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US-China Decoupling: Some Evidence of Changing Trade and Investment Patterns

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Acknowledgments

Learning about US–CH decoupling and understanding how political decisions can affect complex trade patterns has been rewarding . By working on this thesis, I have gained valuable knowledge. It seems that the issues regarding decoupling are still in their infancy, and it will be interesting to continue to follow the development and to see how decoupling will affect international trade.

I want to thank my supervisor for helping me with the development of this paper. I sincerely appreciate the feedback and motivation I have received. I would also like to thank the factuality at NMBU for help with all my inquiries.

Abstract

This thesis aims to investigate whether discernible shifts have occurred in US-China trade patterns in the semiconductor industry as a result of the United States' policy efforts to disengage from China. The objective is to comprehensively analyze trade data and policy measures to understand the economic consequences stemming from initiatives to decouple trade relationships.

The research will focus on identifying changes in the volume, and direction of trade between the two countries. Additionally, the study will try to comment on the various policy measures implemented by the United States to reduce its economic dependence on China. Through analysis, this research endeavor seeks to provide insights into the dynamics of US-China trade relations and the implications of decoupling.

Understanding these shifts in trade relations between the United States and China is important for policymakers, businesses, and stakeholders to make informed decisions and navigate this evolving landscape of trade.

Keywords: *Decoupling, Gravity Model, China, United States, Economics, Trade*

Summary

The trade relationship between the United States and China has been mutually beneficial and has seen significant transformations over recent years. Historically characterized by robust interconnectedness, this relationship is now at risk of being dismantled due to the U.S.'s perception of China breaching international trade agreements. In response, the U.S. has imposed tariffs and other restrictions on China to compel compliance with trade obligations.

This paper investigates whether trade policies associated with decoupling are impacting the trade of semiconductors between the U.S. and China. To address this question, the study employs panel data spanning from 2013 to 2022, examining both total exports and imports as well as specific data on semiconductor trade.

Through this approach, the paper seeks to provide insights into the effectiveness of the decoupling strategy on the semiconductor industry, offering valuable implications for policymakers and stakeholders in the tech industry.

1. Introduction

In 1979 when the United States (US) and China (CH) normalized their relationship, CH underwent a series of economic reforms, one of them being the open-door policy under Vice Premier Deng Xiaoping that enabled CH integration into the global economy. And since then, CH has experienced incredible economic growth. Between 1980 and 1999 the volume of CH foreign trade almost grew tenfold, going from 38 billion US Dollars to 360 billion USD (Holbig & Ash, 2002).

This trend of more liberal trade has played a pivotal role in facilitating the increased movement of goods and services between countries. This has led to the creation of complex global supply chains, increasing the economic efficiency and interdependence between nations. Let's consider two important metrics since CH's ascension to the World Trade Organization (WTO) in 2001. Since then, there has been a notable decrease in global poverty levels (World Bank, 2024c) and more than a doubling of global GDP per capita in USD (World Bank, 2024a) improving the living standards for millions of people worldwide. And if we consider that the US is one of the biggest consumer markets in the world (Kharas & Fengler, 2021), a large share of the production traded by CH is consumed by US consumers. As such, US consumers have been direct beneficiaries of CH production, raising their material living standards. This trade relationship has been beneficial for the economy of both the US and CH, which today are the two biggest in the world. So, as economic interdependence has benefitted both, one would think that this would continue.

However, tensions have emerged due to CHs alleged use of what the US considers unfair and sometimes illegal trade practices. Allegations of market-distorting subsidies, intellectual property (IP) theft, and violations of trade agreements, along with a more assertive CH in territorial disputes have fueled growing unease in the United States (Mahmood & Cheema, 2018). It is particularly the increased interdependence and illegal trade practices by CH in key sectors such as semiconductors that have raised concerns on the background of CH's territorial pursuits which have the potential to threaten global supply chains and regional stability. In response to these trade and geopolitical challenges, there have been calls in the US for a potential "decoupling" from the Chinese economy, aiming at reducing the interdependence that has been beneficial for both countries.

As such, reducing the interdependence is seen as a strategic imperative to safeguard US technological edge and security interests. The implementation of various retaliatory measures against CH by the US is driven by policy objectives aimed at addressing what is perceived as unfair economic practices by CH in an attempt to pressure them to adhere to the same rules established by multilateral agreements. By creating a level playing field, policymakers hope to mitigate the adverse impact of these practices on American businesses and workers, ensuring that all Americans have an opportunity to thrive in the global marketplace (USTR, 2018). Therefore, it is reasonable to imagine that decoupling efforts that revolve around security concerns can take priority over those that are purely over economic conditions, which carries the risk of reducing economic efficiency associated with international trade (El-Erian, 2023).

Therefore, understanding the multifaceted issue of decoupling between the two largest economies can potentially be of interest to policymakers and investors alike as it might disrupt global trade and existing supply chains. It also can serve as a potential indicator for discerning the future trajectory of US-China trade relations and offers insights into international trade dynamics.

