US semiconductor industry. However, at the same time, many high-ranking officials did not consider the chip issue a severe problem, leading to slow progress in the US semiconductor industry during the Obama administration (Miller 2023).

With Trump’s election in 2016, there was a significant shift in focus towards the semiconductor industry. Starting in 2018 with the inception of the US-China trade war, the Trump administration involved semiconductor companies in the dispute. Over four years, the Trump administration not only imposed tariffs to restrict the entry of Chinese semiconductor products into the US market but also employed entity lists to limit transactions between Chinese and American companies. These protectionist measures undoubtedly inflicted severe blows on China’s semiconductor industry over Trump’s term through early 2021.

Following the transition to the Biden administration in January 2021, the US not only continued Trump’s policies but also intensified efforts with new legislative measures. These measures included the Secure Equipment Act signed in 2021 and the CHIPS and Science Act signed in 2022. These bills have prevented Chinese semiconductor companies from entering the US market and severed the possibility of other semiconductor companies that receive US government subsidies from investing in China over the next decade. The US sanctions on China’s semiconductor industry have become comprehensive, obstructing not only the supply of Chinese technology (e.g., Electronic Computer-Aided Design (ECAD) software) but also cutting off the sources of equipment necessary for chip manufacturing in China (e.g., ASML lithography).

Why has the US shifted its stance to impose strict sanctions on China’s semiconductor industry today? Many US government documents and relevant scholars believe that this is due to concerns about US national security. This study will continue this viewpoint and explain the US behaviour from the perspective of realism in international relations theory.

Related Document and Research: Semiconductor Frictions and US National Security

US Government Documents

Regarding chips or semiconductors, the US has repeatedly emphasized that this is a national security issue. In August 2022, the US Department of Commerce decided to revise the Export Administration Regulations (EAR) to implement export controls on four technologies, three of which are related to the semiconductor industry (Gallium Oxide - Ga2O3, and diamond; ECAD software specially designed for the development of ICs with Gate-Allaround Field-Effect Transistor – GAAFET - structure)
These materials and technologies are required to obtain export licenses when exported or re-exported to China. The stated reasons for these controls, as announced by the US, are national security and counterterrorism concerns. In March 2023, the US Department of Commerce issued a proposed rule, which aims to implement provisions related to national security protection as mentioned in the CHIPS and Science Act (The White House 2023). In the same month, the Department of State announced the International Technology Security and Innovation Fund to support the security of the US semiconductor supply chain and national economic security (The U.S. Department of State 2023 a). In May, the US Department of State issued an announcement, which pointed out “How to scale up global semiconductor production and protect US national security at the same time”. In this announcement, the Department of State mentioned Departments within the State Department are currently allocating International Technology Security and Innovation (ITSI) funding to initiatives aimed at enhancing resilience and security within information and communication technology (ICT) and semiconductor supply chains (The U.S. Department of State 2023 b). In July 2023, in the “Department of Commerce and Department of Defense Sign Memorandum of Agreement to Strengthen US Defense Industrial Base,” it was stated, “The agreement will increase information sharing between the Departments to facilitate close coordination on the CHIPS for America’s incentives program, ensuring that their respective investments position the US to produce semiconductor chips essential to national security and defence programs (Department of Commerce 2023).” This agreement underscores the US commitment to the development of its semiconductor industry, especially focusing on its domestic semiconductor manufacturing and value chain supply capabilities, as well as its ability to produce military-grade semiconductors.

**Previous Studies**

“The tech war is driven by national security concerns in both the US and China (Capri 2020)”. In his report, Capri pointed out bluntly that the technology friction between the US and China is driven by concerns over national security, with semiconductors being at the heart of this technological friction. He pointed out that the sanctions imposed by the Trump administration on the Chinese semiconductor industry were aimed at preventing China’s long-standing “predatory” industrial policies, specifically to hinder China’s ability to transfer technology and steal intellectual property. On the Chinese side, the military-civil fusion policy has promoted the integration of various high-tech industries, including the semiconductor industry, for both civilian and military purposes. While this policy has indeed facilitated the development of Chinese technology, on the other hand, it has led to the inclusion of future industry technologies for military purposes in the US Commerce Control List. Bown (2020, 349-388) took Huawei as a starting point to analyze the semiconductor industry and US national security issues. He pointed out that the US believes that Huawei’s 5G equipment poses a threat to critical network infrastructure, leading the US to cut off trade with Huawei related to chips and related equipment.

