Chip-ing Away at Globalization:
The Deglobalization of the Semiconductor Industry as a Result of Geoeconomics

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Abstract

In the last decade, the People's Republic of China, the United States of America, and the European Union have all passed policies and legislation prioritizing the localization and deglobalization of their semiconductor sources. These semiconductor industrial policies typically rely on direct financial assistance from the state, incentivization of foreign direct investment (FDI), and protectionist measures such as trade barriers and restrictions on inbound FDI in order to accomplish the issuing government's stated goals. This investigation seeks to prove that the often aggressive and protectionist actions by these major powers is the result of the increasing securitization of the semiconductor industry and economics as a broader phenomenon. Geoeconomics is used to explain how these countries have utilized economic policies, relating to semiconductors, in order to achieve their respective long-term geopolitical goals.

Table of Contents

CHAPTER 1: INTRODUCTION

In recent years, the global economy has experienced a shortage of the fourth most traded product worldwide, semiconductors.[1] The global market for semiconductors has grown immensely over the past few decades and shows no signs of slowing down. Since the start of the millennium, sales have doubled from $204.4 billion in 2000 to $440.4 billion in 2020, with a projected growth of $613 billion in 2022.[2] [3] This immensely valuable and critical industry has achieved much of its growth through its manifestation as a globalized value and supply chain, bringing down costs and increasing accessibility. However, the increasing securitization of technology has promoted the governments of major semiconductor markets, consumers and producers, to consider the national security threats associated with economic interdependence. Therefore, states have taken the initiative to deglobalize their semiconductor supply sources in the form of polices such as the funding and subsidization of domestic producers, incentivization of foreign direct investment (FDI), and protectionist measures such as trade barriers and restrictions on inbound FDI. The globalization of value chains, including that of semiconductors, can be explained through geographical specialization that was driven by neo-liberal economic order of the late twentieth century which was founded on free-trade and little government involvement. The current deglobalization of the semiconductor industry offers a stark contrast to its initial globalization, as this process is entirely driven by governments motivated by geopolitical interests and national security. Therefore, this investigation will analyze how government policies that seek to deglobalize and localize the production of semiconductors by

[1] Antonio Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," Boston Consultancy Group & Semiconductor Industry Association, April 2021, 36.
[2] Semiconductor Industry Association, "2021 Factbook," 2.
[3] Thomas Aslop, "Semiconductor Market Size Worldwide from 1987 to 2022," Statista, April 6, 2022.

the People's Republic of China, the United States of America, and the European Union and its member states, demonstrates a trend away from the interconnectedness of economies and is motivated by geoeconomics.

This investigation seeks to answer the following question: why are countries and trade blocs now prioritizing the localization and deglobalization of semiconductor production, and how may geoeconomic theory assist in explaining this? By utilizing geoeconomic theory to answer this question, the investigation is asserting that deglobalization of the semiconductor industry is the result of great power competition and the securitization of economics. The methodology for evaluating the validity of geoeconomic theory in explaining this phenomenon will be evaluated empirically through a qualitative analysis of the semiconductor industrial policies of China, the United States, and the European Union.

The significance of this topic is in its relevance. Semiconductors are a critical product on which the world is becoming increasingly reliant, the level of which continues to grow at an ever-increasing rate. Semiconductors are the backbone of the digital economy; everything from the defense industry, automobiles, consumer electronics, and electrical infrastructure is dependent on the semiconductor supply chain.[4] All of this, in addition to the rapid securitization of the digital world in the form of cyberwarfare and artificial intelligence, is reliant on semiconductors and has made the security of supply of semiconductors a priority for many countries in recent years.[5] In order to address these threats, major consumers of semiconductors have set forth legislation and government policies that seek to fill the gaps in their semiconductor production and/or protect their intellectual property. The goal of localizing and deglobalizing the

[4] Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," 8.
[5] Jannis Ernst, "European Semiconductor Autonomy - A Façade or Reality," April 17 2022, Topics of European Security, Central European University.

semiconductor supply chain looks different for each case, as some need to prioritize research and development over manufacturing or vice-versa. However, despite the differences in policies, all of these approaches are motivated by a pursuit of national security. Therefore the investigation of the deglobalization of semiconductors carries implications for the greater securitization of technology, economics, and interdependence.

A specific analysis of the deglobalization of the semiconductor industry has been developed in academic articles however these articles do not focus on the greater phenomenon and are rather limited in scope. Most articles focus on the actions of one country, as Chad Bown accomplished with the United States, and John VerWey with China.[6] [7] Other articles may focus on singular events, such as the US-China trade war, demonstrated by Willem Thorbecke, or one piece of policy, as Jillian Cota accomplished in regard to the European Chips Act.[8] [9] These limits of scope in the existing literature highlights the contribution that this investigation seeks to make to the scholarship. By analyzing the actions of the US, China, and the EU, this investigation seeks to make its contribution by broadening the scope of analysis for the deglobalization of the semiconductor industry.

Furthermore, the scholarly contribution of this article also extends to its theoretical approach of geoeconomics. The existing literature has thus far failed to connect the deglobalization of the semiconductor industry to geoeconomic theory. While scholarship has detailed the connection between technology and geoeconomics as Glenn Diesen did in his 2021

[6] Chad Bown, "How the United States Marched the Semiconductor Industry into Its Trade War With China," *East Asian Economic Review* 24, no. 4 (2020).
[7] John VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," *Journal of International Commerce and Economics* (2019).
[8] Willem Thorbecke, "The Semiconductor Industry in the Age of Trade Wars, Covid-19, and Strategic Rivalries," *Research Institute of Economy, Trade and Industry*, Discussion Paper Series 21-E-064 (2021).
[9] Jillian Cota, "The European Chips Act: Strategy to Expand Semiconductor Production Resiliency," *Center for Strategic and International Studies* (blog,. March 7, 2022).

book *Great Power Politics in the Fourth Industrial Revolution: The Geoeconomics of Technological Sovereignty*, Diesen makes only a brief mention of semiconductors before merging it back into his broader discussion of technology and geoeconomics.[10] Scholars have also used approaches very similar to geoeconomics as Alex Capri investigates "techno-nationalism via semiconductors" in regard to US actions on deglobalizing its semiconductor sources.[11] However, while Capri does indicate that issues of national security are central to these actions, he does not engage with geoeconomics. This further highlights the contribution of this investigation in that it further the discussion of geoeconomics as much as it does the study of the semiconductor industry.

In order to prove that the deglobalization of the semiconductor industry is a result of perceived geopolitical threats/opportunities, so therefore geoeconomics, this investigation will be conducting an empirical analysis based on qualitative observations. The methodology will therefore analyze each of the three cases individually, utilizing policies, legislation, and statements of politicians to support that these actions are motivated by national security. Chapter 1 will serve as the introduction and overview, presenting the question and thesis, the significance of the topic, and the methodological approach to answer the question, as well as reviewing some literature on the topic. Chapter 2 will serve as context for the investigation, detailing how the production of semiconductors became a globalized industry, including some discussion on globalization theory. Chapter 3 will outline the theoretical framework of geoeconomics and explain how it relates to semiconductors. Chapter 4, 5, and 6 will entail the empirical analysis with each chapter focusing on one case being respectively the China, the United States, and the

[10] Glenn Diesen, *Great Power Politics in the Fourth Industrial Revolution: The Geoeconomics of Technological Sovereignty* (London: I.B. Tauris, 2021).
[11] Alex Capri, "Techno-nationalism via semiconductors: Can chip manufacturing return to America?," Hinrich Foundation (June 2021).

European Union. Finally, chapter 7 will summarize the findings of this investigation, offering commentary on the broader implications and a conclusion.

Chapter 2: Context

Semiconductors are highly advanced components within electronics that allow devices to process, store, and transmit data.[12] The majority of semiconductors are integrated circuits, commonly known as "microchips" or "chips." In 2019, integrated circuits represented 80% of the total semiconductor sales, with the other 20% being comprised of optoelectronics (such as LEDs) sensors and discrete semiconductors (the individual components that together create an integrated circuit such as transistors).[13] Semiconductor devices obtained their name from the materials of which they are typically produced, the conductivity of which falls on the spectrum between conductors, such as metals, and insulators, such as ceramics.[14] Therefore these materials are partially or semi-conductive. The first technical application of these materials was patented in 1906 by American engineer Greenleaf Whittier Pickard, who discovered that these materials were able to detect radio waves.[15] For much of the first half of the twentieth century, semiconductors were found in radio technology and had major military applications in the Second World War. The most influential discovery occurred in 1947 when the transistor was invented at Bell Telephone Laboratories in New Jersey by John Bardeen, William Shockley, and Walter Brattain, for which they all won the 1956 Nobel Prize in Physics.[16] In the late 1950s,

[12] Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," 9.
[13] Jan-Peter Kleinhans and Nurzat Baisakova, "The Global Semiconductor Value Chain: A Technology Primer for Policy Makers," *Stiftung Neue Verantwortung* (2020): 6.
[14] "Semiconductors," *The University of Washington: Department of Material Science and Engineering Education*, https://depts.washington.edu/matseed/mse_resources/Webpage/semiconductor/semiconductor.htm.
[15] Robert Ageton, "Guide to the Greenleaf Pickard," *The Smithsonian Institution: Virtual Archives*, https://sova.si.edu/record/NMAH.AC.0915.
[16] David Lewis, "13 Sextillion & Counting: The Long and Winding Road to the Most Frequently Manufactured Human Artifact in History," Computer History Museum (blog), April 2 2018.

engineers at US-based semiconductor companies, Texas Instruments and Fairchild Semiconductors, discovered how to place multiple semiconductors on a single piece of material, thereby creating the first integrated circuit.