1.1 Objective

This thesis aims to investigate if there have been any distinct changes in the trade pattern of semiconductors between the US and CH amidst policy efforts to decouple in this sector by the US. The focus is on understanding the motivations behind decoupling, particularly concerning the "critical" commodity, and the impact on bilateral trade. Through analysis of policy actions and trade data, the thesis provides insights into the US-CH trade relations in the semiconductor sector and the efforts decouple.

The thesis will analyze the import and export trends in the semiconductor sector, for the period from 2013–2022. More specifically the thesis will investigate semiconductors categorized under the harmonized system (HS-8542).

Semiconductors play an indispensable role in powering the technology that we use in our daily lives. They are integral components in everything from refrigerators, smartphones, laptops, and military equipment, ensuring their effective functionality (Semiconductor Industry Association, 2023).

The thesis has two research objectives to get a comprehensive overview of possible trade changes in these sectors. The two objectives are:

1. Analyze any changes in the trade patterns for the selected sector between the United States and China in 2013-2022.

2. To assess whether any potential changes in the trade patterns have been due to changes in policy by the US.

The trade data used for the analysis are collected from the publicly available UN Comtrade database. There, trade data for the respective HS-codes for the period between 2001–2022 has been collected and will be used in different econometric models.

1.2 Organization

The organization of the thesis will be structured into six chapters. The second chapter gives background information on US-CH trade patterns and the shift in political thinking in the US toward decoupling. In chapter three economic trade theory is considered to discuss how WTO rules conform to the theory and provides a review of the existing literature. Chapter four identifies the sources of the data, defines the variables used, and specifies the model for the analysis. Chapter five reports on the regression results. Finally, chapter six the conclusion and concluding comments.

2. Background

2.1 China's accession to WTO

For three decades after the creation of the People's Republic of China (PRC) in 1949, bilateral trade with the US was practically non-existent, as Washington had severed connections with the communist government in Beijing for ideological reasons. But in 1971, Secretary of State Henry Kissinger under the Nixon administration undertook an unofficial trip to CH to reduce tensions between the two nations and to strengthen US influence in the region. Following the unofficial diplomatic visit, the US formally acknowledged the PRC and granted it a permanent Security Council seat at the United Nations. After recognition from the US, CH began a series of economic reforms under Vice Premier Deng Xiaoping most notably regarding trade, and its open-door policy which began with the adoption of a new economic development strategy to increase trade and investment in late 1978 (Council on Foreign Relations, 2024).

1979 marked a turning point in US-CH trade when the United States normalized its relations with China in an attempt at keeping the Communist Chinese Party (CCP) economically and politically aligned with democratic Western nations and not with the communist Soviet Union. The normalization led to a substantial surge in trade over the subsequent four decades—from a few billion dollars annually to hundreds of billions of dollars (Siripurapu & Berman, 2024).

Later, in 1986 CH applied to rejoin the multilateral trade organization, the General Agreement on Tariffs and Trade (GATT), the predecessor to the World Trade Organization (WTO). CH would later join the WTO after long negotiations with the United States and other members in late 2001.

Passing the United States–China Relations Act of 2000 was instrumental in the trade relationship that would later form between the US and CH. Former US president Bill Clinton encouraged the US Congress to sign the US–CH Relations Act, saying:

"*Economically, this agreement is the equivalent of a one-way street. It requires China to open its markets—with a fifth of the world's population, potentially the biggest markets in the world—to both our products and services in unprecedented new ways*," (Clinton, 2000).

The act was important because before China joined the WTO it needed a special waiver from the US president to conduct trade with the US to ensure it would have most favored nation (MFN) status, which it had gained annually since 1980. This was because CH fell under the coverage of Title IV of the Trade Act of 1974 (Hecker, 1998). Specifically, section 401 of the Trade Act which required that the President deny MFN status on products from several countries, including CH.

However, section 402 of the Trade Act, also known as the "Jackson-Vanik Amendment," permitted a 1-year exception to the rule when the President determined that a country, such as CH, substantially complied with certain freedom of emigration objectives (Hecker, 1998).

But, since the Jackson-Vanik amendment provision only allowed for a 1-year waiver of Title IV restrictions, congress could potentially deny CH the waiver granted by the president. At the time, the Clinton administration planned to ask Congress to enact legislation that would remove China from Title IV's coverage. The administration believed that the conditional MFN status granted to China under the Jackson-Vanik amendment conflicted with the WTO principle of providing unconditional MFN to WTO members. So, in adherence with one of the core principles of GATT/WTO the US Congress enacted the US-China Relations Act of 2000 which granted China permanent MFN status, and thus CH could become a permanent member of the WTO (Hecker, 1998), a membership that helped the country become the exporter it is today.

2.2 China as a global player

As CH entered the WTO in late 2001, US imports of Chinese goods rose from just over 100 billion in 2001 to over 500 billion in 2022. The surge in trade between the US and CH since 2001 can be observed in Figure 1.