Reginald Jones Senior Fellow Chad P. Bown conducted an interview in 2022 with Kevin Wolf, the Former Assistant Secretary of Commerce for Export Administration under the Obama administration, regarding national security concerns and US sanctions on Chinese semiconductors. In the interview, Wolf shared his perspectives on the frictions of semiconductors with China and US national security. First, similar to Capri’s viewpoint, Wolf expressed concerns about China’s policy...
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of civil-military fusion, where advanced civilian products are utilized for military purposes, posing a threat to the US. Secondly, the Biden administration has explicitly voiced security concerns about advanced semiconductors used in China because of their clear relevance to China’s military modernization and weapons of mass destruction. There is a risk that advanced semiconductor exports to China and manufacturing equipment could be used to enhance China’s military capabilities. Moreover, China’s Semiconductor Manufacturing International Corporation (SMIC) developed highly advanced 7-nanometer chips in 2022, and China’s military actions regarding the Taiwan issue have raised significant concerns in the US. These concerns were key factors behind the US initiating an export control policy change in October 2022, which aimed to restrict the export of advanced chips and related equipment to China (Wolf 2022).

Some experts have discussed the national security issue from the perspective of artificial intelligence (AI). Advanced semiconductor chips are considered a crucial foundation for AI, and it is anticipated that AI will change the way wars are conducted in the future. In future conflicts, AI is expected to replace humans in operating weapons, such as AI-guided missile attacks, coordinated firepower strikes, drone swarms, and cyberattacks. China’s substantial investment in AI technology development and its associated military policy (building a fully modern military based on “informatization,” “intelligentization,” and “mechanization” by 2027) undoubtedly pose a threat to US national security (Shivakumar and Wessner 2022). Allen (2023 a) pointed out a similar view. He mentioned that “Like their counterparts in the US, China’s leaders, including Xi Jinping, general secretary of the Chinese Communist Party, believe that leadership in AI is foundational to the future of economic and military power.” He also pointed out that in 2017, both the Chinese military and the US embarked on the modernization process of AI simultaneously, and both sides urgently needed AI chips to support their respective developments. Compared to the US, China currently relies on imports to acquire AI chips, but the Chinese government plans to achieve self-sufficiency in the future. The Biden administration, based on concerns about military threats, implemented export restrictions on AI chips and manufacturing equipment to China in the October 2022 export control policy change.

In summary, the sanctions imposed by the US on the development of China’s semiconductor industry are widely analyzed by scholars as being driven by the need to protect national security. Firstly, there are concerns about China’s use of civilian products for military purposes. Secondly, there are apprehensions about the potential security risks associated with China gaining access to critical technologies in the US. Thirdly, there is a worry about the security of the US semiconductor industry’s supply chain. Fourthly, due to the semiconductor industry’s role in supporting other high-tech sectors, the US aims to slow down China’s advancement in other high-tech areas, such as AI and supercomputing, which could fundamentally alter the dynamics of warfare. This also serves to restrict the development of Chinese espionage technologies.

This study is based on the identification of relevant documents and research content and similarly explores the issue of sanctions on China’s semiconductor industry from the perspective of US national security. In contrast to previous research, this study attempts to explain the semiconductor issue and its implications for US national security from the perspective of international relations theory. Specifically, it aims to provide explanations within the framework of realism theory, addressing US
national security, the impact of the semiconductor industry on US national security, and the challenges posed by the development of China’s semiconductor industry to US national security.

US National Security under Realism

Realism, as one of the dominant theories in international relations (Richard 2012, 36-41), originated from ancient thinkers such as Thucydides. Thucydides laid the foundation for realism by asserting the inevitability of war and emphasizing states’ pursuit of power (Beate 2006, 7). Over time, realism has evolved into three major categories: classical realism, neorealism, and neoclassical realism.

Classical realism combines human nature and the state, emphasizing that selfish human behaviour manifests in state actions, resulting in key factors for conflicts between states (Lobell, Ripsman, and Taliaferro 2009, 14-16). Morgenthau (1948) defined classical realism as the impact of human nature on international politics, where state interests are defined as power, morality has no necessity in political behaviour, and the morality of a specific state does not equate to universal morality. Neorealism, introduced by Waltz (1979, 102), emphasizes the constraints of the international system on state decisions. The theory posits that the international political structure is anarchic, with states primarily pursuing survival. In an anarchic environment, states inherently act in a “self-help” manner, with the foremost pursuit being their own security rather than power. Neoclassical realism integrates domestic and international structures (Dougherty and Pfaltzgraff 2001, 88). Regarded as a diplomatic policy analysis method, it asserts that a state’s foreign and security policies are determined by unit-level factors, including social relations, political systems, strategic culture, and leadership (Ripsman 2011). Additionally, the growth of a state’s power leads to more confident diplomatic policies and military actions (Rosa, Benati, Foradori and Longoni 2020).

In short, realism emphasizes the competition for power and interests between states, as well as the instinct for self-preservation. Realism revolves around four core elements: firstly, nation-states are considered the primary participants in international relations; secondly, it underscores egoism, wherein the pursuit is solely for self-interest; thirdly, it highlights the state of anarchy, leading to conflicts in international relations; and finally, it underscores power politics. It emphasizes the security dilemma issues triggered by arms races among nations in pursuit of power and security (Reus-Smit and Snidal 2008, 133).