Following the invention of the integrated circuit, semiconductor development accelerated rapidly. George Moore, the co-founder of Fairchild Semiconductor and later the CEO of Intel, hypothesized that "the complexity for minimum component costs has increased at a rate of roughly a factor of two per year. Certainly, over the short term this rate can be expected to continue, if not to increase."[17] Although Moore did not support his claim with any empirical evidence and only hypothesized it would be true until 1975, his theory has continued to be mostly true in that the number of transistors on an integrated circuit has continued to increase by a factor of two per year even in the present day.[18] This phenomenon led to Moore's observation becoming known as Moore's Law. The rapid growth in processing power and ability of semiconductors led to huge advances in technology and increased accessibility and affordability of consumer electronics. Therefore what had once been a military-use-dominated industry shifted to the civilian sector and led to rapid economic growth within the industry. In 1957 the semiconductor industry surpassed a value of $1 billion (inflation-adjusted 2022). By 1966 that value had surpassed $9 billion; by 1979, it was $40 billion, and by 1989 it had exceeded $110 billion (inflation-adjusted 2022).[19] [20] This value continued to grow immensely from the years 1987 to 2021, as demonstrated by the graphs visualizing global sales of semiconductors, one being inflation-adjusted to 2022 United States Dollars (Appendix 1.1) and the other being

[17] George Moore, "Cramming More Components into Integrated Circuits," *Electronics Magazine* 38, no. 8 (1965): Accessed online.
[18] David Brock, "How Moore's Law Came to Be," In *Core 2015: Moore's Law @ 50,* Computer History Museum, 31.
[19] Joint Electron Device Engineering Council (JEDEC), "JEDEC History," 2022, https://www.jedec.org/about-jedec/jedec-history.
[20] 1957, 1966, and 1979 were the only years prior to 1987 for which data was readily available.

nominal dollar amounts (Appendix 1.2). Graphs 1 and 2 reveal that the average rate of growth for the industry from 1987 to 2021 was between 7.0% (inflation-adjusted) and 9.9% (nominal dollars) annually. Growth rates varied greatly throughout this time period, mainly seeing downturns as a result of global and US recessions, such as 1991, 2000-2001, and 2008-2009. However, from graphs 1 and 2 it is observable that growth rates continued to increase during the 2020 recession resulting from the COVID-19 Pandemic, most likely because of increased demand for consumer electronics as digital work and education became the dominant form of interaction.

While innovation in semiconductor technology and the increasing scope of their applications was certainly the driving factor in the growth of global semiconductor sales by value, the globalization of the production of semiconductors also contributed to growing overall sales as the prices decreased, increasing accessibility. This industry was originally dominated by the United States in all aspects of production because the semiconductor had been invented there, and the US military was the primary consumer of integrated circuits in the 1950s. The first instance of globalizing the semiconductor value and supply chain occurred in 1961 in the form of foreign direct investment. Fairchild Semiconductor outsourced the basic manufacturing and assembling of the value chain to Hong Kong to take advantage of lower labor costs.[21] More semiconductor producers soon followed this method, outsourcing the most labor-intensive and least technical parts of the production process. Though outsourcing originally started in the form of foreign direct investment but it began to shift towards contracted production through the use of foundries, independent manufactures working under contract.[22]

[21] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War With China," 354.
[22] Antonio Varas et al., "Government Incentives and US Competitiveness in Semiconductor Manufacturing," Boston Consultancy Group & Semiconductor Industry Association. September 2020, 7.

The business models of the semiconductor industry changed immensely as the industry increasingly globalized. While integrated device manufacturers (IDMs) were the predominant form in the early days of the industry, meaning they were vertically integrated and controlled all aspects of production "in-house," the rapid pace of innovation revealed the increasing need for specialization.[23] Outsourced Semiconductor Assembly and Testing (OSATs) became popular among US-based IDMs in the 1960s because the assembly and testing phase of production could be conducted with low-skilled labor and did not require as much capital to establish. However, this outsourcing differed from the case of Fairchild Semiconductor because it was not in the form of FDI but rather completed through contracting out part of the value chain. Throughout the 1990s, the fabless-foundry model became increasingly attractive as "the pace of innovation made it increasingly difficult for many firms to manage both the capital intensity of manufacturing and the high levels of R&D spending for design."[24] Fabless semiconductor producers focus exclusively on the design of semiconductors, the manufacturing of which is then contracted out to foundries, which exclusively focus on manufacturing. Fabless production will also rely on OSATs to complete the production process. In 2019 fabless firms accounted for 30% of all semiconductor sales, up from 10% in 2000. However, IDMs still account for the majority, with 70% of all sales in 2019.[25] However, despite IDMs still being the dominant industry model, no modern semiconductor producer is completely vertically integrated, with every company contracting out at least one part of the production process.

Graph number 3 (Appendix 1.3) reveals how manufacturing became increasingly globalized from 1990 to 2020. The share of manufacturing taking place within the United States

[23] Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," 23.
[24] Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," 25.
[25] Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," 24-25.

and the European Union dropped rapidly as semiconductor producers favored moving manufacturing to states and regions with lower labor and start-up costs. However, despite manufacturing being an incredibly globalized part of the production process, the majority of sales of semiconductors are made by US-based companies. Graph Number 4 (Appendix 1.4) reveals the extent to which the United States still dominates the semiconductor industry. Despite only accounting for 12% of global manufacturing, American companies hold 48% of the global market share in semiconductor sales. Similarly, while China accounts for 15% of global manufacturing, it only composes 5% of the global market share. This imbalance is the result of geographical specialization by semiconductor producers. Labor and operating costs offer a comparative advantage for China in manufacturing, while a larger pool of highly skilled and specialized workers offers the United States a comparative advantage in research and development. Although a globalized value chain is inherently more prone to threats, the "geographic specialization and rationalized production networks" has been beneficial in bringing down the cost of producing semiconductors, allowing for more affordable electronics and increased digitization.[26] Ideally, the global economy could find a balance between domestic production which satisfies national security interests, and globalized production in order to keep prices down while also sharing the economic gains that will result from the growing demand for semiconductors.

THEORETICAL CONTEXT – GLOBALIZATION AND DEGLOBALIZATION THEORIES

The question as to why semiconductor production became a global value and supply chain is explained through globalization theory. Similar to the actions of most industries in the late twentieth and early twenty-first centuries, semiconductor producers took advantage of the

[26] Capri, "Techno-nationalism via semiconductors: Can chip manufacturing return to America?," 4.

reduction of trade barriers, increases in communication technologies, and lower shipping costs in order to lower production costs.[27] [28] Increases in communication technologies allowed for the highly complex designs and templates to be sent anywhere in the world where they could be produced for a fraction of the cost. Reduced shipping costs further incentivized the offshoring of production as transportation no longer represented an expensive hurdle in the supply chain. The reduction of trade barriers gave producers access to cheap labor and lowered start-up costs for an industry that requires expensive facilities and equipment. In the early 2000s, scholars correctly predicted that semiconductor production would become a highly globalized industry. Tomokazu Arita and Philip McCann's "A comparative analysis of the location behavior of the US and European semiconductor manufacturers" was published in 2003 and theorizes that research and development of semiconductors will become further separated from manufacturing based on the cost of labor and available skillset within the labor market. Arita and McCann's hypothesis was a correct prediction, in that the geographic gap between research/design and manufacturing did drastically increase.[29] However, there currently seems to be a reversal of this phenomenon as countries seek to lessen the geographic gap between research and design and manufacturing.

The seminal work on globalization theory is *Global Shift: Mapping the Changing Contours of the World Economy* by Peter Dickens. Although first published in 1986, the book is now in its seventh edition, which was published in 2015. Dickens does not supply a neat and clear-cut definition of what globalization is or means; rather, he spends the entire book outlining the roles of the actors and centers of globalization. Dicken's description of transnational

[27] Gao Shangquan, "Economic Globalization: Trends, Risks, and Risk Prevention," *United Nations: Committee for Development Policy*: Background Paper No. 1 (2000): 1.
[28] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War With China," 351.
[29] Tomokazu Arita and Philip McCann, "A comparative analysis of the location behavior of the US and European semiconductor manufacturers," 43rd Congress of the European Regional Science Association, August 27-30, 2003 (Jyväskylä, Finland: European Regional Science Association), 9-11.

corporations (TNCs), one of the actors within the global economy, can help to explain why semiconductor production became such an interconnected and globalized value chain. Firstly, Dickens specifies that it is not only manufacturing that globalizes, but every aspect of production and that "different business functions have different locational needs and, because these needs can be satisfied in various types of geographical location, each part tends to develop rather distinctive spatial patterns."[30] Therefore, Dickens is specifying that while manufacturing may develop in a geographical location with lower costs, research and development will grow in geographical locations with higher-skilled labor. Dicken's observations on the natural formation of geographical gaps in production support the ideas of Arita and McCann that specifically relate to the semiconductor value chain.