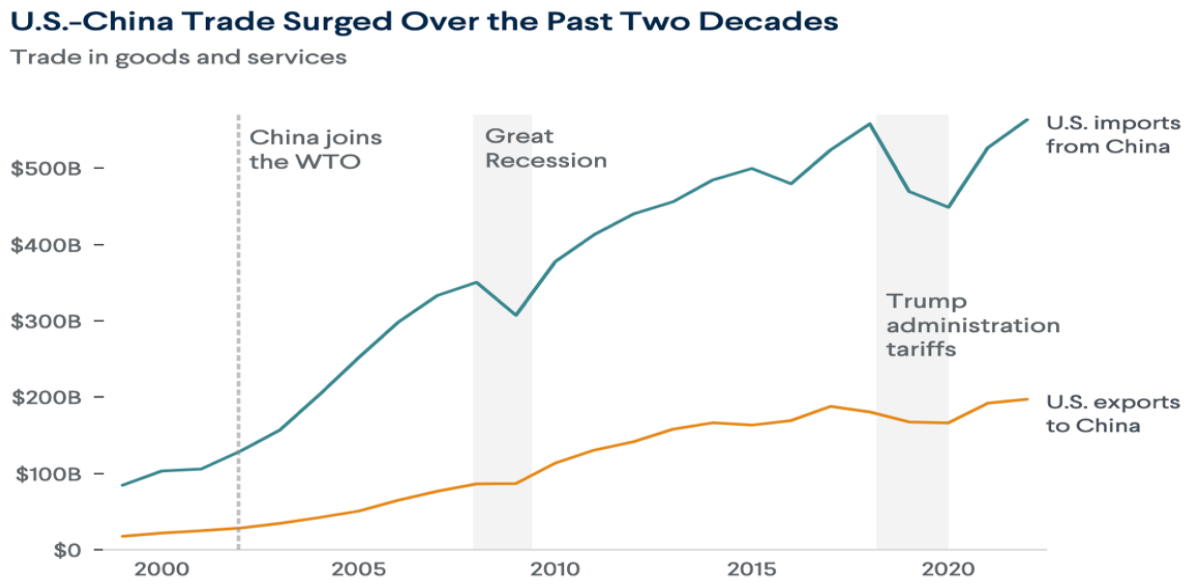

Figure 1: Overview of US imports and exports from China (Siripurapu & Berman, 2024)

As CH's economy has become more open it has become a powerhouse in global trade. CH's rise has been unprecedented, with its influence reverberating across various sectors and economies worldwide. Its integration into global trade was felt globally as it caused the loss of many manufacturing jobs in sectors that were competing with Chinese imports. At the core of CH's role as a global manufacturer lies its competitive advantages, which mainly consist of a vast labor force, but also an increasingly robust infrastructure enabling CH to be the top trading partner for over 120 countries, some of which include the likes of Japan, Australia, Russia, South Korea, and Brazil (Green, 2023). The growth in CH's share of total global merchandise trade, from 4.2% in 2001 to 14.4% by 2022 (Development, 2023), highlighting the nation's important position in global trade. This importance is further underscored by its status as the world's largest manufacturer, accounting for a staggering 35% of global gross production by 2024 (Baldwin, 2024).

CH's comparative advantage (CA) which enables it to produce goods efficiently and cost-efficiently has led to its increased trade volume. With its large labor market, CH became the "factory of the world", CH increased its trade with the world almost nine-fold between 2000-2020, during that same period, CH exports increased by 870%, also the value of the goods trade increased by a large margin, total trade value rose by 810% (Kawate, 2021).

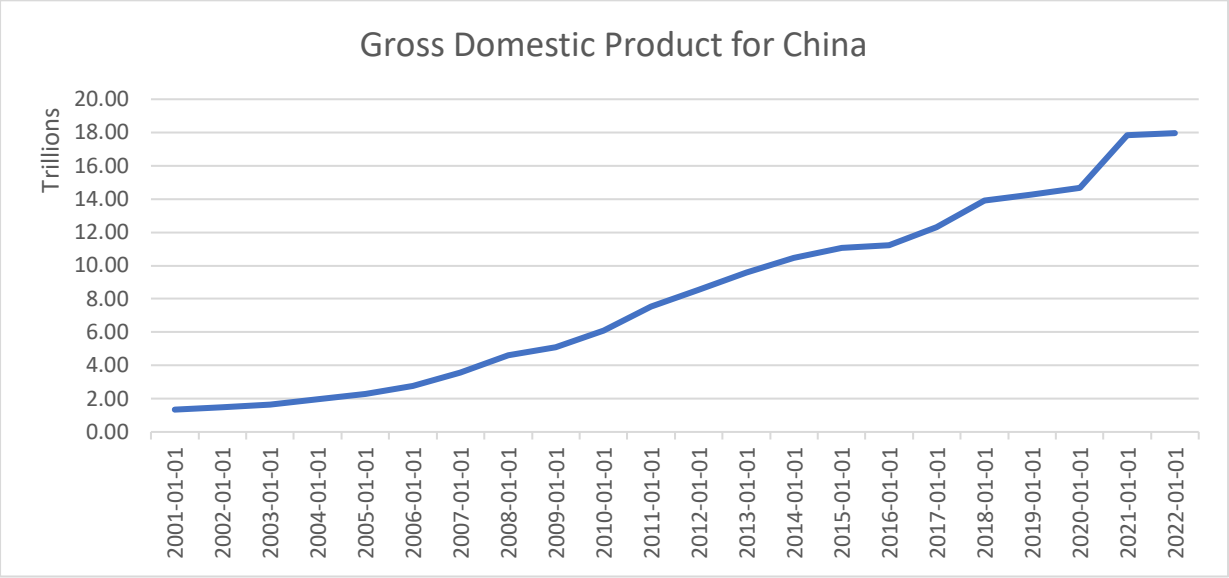

Figure 2: GDP of China 2001–2022 (World Bank, 2024b)