The definition by the US Environmental Protection Agency (EPA), of national security is “the security and defence of a nation-state, including its citizens, economy, and institutions, which is regarded as a duty of government. Originally conceived as protection against military attack, national security is now widely understood to include non-military dimensions, such as security from terrorism, minimization of crime, economic security, energy security, environmental security, food security, and cyber-security. Similarly, national security risks involve international threats, such as cybercriminals and violent non-state extremists; as well as the domestic threats posed by hazardous material releases and natural disasters (EPA 2023).” As the concept of national security evolved, incorporating diverse dimensions such as economic security, environmental security, and cybersecurity, it reflects a broader realist understanding of the multifaceted nature of power. Furthermore, based on the National Security Strategy report issued by the Biden administration
in 2022, the key areas of focus for US national security can be summarized as follows. 1. Strengthening domestic foundations, including enhancing industrial capacity, investing in human resources, and strengthening democratic institutions, to strengthen the economic foundation and gain a competitive advantage in international competition.

Expanding diplomatic relationships, by strengthening relations with other countries and establishing favourable conditions for competition that benefit the US. 3. Modernizing military capabilities, by pursuing military modernization, advancing technology, and investing in defence, to protect the interests of the US and its allies. 4. Building alliance partnerships, to promote a vision of a free, open, prosperous, and secure world and make meaningful progress on issues such as climate change, global health, and food security. Overall, the key areas of focus for US national security are “to protect the security of the American people; to expand economic prosperity and opportunity; and to realize and defend the democratic values at the heart of the American way of life (The White House 2022).” The Biden administration’s National Security Strategy report further emphasizes strengthening domestic foundations, expanding diplomatic relationships, and modernizing military capabilities. In addition, the National Security Agency (NSA) in the US has a primary focus on cybersecurity and signals intelligence in its mission. Its purpose is to ensure the security of military communications and data (NSA, n.d.). In sum, the concept of national security in the US originated from the focus on enhancing its military and defence capabilities. Over time, in addition to emphasizing military strength, it has expanded to include non-military security such as economic security, and diplomacy security. In terms of military capabilities, national security emphasizes the importance of advanced technology, as well as cybersecurity and intelligence.

From the perspective of realism, the US core concern regarding national security lies in preserving its power and influence in international affairs. Grounded in zero-sum thinking, the US has consistently prioritized the enhancement of military strength as the focal point of its long-term security strategy. However, in today’s international society, non-military factors such as economic and diplomatic influence are also steadily gaining prominence, exerting a growing impact on the global landscape. As the predominant global force, the US considers the maintenance of both its military and non-military capabilities as the paramount task for national security. Essentially, this effort is aimed at upholding the US hegemonic position on the international stage and safeguarding the national interests and power derived from the international order led by the US.

With the development of emerging technologies, the rapid escalation of military capabilities and significant impetus for economic growth shifts the focus of security issues towards competition in technological prowess. Sanctions against China’s semiconductor industry can be interpreted from a realist perspective as a response to challenges against US global influence and power. Within the framework of realism, these sanctions can be seen as a means for the US to limit technological advancements in critical areas by other nations, thereby preserving its dominant position in the international system.
The Impact of Semiconductors on US National Security

It can be stated that the national security and economic stability of the US are inextricably linked to the semiconductor industry. The US heavily relies on semiconductor technology for the performance of major defence systems and platforms, as well as the daily functioning of the civilian economy (Shivakumar and Wessner 2022). The development of the semiconductor industry plays a critical role in ensuring both military security and economic security in the US.

In military security, the focus lies on a nation-state’s capacity to safeguard itself and deter potential military threats (Idachaba 2019). Military power is one of the most important factors in Military security. Economic security is understood as a crucial component of national power. Economic security is broadly defined as the ability of people to consistently meet their needs. The International Labor Office (2004) elaborates on economic security by identifying seven key elements: Income security, Labour market security, Employment security, Work security, Skills security, Job security, and Voice representation security. Some also link national security to economic security by emphasizing consistent access to employment opportunities, personal assets, and assured income (Katsos 2018). For this section, this study will focus on GDP/income and employment as the central elements of economic security.

The Impact of Semiconductors on US Military Power

In a sense, semiconductors can be considered naturally suited for military purposes. Texas Instruments, Inc. (TI) is one of the companies credited with the invention of integrated circuits (ICs), with the other company being Fairchild Semiconductor. In 1958, Kilby, while employed at Texas Instruments, successfully developed the integrated circuit chip. This breakthrough occurred during a period of intense military equipment competition between the US and the Soviet Union. The US military promptly decided to apply the newly developed chip technology to weaponry. In the second year following Kilby’s invention of the chip, Texas Instruments secured investment from the US Air Force Electronics Laboratory for its chip research. Shortly thereafter, TI obtained contracts for chips and small Air Force devices and, in 1962, applied its technology to the “Minuteman II” intercontinental missile (Ceruzzi 2017). During the same period, Fairchild Semiconductor, the other pioneer in ICs, secured a significant contract from the National Aeronautics and Space Administration (NASA). As the Soviet Union launched its first artificial satellite into space, the US embarked on a determined mission to catch up and assert its dominance in the realm of space exploration. In 1962, as an integral part of the Apollo program, the US planned to use ICs developed by Fairchild Semiconductor to propel Apollo 11 to the Moon (Miller 2023). With the substantial orders from NASA, Fairchild Semiconductor experienced rapid growth and expanded its chip sales to the US military. By 1965, the company’s founder, Noyce, noted that approximately 95% of its IC products were sold for military and aerospace applications (Miller 2023).