Scholars such as Pol Antràs argue that the world has not entered an era of deglobalization. Rather than deglobalization being a new phase in the world economy, Antràs argues that growth rates experienced in the 1980s, 1990s, and early 2000s up until the Great Recession were unsustainable and that the decrease in growth is a natural correction.[31] Therefore, Antràs is stating that the world has still been globalizing since the Great Recession, just at a decreased rate than it was previously accustomed to. Antràs's scholarship highlights an important point that globalization is not an "on/off" switch but rather a spectrum. The world has not stopped globalizing. In fact, the world continues to globalize, but the rate has slowed since 2008. Although this investigation will continue utilizing the word deglobalization to refer to the localization efforts of the world's major semiconductors markets, it does agree with Antràs in

[30] Peter Dickens, *Global Shift: Mapping the Changing Contours of the World Economy*, 6th ed. (New York: The Guilford Press, 2011), 134.
[31] Pol Antràs, "De-Globalisation? Global Value Chains in the Post-COVID-19 Age," European Central Bank Forum: "Central Banking in a Shifting World," June 2020, 1-2.

that globalization has not stopped entirely, but rather greatly slowed in favor of domestic production.

CHAPTER 3: THEORETICAL FRAMEWORK - GEOECONOMICS

In order to explain why a number of the world's major powers are focusing on increasing domestic production of semiconductors, one must understand the securitization of the industry. More broadly, the theoretical framework of geoeconomics can help to explain the overall securitization of economics. A unique source that reveals how long the geoeconomic value of semiconductors has been known is found in a book by former US President Richard Nixon in which he stated: "Still others contend that, as the cold war weaned, the importance of economic power and 'geoeconomics' has surpassed military power and traditional geopolitics. America, they conclude, must beat its swords not into plowshares, but into microchips."[32] Geoeconomics is a relatively new field of international relations with a large variation and often contradicting definitions provided by scholars.

The theory was first hypothesized by American military strategist Edward Luttwak in his 1990 article "From Geopolitics to Geo-Economics: Logic of Conflict, Grammar of Commerce."[33] Luttwak defined geoeconomics as pertaining to the economic branch of great power politics and positioned it as a subset or branch of the greater geopolitical theory. Luttwak hypothesized that traditional military competition would decrease in favor of global market competition because of the non-zero-sum nature of economic competition. Luttwak's highly simplistic definition of geoeconomics became a point of contention for many scholars, especially

[32] Richard Nixon, *Seize the Moment: American's Challenge in a One-Superpower World* (New York: Simon and Schuster, 1992), 23.
[33] Edward Luttwak, "From Geopolitics to Geo-Economics: Logic of Conflict, Grammar of Commerce," *National Interest,* no. 20 (1990): 17-23.

in regards to what scope qualified geoeconomics. Some scholars believed that geoeconomics had to take place outside of the Great Power's borders in an effort to expand its sphere of influence. For example, Kim stated that "Geoeconomics should be considered as a form of grand strategy and defined as the use of economic instruments to advance mid- to long-term strategic interests in a geographical region of the world."[34] In contrast to scholars such as Kim, Kai-Alexander Schlevgot theorized that domestic competition between cities and regions within one country might even qualify as geoeconomics.[35]

A more comprehensive and applicable definition of geoeconomics was provided by Robert Blackwill and Jenifer Harris, who stated geoeconomics as “the use of economic instruments to promote and defend national interests, and to produce beneficial geopolitical results; and the effects of other nations’ economic actions on a country’s geopolitical goals.”[36] Blackwill and Harris’s definition breaks away from Luttwak, Kim, and Schlevgot in stating that geoeconomics is fundamentally different than geopolitics. This assertion is mainly based on excluding geography as a factor, and focusing solely on “how a state builds and exercises power by reference to economic factors.”[37] In other words, geoeconomics is a means to advance geopolitics. The definition of Blackwill and Harris is more broadly applicable in the sense of what economic actions justify geoeconomics. However, their definition is more narrow in that actions which are not inherently economic, such as military force with the end goal of economic gain, cannot be considered geoeconomics.

[34] Dong Jung Kim, “Making Geoeconomics an IR Research Program,” *International Studies Perspectives* 22 (2021): 321.
[35] Kai-Alexander Schlevgot, “Institutional and Organizational Factors Affecting Effectiveness: Geoeconomic Comparison Between Shanghai and Beijing,” *Asia Pacific Journal of Management* 18, (2001): 519.
[36] Robert Blackwill and Jenifer Harris, *War by Other Means: Geoeconomics and Statecraft*, (Cambridge MA: The Belknap Press of Harvard University, 2016): 20.
[37] Blackwill and Harris, *War by Other Means: Geoeconomics and Statecraft,* 24.

Overall, this investigation will adopt the definition of Blackwill and Harris in regards to geoeconomics. There is agreement with Luttwak, in that geoeconomics is a subset of great power politics, in which actors will utilize economic means to exert geopolitical power. In terms of scope, this investigation considers both foreign and domestic actions to be considered geoeconomics. While a long-term grand strategy should be the end goal, it is not limited by domestic or foreign efforts as Kim and Schlevgot define it.

The scholarship of Norrin Ripsam addresses the same theoretical bridge that this investigation also seeks to explain, that between deglobalization and great power politics, or more specifically, geoeconomics. Ripsam tests the commercial liberal theory that economic interdependence decreases the likelihood of conflict and that decreases in globalization should correlate with increases in geoeconomic great power competition. Ripsam ultimately concludes that increased geoeconomic great power competition has not been caused by deglobalization, but rather that if "deglobalization persists, we can expect it to alter and intensify great power competition."[38] This investigation will also investigate the relationship between globalization and great power politics. Ripsam attempted to use deglobalization to explain an increase in great power competition and found no causal relationship to support this. This investigation distinguishes itself from Ripsam's in that it seeks to find a relationship between increased great power competition, of which geoeconomics is a subset, and increases in deglobalization, reflected by the semiconductor industry.

[38] Norrin Ripsam, "Globalization, Deglobalization, and Great Power Politics," *International Affairs* 97, no.5 (2021): 1333.

CHAPTER 4: METHODOLOGY AND CASE SELECTION

This investigation will seek to prove that the world's primary consumers of semiconductors are putting an increased emphasis on deglobalizing their value and supply chains particularly in the form of state-led or state-sponsored plans and funds. Each of the cases has unique approaches that seek to fill the respective gaps within the their supply and value chains. For instance, the United States leads the world in research in design but lags in manufacturing, therefore it has dedicated more funding to create manufacturing plants. China has a growing manufacturing industry, but is greatly behind on research and development and is therefore prioritizing growth in this sector. While the EU has issued a more balanced approach in enhancing both research and design, and manufacturing. Because of these differences in approach the general measure for comparison will be financial resources allocated, as well as the political discourse by analyzing wording politicians and official government documents in order to determine the aggressiveness and urgency that each country or union places on deglobalizing their semiconductor supply and value chains.

The selections of the United States and China as case studies for this investigation is very straightforward, these are the two major consumers of semiconductors in the global markets and have both issued the most aggressive campaigns to deglobalize their semiconductor sources. The EU as an example is not as clear, in regards to consumption the EU is behind the United States and China. However, the EU offers a valuable comparison as its policies are less aggressive and focus more on building up resilience to external threats than China's mission for self-sufficiency of the United States' maintenance of dominance. While the deglobalization of semiconductors is a global phenomenon that effects many markets, not just "great powers," the exclusion of other countries and trade blocs is firstly to manage the scope of this investigation, but also because the motivation of major exporters of semiconductors such as South Korea and Taiwan to increase production is more economic than for national security. Although these countries have initiated state-led initiatives to increase production, these actions are typically motivated by increased economic gain found in international markets, and not to secure supply for domestic markets.[39] Therefore, these major suppliers that do not consume nearly as much are more motivated to increasingly globalize rather than deglobalize.

CHAPTER 5: THE PEOPLE'S REPUBLIC OF CHINA

China currently stands as the largest importer of semiconductors, with an import value of over $150 billion in 2021.[40] While China represents the largest market for semiconductors, and immense capacities for assembly and testing, the global market share of semiconductors held by China was 5% in 2020 (Graph 4, Appendix 1.4). While China has benefited immensely from the access to foreign semiconductors, allowing it to jump start the digitization of its country and its economy, the Chinese government has now made technological independence a central issue on its agenda.[41] The main hurdle in fulfilling that is closing the research and development gap. While China has successfully established its own semiconductors producers, these are technologically years behind the industry leaders, meaning China is unable to independently produce the highly advanced semiconductors needed for modern day computing. In order to accomplish its stated goal of self-sufficiency, the Chinese Communist Party (CCP) has established a number of interconnected and compounding policies that create government funds

[39] Tristan Kempf, Vito Bobek, and Tatijana Horvat, "The Impacts of the American-Chinese Trade War and COVID-19 Pandemic on Taiwan's Sales in Semiconductor Industry," *International Journal of Economics and Finance* 13, no. 4 (2021): 68-70.
[40] Semiconductor Industry Association, "2021 Factbook," 13.
[41] Christopher Thomas, "Lagging but Motivated: The State of China's Semiconductor Industry," *Brookings Institution: TechStream*, January 7, 2021.

to assist in the creation of semiconductor national champions, encourage foreign direct investment for the purpose of technology transfer, and put financial resource towards the acquisition of foreign semiconductor producers for the purpose of technology transfer. The actions of the CCP are motivated by geoeconomics because China views its reliance on foreign sources of semiconductors as a national security threat and for the geopolitical power gains that come with a comprehensive semiconductor industry.