In figure 2 we can see the large GDP growth of CH´s economy over the period from 2001–2022, in that timeframe the CH´s GDP has gone from 1.34 trillion USD to just under 18 trillion USD. Historically the export-led growth of CH consisted mainly of labor-intensive products which accounted for most of the exports. CH´s specialization in labor-intensive manufacturing such as apparel, footwear, home goods, and textiles, had earlier been the basis for the export-led growth of what is known as the Asian Tigers–Hong Kong, Singapore, South Korea, and Taiwan in the 1970s and 1980 (Bozkurt & Karaköy, 2022). But in recent years China has increased its export of more advanced goods such as computer parts, smartphones, and recently electrical vehicles (EV). By shifting its economy from labor-intensive production to resource-intensive production CH has become the main producer of many critical commodities, such as semiconductors. This has strengthened CH's position in global trade and made many industries rely on Chinese exports for their production inputs.

Figure 3 illustrates a significant milestone for CH in terms of global trade. China surpassed the US in merchandise trade back in 2007. Since then, the gap between the two has continued to widen, highlighting CH's growing importance in international trade. This trend underscores CH's economic transformation and its emergence as a major player in global trade. As CH continues strategic initiatives such as the Belt and Road Initiative from 2013 and Made in China 2025, it is set to find itself in a position to reshape the global trade landscape in potentially profound ways.

Figure 3: Annual Merchandise trade with the world for the US and China (WTO, 2022)

The widening gap between CH and the US in merchandise trade also reflects CH's rapid industrialization and the success of its export-led growth strategy. CH's large and diverse manufacturing base, combined with its CA in cost and production efficiency, has propelled its exports to new heights in the last two decades. CH's expanding role as a trading partner for countries around the world has contributed to its sustained trade growth. Furthermore, investment in infrastructure through the Belt and Road Initiative has helped facilitate the domestic increase in trade and development across numerous regions in China further bolstering its trade volumes.

While CH solidifies its position within the global economy, it has become increasingly assertive in its territorial ambitions. Territorial disputes over areas such as Hong Kong, Taiwan and sections of the South China Sea have become a strong point of contention. CH's heightened involvement in these areas, coupled with the militarization of the South China Sea, has triggered concerns among policymakers in the US dating back to 2015. This assertiveness is perceived by the US as a hindrance to the establishment of a global order that is resilient against authoritarianism and conducive to bilateral transactionalism (Wyne, 2020).

CH's use of multilateral institutions beyond the WTO, IMF, and the World Bank (WB) has also raised concerns in Washington. The Belt and Road Initiative (BRI) and the Asian Infrastructure Investment Bank (AIIB) are being viewed as mechanisms for advancing CH's economic and geopolitical interests outside established multilateral frameworks. These developments have led to a reassessment of CH's role in the global economy and its implications for US interests. Policymakers in the US are increasingly viewing CH as a strategic competitor, both economically and militarily, and are seeking to address the challenges posed by CH's economic rise through various policy measures.

2.3 Trump and Biden China-Policy

2.3.1 Trump Policy on US Trade with China

The US initially perceived CH's integration into the global economy as a positive development, as it was assumed that CH would adhere to multilateral rules established by institutions such as the WTO. However, the last two US presidents have set tariffs on Chinese goods worth billions of dollars because CH potentially evades commitments made through multilateral agreements within the framework of the WTO. As such, there is a growing sense that CH is not fully complying with its obligations in international trade and is engaging in practices that undermine fair competition and distort trade (Mahmood & Cheema, 2018).

In response to these trade challenges, former President Donald Trump and his administration engaged in trade tactics that marked a clear change in US-China trade relations, leading to the most significant shift in the US "China Policy" since 1972 (Wei, 2019). Early in his presidency, Trump argued that US workers were losing jobs because CH was engaging in

unfair trading practices, so his administration wanted to compel CH to make changes to its state-led economic model and increase purchases of US-produced goods in an attempt to reduce the trade deficit, boost manufacturing and create jobs for US workers (Hass, 2024).

Due to the Trump era reassessment of US–CH trade relations, the term "decoupling" emerged in academic think-tank literature to describe the relationship between the US and CH in 2018 (Rudd, 2019). The concept gained prominence later that same year as a key policy objective in shaping the trajectory of US-China relations, particularly by former Chief Strategist Steve Bannon during the Trump administration. Bannon advocated for active measures by the US government to "decouple" from China, aiming to reduce dependence on the country (Rudd, 2019).