The early development of semiconductor chips was closely intertwined with military activities. With the advancement of semiconductor technology, military capabilities have become increasingly reliant on semiconductors. During the Cold War, the competition between the US and the Soviet Union in nuclear weapon military equipment necessitated the use of computer chips to enhance the precision
of weapons, with more advanced chips leading to higher accuracy. In the late 1980s, Shintaro Ishihara confidently mentioned in his book “The Japan That Can Say No” that without Japan’s next-generation computer chips, the precision of US nuclear weapons would be compromised. He suggested that if Japan ceased providing chips to the US, Washington would be rendered helpless. He even suggested that Japan could determine the global military balance at the time, for example, by selling chips to the Soviet Union instead of the US (Ishihara 1989). Of course, history provided a different answer, as Ishihara’s perception of Japan’s international standing at the time was exaggerated, and Japan ultimately did not surpass the US in the semiconductor industry. However, it cannot be denied that advanced chips have a decisive impact on military power, as those who possess more powerful chips also have stronger armed forces.

In the 21st century, semiconductors have played an increasingly crucial role in modern military capabilities. In an announcement released by the US Department of Defense (2022 a), it is asserted that fourteen key technologies are of utmost importance to US national defence. These are quantum science; future-generation wireless technology; advanced materials; trusted artificial intelligence and autonomy; integrated network systems-of-systems; microelectronics; space technology; advanced computing and software; human-machine interfaces; hypersonics; and integrated sensing and cyber; biotechnology; renewable energy generation and storage; and directed energy. Among these fourteen critical areas, semiconductors are included (microelectronics). Furthermore, the majority of these technologies are closely related to semiconductors, meaning that semiconductor chips are essential to support these key technologies. The US must maintain a world-leading position in these critical areas to ensure its military superiority.

As the foundation for other technologies, the US has allocated substantial funding for the development of defence-oriented microelectronics technology. In the budget request for the fiscal year 2024, the microelectronics field received approximately $1.7 billion in funding (Lopez 2022), making it one of the highest-funded areas among the critical fourteen technology domains. In September 2023, the US Department of Defense announced the allocation of nearly $240 million to eight regional “Innovation hubs.” These centres will be part of the shared microelectronics commons aimed at stimulating the growth of microelectronics development in the US (Lopez 2023). These projects aim to introduce the most advanced microchips into the daily systems used by the US military, such as ships, aircraft, tanks, long-range ammunition, communication equipment, and more. In addition to researching microchips, these Hubs also have a strong focus on areas such as AI and 5G (Lopez 2023).

Semiconductors are the cornerstone, and their extraordinary power becomes more evident when they are combined with other technologies. Taking AI and 5G as an example—two of the most influential technologies in modern warfare — the development of the semiconductor industry (microelectronics) serves as a powerful driving force that greatly advances AI and 5G technologies.

1. AI

The US is equally committed to investing in AI technology with unwavering effort. In 2021, there are US$800 million put into defence AI research; in 2022, the Pentagon plans to spend US$874 million on AI and machine learning technologies, and there are more than 600 AI projects (Keller 2021).
These funds and projects are evidence of the importance the US places on AI for military purposes. However, as for AI, this technology heavily relies on semiconductor chips. The most advanced artificial intelligence systems require semiconductor chips designed with rules as fine as 7 nanometers to 5 nanometers to operate (Shivakumar and Wessner 2022). Currently, the US is unable to manufacture chips of this calibre and relies on TSMC for production. This fact is one of the reasons driving the US to establish semiconductor fabs domestically.

2. **5G**

The US Department of Defense has also invested significant time and financial resources in the military application of 5G technology. The US Department of Defense is the largest 5G enterprise customer in the world, and it is committed to integrating core corporate technologies into the military sector. In 2021, the Department of Defense used US$600 million to architect and deploy the largest 5G wireless initiative and proposed to use it to test that 5G technology use in the military and make its own 5G technology a world leader (Wireless Infrastructure Association, WIA, 2021). In 2022, The Department of Defense establishment of a 5G and FutureG cross-functional team, which team can accelerate the adoption of transformative 5G and future generation wireless networking technologies to make US military can operate effectively anywhere (Department of Defense 2022 b). Similarly, the use of 5G technology relies on the supply of 5G chips. Without the hardware chips to support it, 5G technology cannot function effectively. This is also one of the reasons why the US has prohibited the export of 5G chips to Chinese companies like Huawei.