China's semiconductor industrial history can be divided into four sections.[42] The period from 1956-1990 saw Soviet style central planning focused on domestic production. 1990 to 2002 symbolized a period of "catch-up" when Chinese firms attempted to partner with international industry leaders but found limited success.[43] 2002 to 2014 rode on China's overall economic success, utilizing its growing domestic market allowed a number of Chinese-based semiconductor companies to become established. 2014 to present is what this section will mainly focus on, this period has thus far been characterized as detailed government plans to increase its domestic semiconductor research, design, and manufacturing in order to reduce its dependence on foreign supply.[44]

CHINESE CENTRAL GOVERNMENT SEMICONDUCTOR POLICIES AND FUNDS

Although direct government assistance to the Chinese semiconductor industry did exist prior to 2014, these investments have been dwarfed by the current measures. Furthermore, Chinese state-sponsored actions before 2014 were mainly motivated by economic gain that could be achieved through specialization in the manufacturing, testing, and assembly parts of the value chain, as opposed to the modern pursuit of self-sufficiency motived by national security and

[42] VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," 3.
[43] VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," 11.
[44] VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," 12.

geopolitical power. "The Guidelines to Promote a National Integrated Circuit Industry," (National IC Plan) published in 2014 is the first step in the current Chinese plan for becoming independent in semiconductor production. The National IC Plan designates Chinese national champions in semiconductor production to be supported with funding for the purposes of inbound and outbound FDI, with the ultimate goal of fostering technology transfers.[45] Furthermore, the plan established the National Integrated Circuit Fund which is designated to receive $150 billion in funding from the national and provincial governments, which is to be used to subsidize domestic semiconductor producers and acquire foreign companies within the semiconductor value chain, this will be discussed in detail in the following sub-section. The National IC Plan was highly ambitious in its goals, such as achieving a compound annual growth above 20% by 2020, and have a Chinese semiconductor national champion in the "tier 1" of global semiconductor producers by 2030.[46] China was successful in achieving the first of its stated goals, 2020 saw an "unprecedented" compound annual growth of 30.4% in Chinese semiconductor sales.[47] If this growth can be sustained and if its other stated goals can be accomplished remains to be seen, but it does prove that the National IC Plan is thus far effective. The language within the plan reveals how these ambitions are fueled by geoeconomics:

> [To] promote IC industry breakthrough and overall improvement, advance the transformation of China's economic development system, help safeguard China's national security, and effectively provide support for the overall strengthening of China's comprehensive national power. [48]

[45] VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," 13.
[46] Christopher Thomas, "A New World Under Construction: China and Semiconductors," McKinsey&Company, November 2015.
[47] Semiconductor Industry Association, "China's Share of Global Chip Sales Now Surpasses Taiwan's, Closing in on Europe's and Japan's," January 10, 2022.
[48] Chinese Ministry of Industry and Information Technology, "The Guidelines to Promote a National Integrated Circuit Industry," trans. United States Information Technology Office (Washington D.C., 2014).

The extract from the National IC Plan clearly states that "national security" and "national power are central to the purposes of the Plan and the advancement of the Chinese semiconductor industry. This motivation for self-sufficiency is reflected in all semiconductor plans following the National IC Plan and supports the conclusion that the deglobalization of the semiconductor value and supply chain for China is motivated by geoeconomics.

One year after the release of the National IC plan the Made In China 2025 (MIC25) program was announced by the CCP in 2015. MIC25 set goals for expanding and advancing domestic manufacturing of a wide variety of industries over the years of 2015-2025 but also beyond that. Central to this plan was electronics and technology, with a particular focus placed on semiconductor production on which this analysis will be exclusively focusing. The core of the plan was to secure China as the dominant manufacturer of advanced electronics by 2049. This is to be achieved by advancing all parts of the semiconductor value chain, but with a specific emphasis on research and development. MIC25 takes a similar approach as the National IC Plan in that it also established a number of funds to "facilitate indigenous R&D, acquisition of technology from overseas, and cultivate the technology, intellectual property, and brand identity necessary to achieve this goal."[49] The Roadmap for the Made in China 2025 plan elaborates on the plan laid out in the original MIC25 giving it more concrete goals:

> The local value of output of Chinese-made integrated circuits is expected to reach US$48.3 billion in 2015, meeting 41% of domestic market demand. This value is expected to reach US$85.1 billion in 2020, meeting 49% of domestic market demand. In 2030, it is expected to reach US$183.7 billion, meeting 75% of domestic market demand.[50]

[49] VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," 14.
[50] Chinese Academy of Engineering, "Roadmap of Major Technical Domains for *Made in China 2025"* trans. Ben Murphy (Washington D.C: Georgetown University Center for Security and Emerging Technology, 2021), 2.

These goal have proved to be highly ambitious on China's part, it has still not met its 2015 goal of supplying 41% of its domestic market demand. This is partially due to the immense increase in demand which has happened since 2015 but also the somewhat unrealistic nature of the goals. Nevertheless, the highly ambitious nature of the goals reveal how dedicated the government is to achieve self-sufficiency.

The Thirteenth and Fourteenth Five-Year Plans, covering the years 2016-2020 and 2021-2025, both put a strong focus on self-reliance and self-sufficiency in regards to science and technology in China. The plan outlines the Chinese state's intent to expand research and development and manufacturing of more advanced semiconductors. Although the plan lacks specifics on how these goals will be achieved, it very explicitly conveys the motivation for achieving self-sufficiency.

> We will adhere to the core position of innovation in China's overall modernization, have science and technology self-reliance and self-improvement act as strategic support for national development, and be oriented toward the world's cutting edge in science and technology, toward the main economic battlefields, toward the nation's major needs, and toward the lives and health of the people.[51]

By stating it will orient this technology towards the "economic battlefields," China is directly engaging in the securitization of economics. The statement therefore supports the idea that geoeconomics is motivating the deglobalization of the semiconductor value chain in the case of China.

Foreign Direct Investment and Acquisitions as Means to Gain Technology Transfer

The funding created by the National IC Plan, MIC25, and the Thirteenth and Fourteenth Five-Year-Plans for semiconductor producers has had a very noticeable effect on outbound

[51] Xinhua News Agency, "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035," trans. Ben Murphy (Washington D.C: Georgetown University Center for Security and Emerging Technology, 2021), 11.

investment by Chinese companies mainly in the form of acquisitions. The effect of the funds these policies established is most evident when considering data on Chinese acquisitions of US-based semiconductor producers. Prior to 2014, when the National IC Plan was announced, China had acquired a total of 6 US-based semiconductor companies, valued at $213.8 million.[52] By 2016 the total reached 216 mergers and acquisitions of US-based semiconductor producers by Chinese companies amounting to a total of $8.1 billion.[53] A similar spike in outbound FDI by Chinese companies is also observable in the European Union. Although industry specific data is not available, as it is for the United States, there is an overall spike in mergers and acquisitions of European companies by Chinese companies. In 2014 the amount of spent by Chinese companies on mergers and acquisitions in Europe was approximately $55 billion, in 2015 it was $110 billion, and in 2016 it was $260 billion.[54] Chinese mergers and acquisitions of European and American companies peaked in 2016 as both the United States and European Union increased their restrictions and review process of foreign investments, particularly those originating from China. These FDI limits of the EU and US will be reviewed in their respective chapters. Overall, the aggressive acquisition of foreign semiconductor producers, actively and financially encouraged by the Chinese central government, displays China's attempt to fill its gaps in research in development all for the mission of self-sufficiency.

Other than supporting outbound FDI, Chinese policies also encouraged and incentivized inbound FDI with the purpose of technology transfer. For a foreign company to be able to invest in China it must partner with a domestic company, while foreign companies know this may cost them in technology transfer the Chinese market is too substantial and profitable to ignore. The

[52] VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," 15.
[53] VerWey, "Chinese Semiconductor Industrial Policy: Past to Present," 15.
[54] Agatha Kratz et al., "Chinese FDI in Europe 2021 Update," Mercator Institute for China Studies and the Rhodium Group, April 2022, 4.

Chinese push for inbound FDI has been successful, US-based semiconductor producers Qualcomm and Intel have both recently declared new investments and cooperative projects with Chinese semiconductor producers.[55]

CHAPTER 6: THE UNITED STATES OF AMERICA

The United States has historically been the leader of the semiconductor industry, with US-based companies having invented the transistor and integrated circuit. However, while the United States once dominated all aspects of the semiconductor value chain, specialization as a result of globalization has caused the United States to lose its control over the manufacturing and assembly parts of the production process. Nevertheless, the United States still maintains the majority of the global semiconductor market share, at 47% in 2020 (visualized by Appendix 1.4). The maintenance of the United States global semiconductor market share despite its diminishing control of manufacturing and assembly is due to US-firms maintaining their supremacy in the research and development of semiconductors. The United States has the highest rate of research and development expenditures as a percent of sales, at 18.6%.[56] This is compared to Europe at 17.1%, Japan at 12.9% and China at 6.8%.[57] Despite the European reinvestment percentage coming close to that of the United States, the nominal amount invested in research and development is sure to be vastly different because of the United States' market share. The United States has taken geoeconomic actions to maintain its control of the industry. It has done so in the form of targeted trade barriers against China, and more presently by incentivizing the localization of the manufacturing part of the semiconductor value chain through state funding

[55] Thomas, "A New World Under Construction: China and Semiconductors," 4.
[56] Semiconductor Industry Association, "Semiconductor Industry Association Annual Databook," 2021, 46.
[57] Semiconductor Industry Association, "Semiconductor Industry Association Annual Databook." 46.

and foreign direct investment incentives. This will be demonstrated through an evaluation of recent US policies and discourse by politicians.