The literal definition of "decoupling" refers to the separation or disengagement of one entity from another (Merriam-webster, 2024). However, within the context of this thesis, the term "decouple" is used to denote efforts aimed at reducing reliance on a specific country (i.e., the US economy from CH), due to economic and or security considerations.

During the latter half of the Trump administration, these sentiments became more evident as there was a clear shift towards adopting a more assertive stance towards CH. This shift was reflected through various new policy measures, such as import tariffs, restrictions on Chinese investments in the US tech sectors, and efforts to strengthen military alliances to counter Chinese influence in the Indo-Pacific region.

The administration’s early indications that it was ready to declare CH a currency manipulator and confront them on issues related to export subsidies, IP theft, and forced technology transfers (FTT) were serious. In 2018, Trump announced tariffs on Chinese products totaling 550 billion USD, which China responded to by imposing tariffs on US goods totaling 185 billion USD (Hass, 2024). And if we consider the policy objective that decoupling entails alone the policy did what it was meant to do, the bilateral trade deficit with China did come (Hass, 2024). But overall, the US trade deficit increased. A possible reason for this is that the tariffs did divert trade flows but did not do enough to incentivize import substitution with US-produced goods. After the tariffs were introduced, there was an increase in imports from countries that are “close” to China in terms of global supply chains, such as Vietnam, Mexico, Thailand South Korea, and others (Hass, 2024).

2.3.2 Biden Policy on US Trade with China

When the current US president Joe Biden took office in 2021, he exercised his executive authority to issue a series of orders that overturned numerous Trump administration policies, related to climate change, immigration, environmental protection, and civil rights (Schoenbaum, 2023). As such, many political analysts predicted that Biden would promptly reject his predecessor's protectionist and nationalist trade policies. However, President Biden has not taken significant steps to reverse the Trump-era trade policies (Schoenbaum, 2023).

US trade officials from both the current Democratic and former Republican administrations have called upon President Biden to reject Trump's policies on trade which would remove the national security tariffs on steel and aluminum, negotiate an end to the China trade war, revive the U.S. commitment to the WTO and the rules-based multilateral trading system and also end the U.S. boycott of the WTO Appellate Body. A possible reason for Biden's inaction might be due to only having a slight majority in the US Congress (Schoenbaum, 2023).

The Biden administration keeps iterating its commitment to multilateralism, and rejection of the inflammatory and protectionist rhetoric of Trump. Yet, most of the failed Trump-era policies have largely continued (Schoenbaum, 2023). The Biden administration has also failed to address the causes that inspired the Trump administration's trade war and protectionist actions, such as the CH´s subsidies, state-owned enterprises (SOE), and forced technology transfers (FTT) (Schoenbaum, 2023).

In particular, three important elements characterize the Biden administration's policies toward international trade (Schoenbaum, 2023). First, like the Trump administration, Biden seeks to bring back manufacturing jobs to the US, this vision harkens back to when unskilled factory jobs were the norm and labor unions were strong. For this reason, Biden signed Executive Order 14005, which requires "to the maximum extent feasible", the US government entities to "buy American" which entails sourcing components and products produced in the US (Schoenbaum, 2023). Additionally, Biden signed Executive Order 14017 which mandates a review of supply chains for products and industries deemed vital to US security and economy, to reduce production shortages, and trade disruptions and limit the potential actions of US competitors and adversaries which could leave the US in a vulnerable position (Schoenbaum, 2023).

Second, the Biden administration perceives international trade policy as a tool to tackle non-trade, societal issues, such as climate change and workers' rights (Schoenbaum, 2023). This approach represents a significant shift from the traditional focus on trade liberalization and economic efficiency.

Third, Biden's approach to trade seems to be characterized by a high degree of caution and political consideration. The Biden administration appears to not tackle trade issues that might provoke even minimal opposition or controversy. President Biden seems to believe that any substantial trade initiative would face significant hurdles in Congress, particularly given the current political climate where the Republican party, under the influence of former President Trump, has adopted a staunchly protectionist stance. In contrast, the Democratic party remains divided on trade issues. As a result, the Biden administration appears to be allowing the Trump-era trade policies to continue (Schoenbaum, 2023).

2.3.3 Trade Ban on Chip Technology

Since 2020 the US government has enforced a ban on the sale of chips made with U.S. technology to Huawei in an effort to restrict the supply of chips to Chinese firms. In 2020, the administration of former President Donald Trump implemented a ban preventing suppliers from selling chips made with U.S. technology to the tech giant Huawei without obtaining a special license. This move was part of a broader strategy to limit Huawei's access to critical technology, the restrictions aimed to curtail Huawei's ability to manufacture advanced 5G infrastructure, and it also accelerated efforts by both the US to reduce their technological interdependence (Nellis & Lee, 2022).

2.4 Breach of International Conventions

Upon joining the multilateral organization, WTO, China pledged to undertake a gradual shift from its rigid command and control economy towards a market-oriented system. This commitment included adherence to the principles of the WTO's rules-based framework, which prioritizes the pivotal roles of markets and private enterprises in driving economic activities (Holbig & Ash, 2002). China's accession to the WTO was anticipated to solidify its long-term trade relationships not only with the United States but also with the global community at large.