In sum up, the semiconductor industry plays a pivotal role in enhancing the military power of the US. Aligned with the realist principles that emphasize the pursuit of national interests and power dynamics, the semiconductor industry is not only one of the fourteen key technologies prioritized for national defence but also serves as critical hardware support for a range of key technologies. In the context of artificial intelligence and 5G, the transformative impact of these technologies on military strength, surpassing conventional weaponry paradigms and potentially reshaping the future of warfare, is significant, with chips being their crucial component. Therefore, the commitment to the development of the semiconductor industry can be explained through a realist lens, reflecting the US dedication to maintaining and expanding its influence and power on the international stage by continually enhancing its military capabilities under the name of national security.

**The Impact of Semiconductors on US Economic Security**

a) **One of the Contributors to GDP**

While semiconductors were initially predominantly utilized in the military sector, they quickly transitioned into civilian applications after a brief period of development. Undoubtedly, this shift has propelled economic growth. For the US, semiconductors are a crucial industry for maintaining its economic prosperity. According to Yu (2022), the long-term absolute advantage in the semiconductor industry has driven rapid economic growth in the US, and the extension of the US semiconductor industry chain has also contributed to global economic development.
Today, semiconductors are indispensable to the US economy and rank among the top five exports of the US, comprising about 45%-50% of the worldwide market share (SIA 2021). Among the top US exports, which include refined oil, crude oil, natural gas, aircraft, and semiconductors, it’s safe to say that semiconductors hold a significant and crucial position in US export commodities.

**Table 1. US Exports of Semiconductors and Semiconductors in Total US Exports Between 2018-2022**

<table>
<thead>
<tr>
<th>Years</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
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<tbody>
<tr>
<td>Semiconductor Export ($Bn)</td>
<td>44</td>
<td>46</td>
<td>49</td>
<td>62</td>
<td>61.1</td>
</tr>
<tr>
<td>% in US Total Export</td>
<td>2.6</td>
<td>1</td>
<td>3.5</td>
<td>3.5</td>
<td>3.4</td>
</tr>
</tbody>
</table>

(Source: author. Data from State of the U.S. Semiconductor Industry, 2019-2023)

Between 2018 and 2022, the value of US semiconductor exports has risen from $44 billion to $61.1 billion. After the COVID-19 pandemic in 2019, while many other industries experienced contraction, the export value of US semiconductor products not only did not decrease but also remained steadily increasing, with an increase of as much as $13 billion from 2020 to 2021. The percentage of US semiconductor exports as a share of total US exports has seen a rapid increase, rising from 1% to 3.5% after 2019.

On a global scale, the US holds nearly half of the semiconductor market share. This figure is more than twice the market share of the second-largest country, South Korea, and more than four times that of the third-ranked country, Japan. It can be said that the world’s semiconductor industry is heavily reliant on the US.

These data indicate that the US semiconductor industry profoundly influences the US economy. As one of the top five industries by total export value, semiconductors contribute to stable revenue for the US economy. Additionally, the semiconductor industry is relatively resilient to external economic impacts. During global economic crises, US semiconductor sales not only remain stable but often increase, making it a dynamic sector. On a global scale, US semiconductor industry sales account for approximately half of the global market, highlighting the industry’s significant role worldwide. Moreover, in 2022, US semiconductor companies collectively generated sales of 275 billion dollars (Slightly higher than Finland’s total GDP in 2022) (SIA 2023). These products find extensive applications in fields such as mobile communication, computing, and automotive industries. These end-user products generate substantial revenue in global markets, consequently contributing additional income to the US economy. Therefore, in the modern economy, US economic growth is significantly influenced by the semiconductor industry, and it is crucial to maintain leadership in this industry to ensure steady economic development.

b) Provide Stable Employment Opportunities

In terms of employment generation, the semiconductor industry has made a significant contribution. In the realm of direct semiconductor employment, due to its sophisticated processes, its value chain is divided into multiple segments. Within the semiconductor value chain, processes are primarily categorized into Electronic design automation (EDA) & Core IP, Design, Equipment, Materials, Wafer fabrication, and Packaging, assembly & testing. Furthermore, within the Design segment, it is further
subdivided into three main aspects: Logic, Memory, discrete, analogue, and others (DAO) (SIA 2022 a). Such intricate specialization has provided a substantial number of job opportunities worldwide. Moreover, in terms of indirect employment, industries with a primary demand for semiconductor chips include computing, mobile phones, telecommunications, automobiles, and more. As Yu (2022) mentioned in his book, the semiconductor industry is like a shining gem, casting a radiant light on various other industries, which in turn prosper. The semiconductor industry, through the many sectors reliant on semiconductor technology, has contributed to the creation of numerous job positions worldwide.

In the US, the primary sectors are chip design, and the direct employment in the semiconductor industry mainly consists of technical workers, engineers, and computer experts, among others. Moreover, in addition to the direct employment opportunities offered by the semiconductor industry, it also provides numerous indirect job opportunities.