TRADE BARRIERS AND EXPORT CONTROLS

Historically, the United States is no stranger to using protectionist trade barriers in order to defend its role as the semiconductor hegemon, typically in the form of protectionist trade barriers. The first instance of this came in the late 1970s and early 1980s when Japanese semiconductor imports into the United States were rapidly increasing. Government intervention was requested by the Semiconductor Industry Association (SIA), which was founded in 1977 by US semiconductor producers, Intel, Fairchild Semiconductor, Advanced Micro Devices (AMD), and the National Semiconductor Corporation.[58] In 1985 the SIA petitioned for Japanese semiconductor producers to be investigated under Section 301 of the Trade Act of 1974, which allows the United States to impose trade sanctions against foreign countries that violate trade agreements or engage in unfair trade practices.[59] This ultimately lead to Semiconductor Trade Agreement being signed by the United States and Japan in 1986 which Japan agreed to expand imports of US-semiconductors and restrict exports in exchange for the United States ceasing its antidumping investigation into Japan.[60] This agreement did not last long, in 1987 the United States placed a 100% tariff on over $300 million of Japanese goods which prompted the Japanese government to convince its firms to decrease exports to the US.[61] While the case of US trade barriers actions against Japan in the 1980s does not directly support the idea that modern day policies are the result of geoeconomics, the case offers a unique contrast to the actions the

[58] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War with China," 356.
[59] Jean Heilman Grier, "The Use of Section 301 to Open Japanese Markets to Foreign Firms," *North Carolina Journal of International Law and Commercial Regulation* 17, no. 1 (1992): 2.
[60] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War with China," 357.
[61] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War with China," 359.

United States took against Chinese semiconductor producers in 2017 which also utilized Section 301. Furthermore, the fact that government intervention in the 1980s was petitioned by US-based semiconductor producers, versus in 2018 when many of these same producers advocated against government intervention, reveals how semiconductor dominance has transformed from an economic issue to a security issue, and highlights how the 2018 US actions against China demonstrate geoeconomics.

The trade barriers established by the United States against China starting in 2018 is perhaps the single most relevant event in the securitization of semiconductor production and the most apparent example of how geoeconomic theory can be used to explain this. In August of 2017, President Donald Trump instructed the US Trade Representative (USTR) to investigate China under Section 301 of the Trade Act of 1974, the same section used against Japan in the 1980s, with the justification the China had engaged in unfair trade practices. In 2018 the USTR found reasons to restrict US trade with China based on four findings:

1. China uses joint venture requirements, foreign investment restrictions, and administrative review and licensing processes to require or pressure technology transfer from U.S. companies.
2. China deprives U.S. companies of the ability to set market-based terms in licensing and other technology-related negotiations.
3. China directs and unfairly facilitates the systematic investment in, and acquisition of, U.S. companies and assets to generate large-scale technology transfer.
4. China conducts and supports cyber intrusions into U.S. commercial computer networks to gain unauthorized access to commercially-valuable business information.[62]

The findings of the USTR on the Chinese violation of Section 301 reveal that the justification is not based on loss of business or allegations of dumping, but rather of predatory business practices that threaten US intellectual property. By utilizing Section 301 with the goal of ensuring national security and not just economic fairness the United States engaged in very clear-

[62] United States Trade Representative, "Section 301 Investigation Factsheet," USTR Archives, https://ustr.gov/about-us/policy-offices/press-office/fact-sheets/2018/june/section-301-investigation-fact-sheet.

cut geoeconomics. The USTR investigation eventually lead to a 25% tariff being placed over $300 billion worth of imports from China, including semiconductors.[63] The national security motivation is further supported when one considers that US-based semiconductor producers protested the action. The SIA stated that it "shares the Trump Administration's concerns about China's forced technology transfer and intellectual property" but deemed the tariffs as "counterproductive" and failing to "address the serious intellectual property and industrial policy issues in China."[64] This opposition reveals that while the sanctions against China were justified as a matter of national security, they did little to actually protect intellectual property.

In order to more effectively protect intellectual property the US turned towards the use of export controls. This began with the addition of Chinese telecommunications national champion, Huawei, to the Entity List, meaning that US-based companies are prohibited from doing business with it unless authorized by the US government.[65] Huawei is the global leader in the production of fifth generation telecommunication network (5G) equipment. The United States viewed this as a national security threat because it feared Huawei could be required to give data that passed through its network to the Chinese government under China's national security law.[66] This first round of export controls again displayed US action as being inherently geoeconomic as Chinese device manufacturers, such as Huawei, account for 22% of the annual sales of US-based semiconductor producers, thereby showing a prioritization of national security issues over economics.[67] The motivation for national security in the matter is further exhibited in a remark made by President Donald Trump in July of 2020

[63] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War with China," 374.
[64] Semiconductor Industry Association, "SIA Statement on Trump Administration Tariff Announcement."
[65] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War with China," 378.
[66] Thorbecke, "The Semiconductor Industry in the Age of Trade Wars, Covid-19, and Strategic Rivalries," 5.
[67] Antonio Varas and Raj Varadarajan, "How Restrictions to Trade with China could End US Leadership in Semiconductors," Boston Consultancy Group, March 2020, 13.

> We stood up to China's intellectual property theft, at a level that nobody has ever come close. We confronted untrustworthy Chinese technology and telecom providers. We convinced many countries — many countries — and I did this myself, for the most part — not to use Huawei because we think it's an unsafe security risk. It's a big security risk[68]

President Trump emphasizes the geoeconomics of the export controls by highlighting the "big security risk" that the United States perceived in Chinese mergers and acquisitions and in doing business with Huawei. The Trump quote also raises the question if US action against China, in regards to semiconductors, is inherently partisan because the action was initiated by a Republican President. However, the rest of this chapter will show how President Obama began the initial blocking of Chinese acquisitions and that President Biden has continued many of the Trump era export controls on China and that he also views Chinese semiconductor policy as a national security threat. Therefore, while partisanship may play a role in how aggressive the actions are within political discourse, the general theme of viewing Chinese semiconductor companies and policies as a national security threat transcends party lines.

Despite cutting off supply from US-producers, Huawei was still able to purchase semiconductors from South Korean, Taiwanese, and other non-US producers. In order to combat this the United States Department of Commerce adjusted the Foreign Direct Product Rule (FDP) which is outlined in General Prohibition Three of the Export Administration Regulations (EAR).[69] This amendment added "software" and "technology" as product the United States had jurisdiction over, as well giving it the authority to limit use "when there is knowledge that the foreign-produced item is destined to a designated entity listed on the Entity List," such as

[68] Donald Trump, "Remarks by President Trump in Press Conference," *White House Archives*, July 14 2020.
[69] United States Industry and Security Bureau, Department of Commerce, "Export Administration Regulations: Amendments to General Prohibition Three (Foreign-Produced Direct Product Rule) and the Entity List," *Federal Register*, May 19, 2020.

Huawei.[70] This forced foreign manufactures that utilized US software or equipment in their production process not to do business with Huawei. In December of 2020 the United States also added Chinese Semiconductor Manufacturing International Corporation (SMIC) to the Entity List.[71]

The actions of the United States thus far relating to imposition of trade barriers and export controls directed at China represent a clear display of geoeconomics. The United States views the Chinese semiconductor and technology industry as a national security threat and is utilizing economic measures to attempt to slow it down, even if at the cost of its own semiconductor industry. In fact, the United States seem to prioritizing the issue of national security in regards to Chinese semiconductor capabilities so much that some experts believe it will hurt the United States in the long-term.[72] While actions such as adding major Chinese semiconductor buyers and producers, Huawei and SMIC, to the Entity List, and the amendment of FDP were perceived as a means to cut China off from the rest of the worlds' semiconductor manufacturers, this could have an adverse effect. The United States imports accounted for under 30% of Chinese semiconductors demand, with the majority of the rest coming from Taiwan, South Korea, and Malaysia. The United States hoped to coerce foreign semiconductor producers into siding with the US over China by threatening to revoke technology and equipment from the production process. While this may have initially worked, it could cause many foreign semiconductor producers to view reliance on US technology as unreliable and encourage them to create their own methods. Another possibility is that foreign semiconductor producers will prefer to side with China, as China is a substantially larger consumer of semiconductors than the United

[70] United States Industry and Security Bureau, Department of Commerce, "Export Administration Regulations: Amendments to General Prohibition Three (Foreign-Produced Direct Product Rule) and the Entity List."
[71] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War with China," 380.
[72] Varas and Varadarajan, "How Restrictions to Trade with China could End US Leadership in Semiconductors," 2.

States. Under the current status quo, Antonio Varas and Raj Varadarajan predicted that the United States could lose up to 8% of the global market share, translating to an approximate 16% loss in sales, and therefore around 13%-25% less to be invested into research and development (based on 2018 status of US semiconductor industry).[73] These numbers reveal how the United States government is willing to sacrifice some of its semiconductor industry advantage in order to stall China's progress for the sake of what it perceives as national security.