This membership was expected to facilitate foreign companies' access to the Chinese market, enabling them to relocate production facilities to China and subsequently export goods produced there.

However, there has been a growing concern over China's apparent circumvention of the commitments it made to other nations across various domains, spanning economics, politics, and military strategies. This trend has raised concerns about China's adherence to international agreements and its commitment to fostering transparent and equitable relations with its trading partners and the broader international community.

2.4.1 Contentious Trade Practices

China's trade practices, particularly those perceived as breaching WTO rules, have sparked significant debate and tension among its trading partners. These issues have wide-ranging implications not only for China's trade partners but also for the future trajectory of international trade and economic relations. Much of the contention stems from what is perceived as unfair trading practices by China in areas such as intellectual property (IP) theft, forced technology transfers (FTT), subsidies to domestic industries (SDI), non-barriers to trade (NBT), and state-owned enterprises (SOEs) (Galbraith, 2018).

The allegations of IP theft against China have raised concerns about the protection of innovation and creativity in the global economy. Intellectual property rights are essential for incentivizing innovation and investment in research and development. Therefore, any perceived infringement on these rights undermines the foundation of a fair and competitive market environment. The practice of forcing foreign companies to transfer technology to gain access to the Chinese market raises questions about fairness and reciprocity in trade relations. It creates a dilemma for multinational corporations operating in China, as they must weigh the benefits of market access against the risk of losing their competitive edge through technology transfers. This issue has become a focal point in trade negotiations between China and its trading partners, particularly the United States.

While subsidies can be a legitimate tool for promoting economic development and fostering strategic industries, excessive subsidies can distort market competition and disadvantage foreign firms. China's extensive use of subsidies in key sectors has raised concerns about market distortions and unfair advantages for domestic companies. Addressing this issue requires careful consideration of how subsidies impact market dynamics and competitiveness. Non-tariff barriers to trade, such as regulatory requirements and licensing practices, can create significant barriers for foreign companies seeking to access the Chinese market. These barriers not only impede market access but also increase compliance costs and administrative burdens for foreign firms.

And, the role of SOEs in China's economy raises complex issues related to market competition and government intervention. While SOEs can play a vital role in promoting national interests and strategic objectives, their privileged position in the market can distort competition and create unfair advantages for domestic companies. Balancing the interests of SOEs with those of private enterprises requires a nuanced approach that promotes fair competition and market efficiency.

As mentioned, these trade practices have been much of the source of the tension between China and its trading partners, particularly the US and the European Union. Especially, within the technology sector there have been many complaints by the United States about unfair and illegal Chinese economic practices. The United States argues that China’s subsidy regime, which includes preferential government financing and procurement of contracts has helped domestic tech firms like Huawei reach their market position (CEIP, 2022)

To counteract these practices the US government introduced a 25 percent tariff on 50 billion dollars of goods from China that contain “industrially significant technologies”. Some of the goods that the tariff was imposed on were goods related to China’s “Made in China 2025”, which is China´s strategic plan to dominate the emerging high-technology industries that will potentially drive future economic growth of China. Some of the justification for the imposed tariffs was to prevent further unfair transfers of American technology and intellectual property to China (Trump, 2018). Addressing these trade issues requires concerted efforts from all stakeholders, including China, its trading partners, and international organizations like the WTO. By promoting transparency, fairness, and reciprocity in trade relations, we can build a more inclusive and sustainable global trading system that benefits all participants.

3. Theory and Literature review

There have been notable transformations in the trade relationship between the two largest economic powers—the US and CH in the semiconductor sector. Once characterized by robust interdependence, the trajectory of their overall trade relationship has entered a phase of discernible change, partially driven by deliberate efforts to decouple their economic ties. This theory and literature review embarks on an exploration of the policies of US-China decoupling, aiming to make clear the critical dimensions that define this relationship and understand the rules that make up the framework that governs international trade between the two and their trading partners. This section of the thesis studies the basic theory of trade patterns and trade rule aspects of US-CH decoupling and review the literature. Through analysis of this, the section seeks to establish the basis for international trade, policy trends, patterns, and areas of consensus or contention within the existing academic literature to get an overview of current discourses on decoupling.

3.1 Comparative Advantages and Free Trade

The theory of comparative advantage (CA) stands as a cornerstone principle in the field of economics, explaining the dynamics of international trade and resource allocation among nations. The concept is rooted in the idea that countries possess unique endowments of resources and capabilities, the theory of CA supposes that trading partners can mutually benefit by specializing in the production of goods and services where they have a relative advantage in efficiency (Bhagwati, 1967).

Under the CA framework, nations are encouraged to engage in trade with counterparts possessing different resource endowments and comparative strengths. By doing so, they can optimize resource utilization and enhance overall economic productivity. This principle becomes particularly apparent when viewed through the lens of the Heckscher–Ohlin model, which emphasizes the role of abundant factors of production in determining a country's comparative advantage (Bhagwati, 1967). For instance, countries abundant in labor resources tend to excel in labor-intensive industries, while those rich in capital resources thrive in capital-intensive sectors. The widespread acceptance of the concept of CA underscores its significance for policymakers and investors alike.