### Table 2. US Semiconductor Industry offered the Jobs Number during 2018-2022

<table>
<thead>
<tr>
<th>Years</th>
<th>Direct Jobs</th>
<th>Additional Jobs</th>
<th>Total Jobs</th>
</tr>
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<tbody>
<tr>
<td>2018</td>
<td>242,000</td>
<td>1,183,000</td>
<td>1,425,000</td>
</tr>
<tr>
<td>2019</td>
<td>241,000</td>
<td>1,179,000</td>
<td>1,420,000</td>
</tr>
<tr>
<td>2020</td>
<td>277,000</td>
<td>1,578,900</td>
<td>1,855,900</td>
</tr>
<tr>
<td>2021</td>
<td>277,000</td>
<td>1,578,900</td>
<td>1,855,900</td>
</tr>
<tr>
<td>2022</td>
<td>345,000</td>
<td>1,966,500</td>
<td>2,311,500</td>
</tr>
</tbody>
</table>

(Source: author. Data from State of the U.S. Semiconductor Industry, 2019-2023)

The data shows that the US semiconductor industry not only provides a significant number of direct employment opportunities for core talents but also contributes to indirect employment in related industries, making a substantial contribution to employment in the US. This contribution has been steadily increasing, with the industry providing 1.4 million jobs in the US in 2018, and increasing to 2.3 million jobs in 2022. In just five years, the number of jobs provided increased by 900,000. Furthermore, SIA (2023) predicts that the semiconductor industry will continue to create more employment opportunities in the future. By 2030, it is expected to provide 460,000 direct jobs, with a growth rate of 33%. Assuming that each direct job generates 5.7 indirect jobs, the semiconductor industry is projected to bring 2.622 million jobs in 2030, totalling 3.082 million positions. Moreover, the semiconductor industry not only contributes to creating new jobs but also makes a substantial contribution to income. In 2020, the semiconductor industry brought in $160.8 billion to the US income (SIA 2021), and in 2021, it contributed $165.1 billion to the US income (SIA 2022 b). This has a positive impact on the US economy.

In summary, the semiconductor industry underscores its profound impact on the economic security of the US. As a critical participant in the US economy, the industry not only ranks among the top five exports but also commands approximately 50% of the global market share, making a substantial contribution to US economic growth. Furthermore, by directly and indirectly creating a significant number of employment opportunities, the semiconductor industry ensures substantial income
for American workers. This aligns seamlessly with the multifaceted nature of national interests emphasized by realism. Against the backdrop of economic growth and employment security, the US semiconductor industry stands out, playing a crucial role in consolidating and ensuring the economic security of the US. This aligns with the framework of realism, showcasing the proactive stance of the US in maintaining and advancing national interests within the competitive landscape of international relations.

The Rise of China’s Semiconductor Industry Challenges the US National Security

In today’s world, China is the largest market for semiconductor chips (SIA 2019). Faced with such a massive demand, China’s domestic semiconductor industry is unable to meet the annual chip requirements, making semiconductor chips one of China’s largest imports. In 2020, China’s self-sufficiency rate for semiconductor chips was only 16% (Tabeta 2021). Not only does China have a low self-sufficiency rate, but it also accounts for only 7% of the global semiconductor market share in 2022 (SIA 2023). Throughout the course of China’s semiconductor industry development, it has faced challenges due to technological lag and a shortage of talent, resulting in slow and tumultuous progress. It can be said that it was only after the establishment of Semiconductor Manufacturing International Corporation (SMIC) in 2000 that China experienced rapid growth in its semiconductor industry (Yu 2022).

**Figure 1. The US and China’s semiconductor global market share (%) during 2018-2022**

![Bar chart comparing US and China's semiconductor market share from 2018 to 2022](source: author. Data from State of the U.S. Semiconductor Industry, 2019-2023)

Figure 1 shows the global semiconductor market share comparison between the US and China. From 2018 to 2022, the US maintained a market share of approximately 46%, while China’s share was only around 5% to 6%.

Given this backdrop, there’s a significant gap between China’s semiconductor industry and that of the US. However, the semiconductor industry in China continues to directly or indirectly challenge
US national security, especially in the competitions related to military capabilities and economic development. From the US perspective, these competitions are seen as new challenges to its international dominance and the international order, constituting a competition for its international power and influence.

**Military Power Challenges**

As mentioned earlier in this study, semiconductors play a crucial role in the development of military capabilities. They not only rely on semiconductor technology itself but also combine it with other advanced technologies such as AI and 5G, which can significantly enhance military power. While China’s semiconductor technology may still lag behind the US, it has made substantial progress in other areas and is approaching a similar level of technological prowess. This article will continue to focus on AI and 5G as examples.