Limits on Foreign Investment

In order to further protect its semiconductor dominance, the United States placed increasing limits on mergers and acquisitions by foreign entities. The Council on Foreign Investment in the United States (CFIUS) possess the authority to block any type of foreign investment if it is perceived as a threat to national security. Following the rapid increase of mergers and acquisitions of US-based semiconductor producers by Chinese companies between 2014-2016, the CFIUS became more active than ever.[74] In 2016 the CFIUS, under the direction of President Barrack Obama, went so far as to intervene in the acquisition of German semiconductor company, Axitron, by Chinese Fujian Group, citing its right to intervene because Axitron had a plant in California and it would pose a national security threat.[75] In 2018 the United States passed the Foreign Risk Review Modernization Act (FIRRMA) which greatly increased the reach and oversight of the CFIUS. The passing of the FIRRMA was directly prompted by "national security risks related to foreign investment, particularly those emanating from countries such as China and Russia."[76] Although China was explicitly named in the

[73] Varas and Varadarajan, "How Restrictions to Trade with China could End US Leadership in Semiconductors," 2.
[74] Bown, "How the United States Marched the Semiconductor Industry into Its Trade War with China," 381.
[75] Kempf, Bobek, and Horvat, "The Impacts of the American-Chinese Trade War and COVID-19 Pandemic on Taiwan's Sales in Semiconductor Industry," 65.
[76] Congress.gov, "H.R.5841 – 115th Congress (2017 - 2018) - Foreign Risk Review Modernization Act," August 2019.

FIRRMA, the caution towards foreign acquisition of semiconductor producers extended even to traditional allies of the US. In 2020, when German semiconductor producer Infineon Technologies wanted to acquire US-based Cypress Semiconductor it had to agree to security guarantees as the US was worried about Infineon's financial interest in the Chinese market.[77] By going so far as to block acquisitions of foreign companies the US actions reveal how national security centric its actions are.

DIRECT GOVERNMENT ASSISTANCE AND INCENTIVES

Aside from the protectionist measures aimed to hinder the growth of China in the semiconductor and technology industry, the United States has set up government plans and policies that aim to maintain the United States as the semiconductor industry leader. These state plans provide funding for domestic producers in order to offset the economic impact of trade barriers with China, increase localized capabilities of domestic and foreign producers through investment incentives, and allocate increased financial resources to maintain research and development dominance.

The Creating Helpful Incentives to Produce Semiconductors (CHIPS) for America Act was passed in December 2020, included within the National Defense Authorization Act (NDAA) for the Fiscal Year of 2021.[78] While this bill created funding programs within US public law, it did not allocate funding to these programs. Nevertheless, the inclusion of the CHIPS for America Act within the NDAA supports that the United States sees economic action in order to maintain its semiconductor dominance as a security issue, supporting it as a geoeconomic action. Funding for the programs created by the CHIPS for America Act were outlined in the United States

[77] Torsten Riecke, "Resilience and Decoupling in the Era of Great Power Competition," *Mercator Institute for China Studies*, August 20, 2020, 7.
[78] Congress.gov, "H.R.6395 - 116th Congress (2019-2020): William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021," January 1, 2021.

Innovation and Competition Act of 2021, otherwise known as the America COMPETES Act. The bill would allocate $52 billion to support the fabrication of semiconductors within the US. Thus far, the bill has been passed by both chambers of the US Congress and should move on for Presidential approval in the near future. President Biden has voiced his support for the bill in a statement:

> Together, we have an opportunity to show China and the rest of the world that the 21st century will be the American century – forged by the ingenuity and hard work of our innovators, workers, and businesses.[79]

President Biden's statement perhaps best sums up the US position on semiconductors. The United States would have likely accepted a maintenance of the status quo of the semiconductor industry pre-2014, the globalization and stretched value chain of semiconductors was not perceived as a major security threat. It was only once China voiced its ambitions of becoming a major player in the semiconductor industry that the US started to worry about where its semiconductors were manufactured or assembled. Therefore, one can discern that the deglobalization of the semiconductor industry is not motivated by economics, but rather economic means to achieve a geopolitical end.

CHAPTER 7: THE EUROPEAN UNION

At the start of the 2000s, the European Union accounted for over 25% of all semiconductor production, and whereas demand has only increased since then, the present share of global semiconductor production of the European Union is 9%. The deterioration of EU semiconductor manufacturing is explained similarly to that of the United States, geographical

[79] Joseph Biden, "Statement by President Biden on the America COMPETES Act of 2022," *The White House,* January 25, 2022.

specialization through globalization caused the labor intensive aspects of production to move primarily to Southern Asia while the EU maintained research and design. The EU did not focus on the threats of this interdependence until the situation between China and the United States in regards to trade barriers and acquisitions became more apparent. This has left the European Union, which accounts for 20% of the worlds demand for semiconductors but only 9% of the research, development, and manufacturing, wondering about the reliability of its semiconductors sources.[80] The EU and its member states have now begun taking action in the form of government funding for domestic producers, incentivization of FDI, but also greater oversight into inbound FDI in the form of mergers and acquisitions.

The European Union's motivation for deglobalizing its semiconductor sources is a pursuit of strategic autonomy. The EU is not looking to become dominant in the industry like China or defend its supremacy like the United States, but the EU surely sees the national security threat that could arise from remaining complacent while other markets prioritize domestic production and self-sufficiency. The EU and its member states have made clear that they, similarly to the United States, see the national security threat to Chinese dominated tech industry, specifically in regards to data collection as a number of member states have banned or limited Huawei from establishing their 5G network.[81] However, relations with the US and the EU are not as good as they once were and EU must be aware that the US will always act in its own interest, even if at the cost of other trade partners, demonstrated by its efforts to coerce the global semiconductor industry to cease business with Huawei and SMIC. This explains how the actions

[80] Varas et al., "Strengthening the Global Semiconductor Supply Chain in an Uncertain Era," 11.
[81] Daniel Gros, "The European Chips Initiative: Industrial policy at its absolute worst," *Centre For European and Policy Studies* (blog), February 10 2022,.

of the European Union in regard to semiconductor localization and deglobalization reflect a pursuit of national security.

GOVERNMENT FUNDING AND SUBSIDIZATION

The European Chips Act was announced by the European Commission in February of 2022. The legislation seeks to increase the resilience of supply chains and expand value chains, mainly by increasing domestic production to meet Europe's needs, and cementing Europe as a long-term leader in semiconductor production. The ultimate goal being to get the EU's global manufacturing share from the current 9%, to 20% by 2030.[82] In order to accomplish these stated goals, the European Chips Act has four major components: 1) Research and Development: While Europe is already a global leader in the design of semiconductors, more resources must be provided to maintain that position in the rapidly growing global industry. 2) "From lab to the fab:" Building off the previous point of European research and development of semiconductors, Europe must bridge the gap between design and manufacturing and create a vertically integrated, domestic, production model.[83] 3) Industry Production: Europe will need to build "first of a kind" advanced production facilities. While these carry immense start-up costs, the manufacturing of advanced semiconductors domestically will benefit other European industries. 4) Local Support: The EU will focus on supporting the growth of start-ups to expand semiconductor research and design, mainly by addressing the "skill shortages" required for this industry.[84] Overall the European Chips Act will allocate more than $44 billion to expand semiconductor production capabilities.[85] By allocating financial resources to its domestic semiconductor producers, the EU

[82] Cota, "The European Chips Act: Strategy to Expand Semiconductor Production Resiliency."
[83] Ursula Van Der Leyen, "Statement by President Van Der Leyen on the European Chips Act," (European Commission, Brussels, Belgium, February 8, 2022).
[84] Cota, "The European Chips Act: Strategy to Expand Semiconductor Production Resiliency."
[85] "Digital Sovereignty: Commission proposes Chips Act to confront shortages and strengthen Europe's technological leadership," (European Commission - Press Release, Brussels, Belgium, February 8, 2022)

hopes to encourage the creation of domestic manufacturing and assembly operations alongside its existing research and development centers, while simultaneously making them more resilient against foreign acquisitions. These actions reflect the geoeconomic action by the EU as it hopes to fill more of its domestic demand in order to be less susceptible to foreign reliance and future disruptions.[86]

INBOUND FDI SCREENING

The EU and its members states have also responded to the increase in acquisition attempts of its domestic semiconductor producers, particularly in regard to China. As stated in the chapter on China, Chinese investments in the form of mergers and acquisitions increased dramatically as a result of Chinese governmental policies and funds. While this action was perhaps not directly in response to Chinese acquisitions, it certainly influenced the decision. In response to this the EU passed investment screening regulation which became effective in October of 2020. This EU action prompted its member states to pass their own FDI screening legislation, eleven member states had such legislation prior to the EU action, an additional seven acted as a result, and all but three of the 28 have plans to initiate their own.[87] From October 2020 to June 2021, there were 265 instance of inbound FDI that member states asked the EU to review.[88] While this data is not limited to semiconductor oriented inbound FDI it reveals how rapidly EU member states began referring inbound FDI to the EU because of national security concerns. A number of the blocked acquisitions in 2020 and 2021 involved semiconductor producers such as Shenzhen Investment Holdings attempt to buy Italian-based LPE, Zhejiang

[86] Ernst, “European Semiconductor Autonomy - A Façade or Reality.”
[87] Kratz et al., “Chinese FDI in Europe 2021 Update,” 14.
[88] Kratz et al., “Chinese FDI in Europe 2021 Update,” 14.

Jingsheng Mechanical attempt to buy Italian-based Applied Materials, and SAI MicroElectronics attempt to buy German-based Elmos Semiconductor.[89]

The blocking of foreign mergers and acquisitions of European companies is central to the EU's achievement of strategic autonomy. The European Union finds itself between two major powers that have many financial resources at its disposal and are highly motivated to dominate the semiconductor industry. Without FDI screening the EU's semiconductor producers risk becoming victims of the ambitions of the United States and China. Therefore the screening and blocking of inbound FDI is a geoeconomic action by the European Union.