When drafting trade agreements or making investment decisions, it is imperative to consider each country's comparative advantages and the potential gains from trade.

David Ricardo, credited with formalizing the theory of CA in 1817, emphasized its role in promoting specialization and international cooperation. Ricardo's emphasis on free trade, without tariffs and trade barriers, was grounded in the belief that nations could harness their comparative advantages to achieve greater economic prosperity through expanded trade relations (Spengler, 2024). Its theoretical importance even today only serves to strengthen its relevance, as the notion of comparative advantage continues to shape global economic policies and strategies, guiding nations towards specialization in sectors where they can maximize efficiency and competitiveness.

By embracing the principles of CA, countries can unlock the full potential of international trade, fostering economic growth, prosperity, and mutual benefit on a global scale. The emphasis on specialization in goods where countries possess a comparative advantage has played a pivotal role in driving increased production and trade, thereby contributing to notable improvements in global poverty levels and living standards, as highlighted in the introduction of this thesis. This emphasis on leveraging comparative advantages has made it a subject of significant interest, particularly in developing nations where trade restrictions often remain high. Focusing on producing goods and services in which they have a comparative advantage, countries have historically enhanced their competitiveness in the global market. This can lead to increased exports, greater economic growth, and improved access to goods and services for both domestic and international consumers. As a result, the benefits of specialization extend beyond national borders, positively impacting global poverty levels and living standards.

Developing nations, in particular, stand to gain substantially from embracing the principles of comparative advantage. By liberalizing trade policies and reducing barriers to international commerce, these countries can tap into their unique strengths and resources to participate more fully in the global economy. This, in turn, can drive economic development, create employment opportunities, and lift millions out of poverty. However, despite the benefits of specialization and trade liberalization, challenges persist, especially in regions where trade restrictions remain high.

As such, efforts to promote free trade and facilitate cross-border exchange are essential to unlocking the full potential of comparative advantage and fostering sustainable economic development.

The emphasis on specialization based on comparative advantage as the basis for international trade has long been a fundamental theorem in economics, which has the potential to give a view into the future of global economic cooperation and multilateral relations. By harnessing their unique strengths and trading with others based on relative efficiencies, countries can drive increased production, trade, and economic growth, ultimately leading to significant improvements in global poverty levels and living standards. Thus, policymakers must consider the option of trade liberalization to realize the full potential of economic development, particularly in developing nations (Bhagwati, 1967).

3.2 Trade Policy and Trade Intervention

Trade policy (TP) serves as an important policy instrument for governments worldwide to safeguard their economies and capitalize on their comparative advantages. Trade policies cover all goods and services imported or exported by a country and come in diverse forms. Economists commonly perceive trade policies as occupying a spectrum, with free trade positioned at one extreme and protectionism at the other. At one end of the spectrum lies the concept of free trade, characterized by minimal government intervention in a nation's trading practices. In a regime of free trade, barriers such as tariffs, quotas, and trade subsidies are typically absent or kept to a minimum, allowing for the free exchange of goods and services with trade partners (The Investopedia Team, 2024a).

Advocates of free trade point to its potential to stimulate healthy competition, enhance economic efficiency, and maximize consumer welfare by enabling countries to specialize in areas where they possess comparative advantages (Langenfeld & Nieberding, 2005). While, at the opposite end of the spectrum we have protectionism, where governments employ extensive regulatory measures to shield domestic industries from exports by foreign competition. Protectionist policies also encompass a range of interventions, including tariffs, import quotas, subsidies, and other non-trade barriers.

The primary objective of protectionism can sometimes not only be to safeguard domestic producers from foreign competition but also to safeguard national security interests (The Investopedia Team, 2024b).

As such governments should be willing to reassess and adjust their trade policies in response to changing economic conditions, and geopolitical or domestic political considerations. This highlights the importance of the policy choice between free trade and protectionism and the complexities of modern global trade relations. Countries must try to adopt trade policies that strike a balance between the extremes of complete free trade and total protectionism when aiming to achieve economic openness while safeguarding domestic industries. This approach is not only conducive to friendly trade relations with potential partners but also ensures resilience in the face of evolving economic challenges. Achieving this middle ground often involves careful consideration and selective intervention to address potential market failures, mitigate adverse social impacts, or pursue strategic economic objectives. Therefore, most governments should recognize the importance of targeted interventions to rectify potential market distortions and promote equitable economic development.

3.3 Free Trade Agreements

Free trade agreements (FTAs) have become central to international trade. An FTA is a treaty between two or more countries aimed at reducing or eliminating certain barriers to trade and investment, and to facilitate stronger trade by participating countries, as such FTAs are an important policy tool in international trade diplomacy. FTAs are agreed upon to bolster economic cooperation by facilitating trade and investment. They often include provisions binding partners involved to lower or eliminate certain tariffs, quotas, and other trade barriers, thus enhancing market access for goods (The Investopedia Team, 2024a). The US and China are among the 154 member nations of the WTO that have agreed to abide by the WTO principles that govern multilateral trade.