1. **AI**

   China is developing rapidly in the field of AI. In today’s world, of the 10 most valuable private AI companies, 7 are US companies and 3 are Chinese companies. Moreover, China’s investment in AI has surged and is now on par with the US, and by 2020, China will have made more citations on AI than the US (Allison 2021). China’s focus on the AI sector has allowed it to grow rapidly in this area. Regarding AI research and development in the military, it is a key way for China’s military power to surpass that of the US. It is also a “trump card” strategy for the development of China’s military power, in using unorthodox technologies to counter enemy weaknesses and thus gain the initiative in warfare (Peng 2005). Today, the Chinese military has made prominent developments in the field of AI. The main areas of focus are robotics, drones, reconnaissance, electromagnetic countermeasures and military AI algorithms. Furthermore, China has declared robotics as its core industry and it accounts for more than half of the world’s drone exports. In addition, China has invested heavily in AI to drive new and transformative advances in biotechnology and military applications of quantum computing (National Security Commission on Artificial Intelligence (NSCAI) 2021).

2. **5G**

   For China, the development of 5G technology is phenomenal. China’s long-term planned layout of 5G technology has given the US and China an advantage in the competition in 5G today. China’s Huawei and ZTE already capture 41% of the global market for 5G technology facilities, compared to the US, where only Cisco Systems is a direct rival to Huawei and ZTE, with less than 10% of the market share (Endresen 2021). Due to the advantages of the Chinese institution, China is in a better position than the US to integrate 5G development into “military-civil fusion”. In other words, 5G can be applied to the military through civilian research, such as the China Electronics Technology Group Corp, various university institutions, the 5G Technology Military-Civil Fusion Applications Industry Alliance (including companies such as ZTE, China Unicom), etc. These civil society organizations are focusing on research in the areas of 5G communications and chips, with the ultimate goal of using these technologies in the military (Kania 2019). In the battle between the US and China over 5G technology in the military sector. More mature 5G technology will greatly enhance the military competitiveness of the PLA, which could narrow the military power gap between the two sides. Mature 5G technology can benefit
the Chinese military in many ways. In contrast to the US military, not only, Chinese 5G technology base stations themselves can occupy an advantage in terms of size, but also, mature 5G technology can also enhance the efficiency of Chinese military barracks, strengthen the accuracy of China’s positioning system - Beidou - and provide important support in military aviation technology (e.g. satellite technology). This shows the importance that the US military places on 5G technology. There is intense competition between the US and China for the integration of 5G technology into the military.

To summarize, China’s technological capabilities in AI and 5G are now very close to that of the US, posing a significant challenge to US military power. However, running advanced AI and 5G programs requires state-of-the-art semiconductor chips as hardware support; otherwise, the technology remains theoretical and cannot be effectively implemented. The US restrictions on Chinese semiconductors are aimed at slowing down China’s development in other high-tech industries that rely on semiconductor hardware as their foundation. Through indirect means, these restrictions impede the advancement of China’s cutting-edge technologies, thereby weakening its military capabilities.

Economy Security Challenges

China’s semiconductor industry lags far behind the US in global trade. However, China’s semiconductor sector still poses economic challenges to US economic security. Firstly, China’s semiconductor development is advancing rapidly, and although it currently lags, it represents a potential challenge shortly. Secondly, China holds a significant position in the semiconductor value chain, especially in semiconductor manufacturing, while the US manufacturing sector is currently in a weaker position.

a) High Growth Rate of China’s Semiconductor

Although China’s semiconductor industry started relatively late and currently lags significantly behind the US in terms of international market strength, its development has been remarkably rapid (SIA 2022 a). In one of its reports, it was mentioned that China’s semiconductor industry is rapidly developing, thanks to government subsidies, procurement incentives, and other policies. The Chinese government provides financial and policy support for the semiconductor industry, offering tax incentives to semiconductor companies and recognizing the importance of semiconductor development through various national government initiatives. “Made in China 2025” highlights that by 2025, 70% of China’s semiconductor demand will be produced internally. In China’s Five-Year Plan, there is a focus on changing the current dependence on others by creating companies capable of independently designing and producing chip-making tools (Kharpal 2020). In the field of advanced semiconductors, China’s central processing unit (CPU), graphics processing unit (GPU), and field-programmable gate array (FPGA) industries saw their total revenue grow at an annual rate of 128%, increasing from $60 million in 2015 to nearly $1 billion in 2020 (SIA 2022 a).

Finally, China’s achievements in semiconductor manufacturing are particularly outstanding. China’s semiconductor manufacturing capability has been steadily growing.
In the semiconductor manufacturing sector, the US global market share has been gradually declining, while China’s share has been rapidly increasing and has already surpassed that of the US. While China’s semiconductor industry still lags behind the US, its development has been rapid, and it has gained a significant global market share in semiconductor manufacturing. This poses a potential challenge to the US semiconductor industry.

b) Unsafe Value Chain

In today’s semiconductor industry chain, China holds a crucial position in semiconductor manufacturing, while semiconductor manufacturing happens to be the weakest link in the semiconductor value chain for the US. This means that despite the US having a leading global position in chip design, the final assembly of chips often takes place in China. This dependency has raised concerns in the US about the security of the industry chain. Consequently, the US emphasizes the urgent need to reshape its semiconductor industry chain to reduce its reliance on China’s chip assembly process to safeguard its industrial security. The US believes that semiconductor assembly in China may pose the following security risks. Firstly, there is the threat of intellectual property theft, as China, being an assembly partner of incomplete trust, raises concerns about the replication of US technology. Secondly, excessive reliance on China’s assembly process may lead to disruptions in the production and delivery of semiconductor products during geopolitical conflicts, thereby raising national security issues (Shivakumar and Wessner 2022).