INCENTIVIZING FOREIGN DIRECT INVESTMENT

Analyzing the incentivization of foreign direct investment by the European Union differs from that of the United States or China as this action typically originates from the member states but will sometimes require the approval of the European Union. While these incentives have not come directly from the EU, they have been furthered by EU backed projects. The largest of these projects is the Important Project of Common European Interest on microelectronics (IPCEI) which includes France, Germany, Italy, Austria, as well as the United Kingdom (which was still an EU member during the IPCEI's inception in 2018). While the funds of this project stem from the states themselves, not the EU, the IPCEI does need the approval of the European Commission to ensure state aid projects follow an overriding European interest and avoid "disproportionate distortion of competition."[90] A criticism of this approach could be that these are not the actions of the EU, but its member states. However, in January of 2022 the EU reaffirmed its support for the IPCEI by lowering the requirements needed to provide state

[89] Kratz et al., "Chinese FDI in Europe 2021 Update," 14.
[90] "About the IPCEI," The Important Project of Common European Interest on microelectronics, 2022, https://www.ipcei-me.eu/what-is/.

funding to microelectronics projects.[91] Thereby conveying its approval for the incentivization of foreign direct investment in regards to semiconductor production. Furthermore, analyzing FDI within the European Union also involves FDI between member states.[92]

Thus far, the IPCEI and its members have provided financial incentives for inter-European investment as well as foreign direct investment. In June of 2021, IPCEI supplied $165.92 million to match German-based Bosch's $1.18 billion investment on a semiconductor manufacturing plant in Dresden, Germany. Former German Economic Minister Peter Altmaier stated in June 2021 that $5.8 billion had been designated for expanding German semiconductor production and backing the IPCEI, with the possibility of that figure being doubled should there be "high interest from significant investors from outside Germany."[93] GlobalFoundries, the US based semiconductor firm, has also applied for funding with the IPCEI, the outcome of which will certainly impact its stated intention to expand EU production capacity in 2024.[94] Tax breaks have been another form of incentive to increase foreign direct investment into semiconductors. As an incentive for Infineon Technologies investing $41.48 million in its global competence center in Villach, the Austrian government allowed 14% of Infineon research costs to be refunded tax free.[95]

Thus far Europe has been successful in fostering not only intra-European investment, but also FDI from outside of Europe. The U.S. based company, Intel, has recently announced its

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[91] Johan Ysewyn, Carole Maczkovics, and Sophie Bertin, "The Commission has revised its communication on the Criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest ('IPCEI')," *Covington and Burling*: Global Policy Watch, EU Law and Regulatory (2022).
[92] Ernst, "European Semiconductor Autonomy - A Façade or Reality."
[93] "Germany ready to double state aid for semiconductor industry – minister," *Reuters,* July 1, 2021, https://www.reuters.com/article/tech-germany-idUSL5N2OD484.
[94] "Germany ready to double state aid for semiconductor industry – minister," *Reuters.*
[95] Glenn Barklie and Naomi Davies, "Where should Intel establish its new European chip Plants." *Investment Monitor,* September 8, 2021. https://www.investmentmonitor.ai/analysis/intel-europe-semiconductor-fdi-investment.

plans to invest over $86 billion over the next decade to expand and enhance its research, design, and manufacturing capabilities in Europe. This investment includes $18 billion on a new manufacturing plant in Magdeburg, Germany, $13 billion on upgrading its existing manufacturing plant in Leixlip, Ireland, and further potential projects in France, Italy, Poland, and Spain.[96] Other multinational corporations have also announced intentions to invest in the EU to create or expand semiconductor research, design, and manufacturing, including Taiwan Semiconductor Manufacturing Company, South Korean based Samsung Electronics, and US based Global Foundries. Despite inbound FDI coming from multiple countries, a considerable majority is coming from US-based semiconductor producers which could threaten the EU's pursuit for strategic autonomy.[97]

CHAPTER 8: COMMENTARY AND CONCLUSION

As revealed by the empirical analysis the actions of China, the United States, and the European Union are all motivated by geoeconomics. Despite the differences in goals or approaches the central motivator for all parties is national security interests. In the case of China, national security implies securing its supply of semiconductors by catching up to existing semiconductor producers to secure its rapidly growing demand. This has required an aggressive growth-oriented approach with massive amounts of financial resources being allocated to creating national champions to compete with the top global semiconductor producers, and by fostering technology transfer either by mergers and acquisitions in the form of outbound FDI, or incentivizing inbound FDI in the form of partnerships between Chinese and foreign semiconductor producers. For the United States, national security has taken the shape of

[96] "Intel Announces Initial Investment of Over €33 Billion for R&D and Manufacturing in EU," Intel Newsroom, March 15 2022, https://www.intel.com/content/www/us/en/newsroom/news/eu-news-2022-release.html#gs.wutsyx.
[97] Ernst, "European Semiconductor Autonomy - A Façade or Reality."

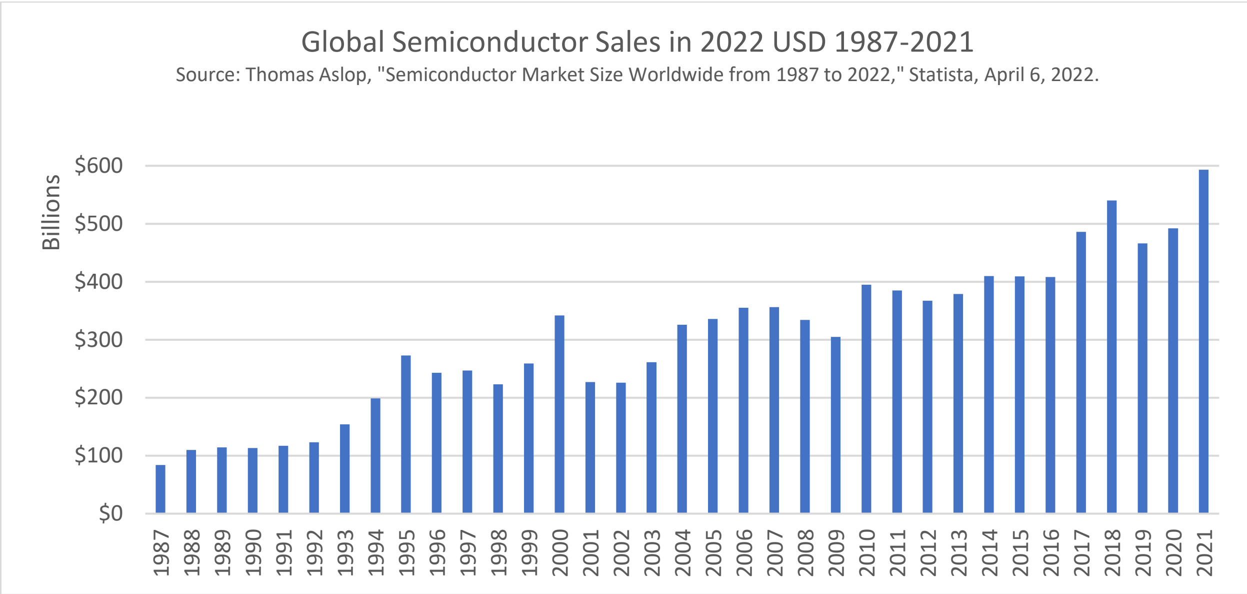
maintaining its dominance of the semiconductor market. As a result, the United States has taken defensive action in an attempt to stall China from growing its semiconductor industry. These actions have taken the shape of trade barriers on business with Chinese companies, the increased screening and blocking of inbound FDI, and the allocation of financial resources to domestic semiconductor producers. Meanwhile the European Union's approach to secure its autonomy in order to reduce the impact of external threats, particularly from what could happen if the situation between the United States and China leads to a complete decoupling of the global semiconductor industry. This has taken the form of financial resource allocation for domestic producers, the blocking and screening of FDI to maintain the European semiconductor industry, and incentivization of inbound FDI to increase production capabilities.

In the broader context, the deglobalization of the semiconductor industry and the geoeconomic explanation hold implications for the broader concept of deglobalization. As major semiconductor markets have increasingly started to view their supply of semiconductors as a national security issue, one can assume that this phenomenon will continue to affect other industries. The ongoing war by Russia on Ukraine heightened the national security threats associated with globalized energy supplies. Furthermore the loss of Ukrainian food exports and increased food prices as a result may cause countries to reevaluate their globalized food sources under the guise security. Just as geoeconomics is a relevant explanation for the deglobalization of the semiconductor industry, the same could soon become true for food or medical supplies. What other industries will become securitized like the semiconductor industry remains to be seen, but it is a reasonable guess to think more and more products and services will be deglobalized as a result of security concerns.

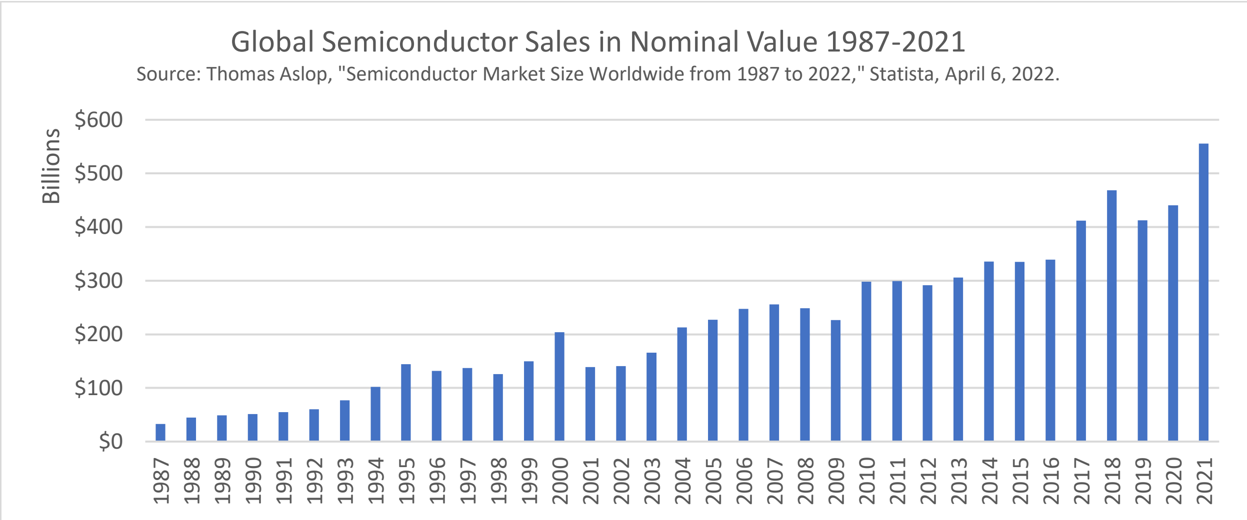
This is only the beginning of the securitization of the semiconductor industry. As China continues to grow its market share through its, thus far, fairly successful government policies and funds, one can predict that the United States will increasingly try to slow it down. The United States has shown it will take drastic action to maintain its dominance, even if at the cost of its domestic semiconductor producers or by threatening foreign producers with loss of US intellectual property if they do business with Chinese companies it views as a risk, so it is impossible to rule out a total ban on business with China by the United States. A complete decoupling of the Chinese and American semiconductor industries would not only be detrimental to the world economy, but would force many other countries to pick sides in a technologically bi-polar world, increasing geopolitical tensions drastically. Furthermore, while EU policy seems to be preparing for such an event, the actions it has taken thus far would not be sufficient to protect it from the fallout a global semiconductor split. While the EU appears to be siding with the United States more than it is with China, as is to be expected based off cooperative history and political systems, the EU must be aware that siding with the United States would undermine its stated goal of strategic autonomy. Additionally, the US has in the past acted aggressively towards foreign producers to protect its own market share. This field of research is sure to develop immensely over the coming decade as many of the policies discussed in this paper began to have lasting effects.

APPENDIX

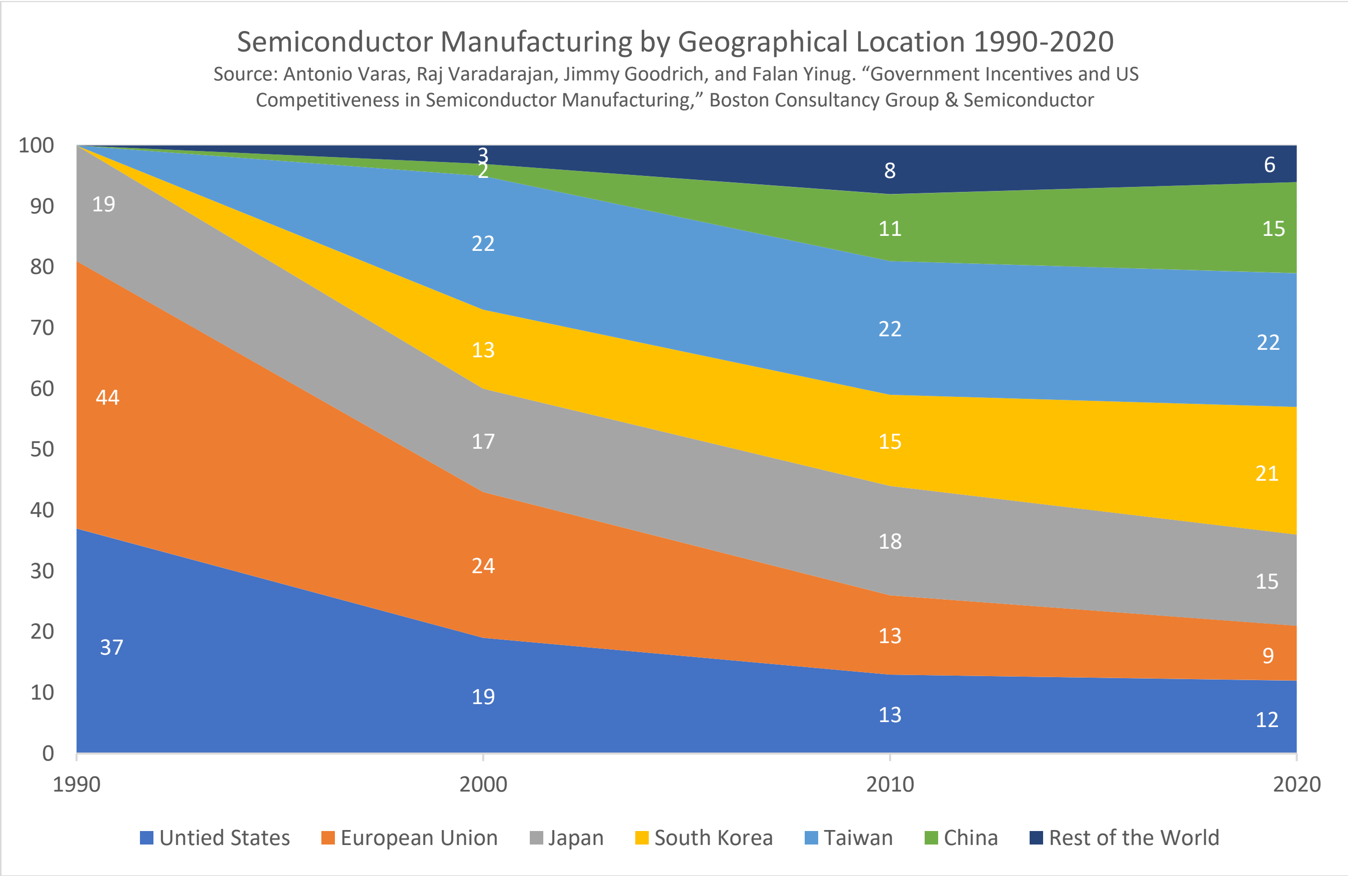
1.1 Graph #1



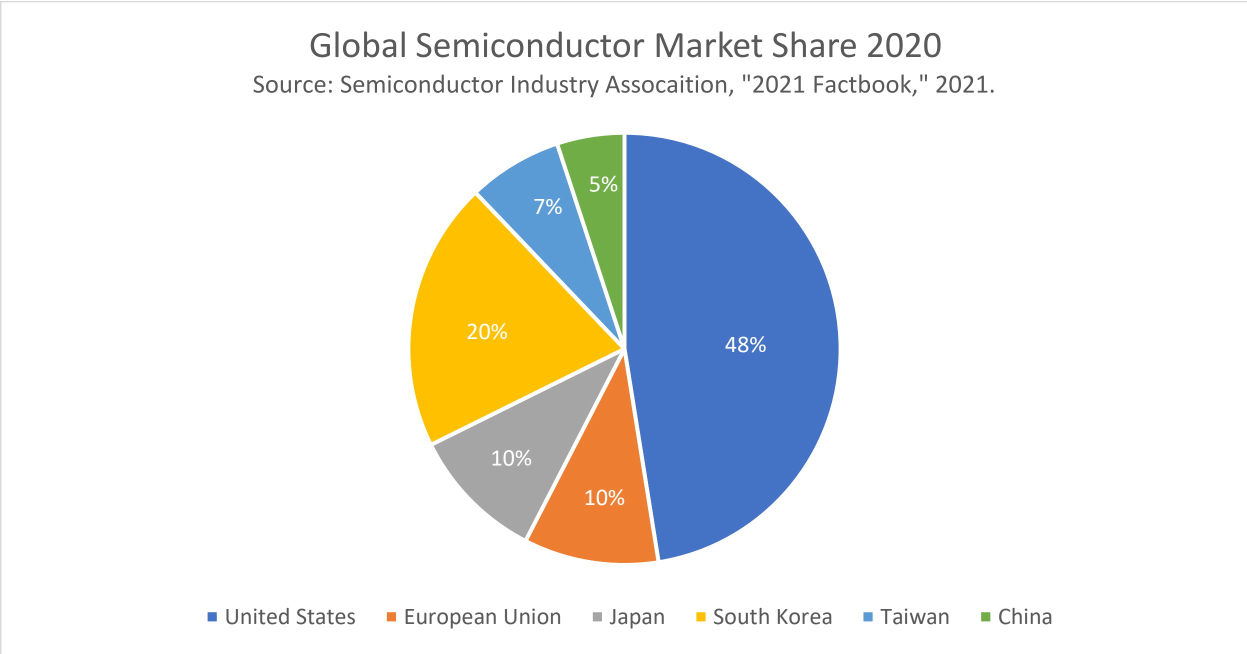
1.2 Graph #2



1.3 Graph #3



1.4 Graph #4



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