Furthermore, China’s advanced manufacturing sector has indirectly affected the profits and employment of semiconductor assembly factories in the US. The US share of global semiconductor manufacturing capacity has eroded from 37% in 1990 to 12% in 2020 (Allison 2021). In the field of semiconductor manufacturing, the significant reduction in US factories has led to a decrease in factory job positions, while China has gained a large number of additional employment opportunities in its rapidly developing manufacturing industry. In response to this pressure on China, the US has begun actively constructing domestic semiconductor fabrication plants. Currently, there are projects...
worth over $300 billion underway in the US, aimed at building semiconductor fabs on American soil (PHCP Pros 2023). If these semiconductor factory plans in the US are completed, they will bring more employment opportunities and income to the country. Therefore, the US is attempting to reduce China’s position in the global value chain through sanctions, or in other words, reduce China’s share in the production of US semiconductor products, to lessen its dependence on Chinese assembly and achieve national security objectives.

**Conclusion**

This study, framed within the context of realism and considering the perspective of US national security, analyzes the reasons behind the US sanctions on China’s semiconductor industry.

Through material analysis, the following conclusions are drawn. Firstly, the US national security strategy can be explained through the lens of realism, wherein the anarchic state of the international society, maximizing one’s power, interests, and influence becomes paramount. As a dominant global power, the US pursues military and non-military influence internationally to maintain the US-led international order, thereby expanding its power or interests. Secondly, the US semiconductor industry plays a crucial role in US national security, contributing significantly to both military and economic aspects. Semiconductor chips are not only directly used in military applications but also, when integrated with technologies such as artificial intelligence and 5G, significantly enhance US military capabilities. Economically, semiconductors are essential products that contribute substantial revenue to the US and provide a significant number of stable job opportunities. Thirdly, China’s semiconductor development poses a challenge to US national security. China’s rapidly advancing semiconductor industry represents a potential future challenge. In the military domain, China has deployed artificial intelligence and 5G technologies for military purposes, showcasing capabilities comparable to the US, though a gap remains in advanced semiconductor hardware support. From the perspective of the economy, China holds a crucial position in the global semiconductor manufacturing value chain, and the US relies on Chinese assembly to finalize its semiconductor products. This dependence on Chinese production for critical products raises concerns in the US. Therefore, the US, driven by national security considerations, has implemented significant sanctions on China’s semiconductor industry to curb the perceived threats posed by China in both military and economic dimensions. At its core, this action also aims to diminish the international competitiveness of emerging nations, thereby safeguarding US power and interests.

This study attempts to explain the US sanctions on China’s semiconductor industry from a realist perspective, asserting that these sanctions are driven by a zero-sum national security ideology. Although this study is an extension based on government documents and scholars’ viewpoints, this study not only provides a more comprehensive view of the US-China semiconductor friction and US national security but also offers a detailed explanation from a realism perspective of the profound significance of the semiconductor industry to US national security, considering aspects such as AI and 5G, as well as GDP and employment contributions.

Additionally, this research provides a necessary background for future studies, such as exploring China’s strategies and semiconductor developments under US sanctions. In response to US actions, the Chinese government has also reacted robustly. On the international front, it primarily seeks
economic and military cooperation with the US through diplomatic negotiations, while also retaliating by restricting exports of Chinese high-tech products (China Briefing 2024). Domestically, it has increased substantial subsidies and tax reliefs for its semiconductor firms. The SIA estimates that these direct and indirect subsidies exceeded $50 billion in 2021 (Allen 2023 b). Some scholars believe these responses have been effective, successfully driving the development of China’s semiconductor industry despite multiple setbacks. However, Chinese companies still have a way to go before they can compete with leading global semiconductor firms (London School of Economics 2022). This research also provides context for the development of the global semiconductor value chain. For example, China, being one of the largest markets for Japanese and Korean semiconductor products, faces economic obstacles due to US sanctions impacting exports from Japan and South Korea to China. Furthermore, weakening the value chain could even affect the development of global semiconductor enterprises, including those in the US (Mark and Roberts 2023). Understanding the background and reasons for US sanctions against China’s semiconductor industry, as well as the details of some policies, will benefit these future studies. These studies will not only enrich the understanding of the political impact of semiconductors on major powers but also enhance the comprehension of the dynamics of the global semiconductor industry and potential changes in its value chain.
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