In addition to the obligations made to the WTO the US and China are part of several binding agreements on trade, currently, The US has an FTA with 20 different countries some being bilateral and others multilateral, the US FTAs build upon the framework and agreements established by the WTO (USTR, 2024), while China has signed off 22 FTAs, which involve a total of 29 countries and a further 10 FTAs are currently under negotiation (Feng, 2024).

While the WTO FTA seeks to remove barriers and keep tariffs to a minimum, there are certain “protectionist” policies that member states are allowed to employ under certain circumstances.

The WTO has defined three scenarios where such policies are justified and not in breach of the Most favored-nation principle. The first is when acting against dumping (selling at an unfairly low price), the WTO agreement allows member states to act against dumping where there is a genuine (“material”) injury to the domestic industry. To enact Anti-dumping measures governments must be able to show that dumping is taking place, this is an important element in anti-dumping actions since they enable countries to deviate from the principles of the General Agreement on Tariffs and Trade (GATT), such as binding tariffs and MFN. This is due to the way that anti-dumping measures involve imposing additional import duties on specific products from the exporting country causing harm/injury. The tariffs imposed should be set in a way to align their prices with the "normal value" or to alleviate injury to domestic industries in the importing country (WTO, 2024a).

The second scenario concerns subsidies that can be shown to have been designed to distort trade, which has the potential to hurt other WTO member’s trade. These sorts of subsidies can be challenged through the WTO dispute settlement mechanism, and if the settlement procedure finds that there is evidence of illegal market-distorting subsidies, the guilty party must halt the subsidies immediately or run the risk of having the complaining country introduce countervailing measures (CVMs) such as duties to offset the injury causing subsidies. Again, because of the way CVMs are implemented which is in breach of core WTO principles, there are detailed rules governing the determination of whether a product is being subsidized, which can often be challenging to calculate. These rules include criteria that must be met when governments are assessing whether imports of subsidized products are in fact causing injury to domestic industry. Additionally, there are established procedures for

initiating and conducting investigations into alleged subsidies, as well as rules governing the implementation and duration of CVMs (WTO, 2024a).

And, the third scenario described by the WTO is regarding safeguards (SGs) which WTO members are allowed to impose temporarily when their domestic industry is facing injury or the risk of injury "deemed to be serious" due to an increase in imports of certain products. The option for SGs was a part of the GATT (Article 19) negotiations, but SGs have historically not been extensively used. Instead, governments have used what the WTO describes as "grey area" measures which implies using bilateral negotiations outside of the WTO framework, such agreements have covered goods relevant to this thesis such as semiconductors and automobiles.

But currently, the WTO prohibits such "grey area" measures, members are obligated to not seek, take, or maintain any form of voluntary export or import restrictions. A surge in imports that warrants SG action can manifest as either a real increase in imports (an absolute increase) or as an increase in the imports' share of a shrinking market, even if the quantity of imports remains unchanged (relative increase). In such cases, whole injured industries or specific companies may request that their government introduce SG actions as long as they are within the rules of the WTO agreement which has clear requirements for initiating SG investigations (WTO, 2024a).

3.4 WTO Principles Governing Multilateral Free Trade

The rules that cover multilateral trade were established through the collaborative efforts of member countries of the WTO. At the center of this framework lies the negotiated terms and conditions of the GATT, which functioned as the primary forum for negotiating reductions in tariffs and trade barriers from 1947 until its replacement by the WTO in 1995. During that period, GATT negotiations were instrumental in defining key principles for the global trading system, with a particular emphasis on the principle of non-discrimination. These negotiations laid the groundwork for creating a more open, transparent, and predictable system for international trade, intending to foster economic growth and development among its members. In addition to tariff reductions, the GATT also addressed other critical aspects of trade, such as trade remedies, dispute settlement mechanisms, and the promotion of fair competition (WTO, 2024c).

Some provisions of these multilateral trade agreements may contain provisions that limit the extent to which the US can unilaterally decouple from China without facing legal consequences. So, by examining the rules that govern international free trade, we can better understand the legal framework that the US must navigate as it pursues its policy objective of reducing dependence on China by decoupling.

3.4.1 Trade Without Discrimination

The principle of most-favored-nation (MFN) treatment is the first rule of the WTO, which ensures that countries do not discriminate against trading partners. Under MFN, if a country grants special treatment or concessions to one trading partner (such as a lower customs duty rate), it must extend the same treatment to all other WTO members. The principle of MFN treatment is such an important element of the rules that govern international trade that it is included in all WTO agreements, it is not only a guiding principle for the General Agreement on Tariffs and Trade (GATT) for trade in goods which is the focus of this thesis, but also for the General Agreement on Trade in Services (GATS), and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) (WTO, 2024b).

While MFN is an important rule across all these agreements, there are some exceptions permitted. As such, countries can form free trade agreements that apply only to goods traded within the group, allowing discrimination against goods from outside (WTO, 2024b). An example of this is the deal struck by the US, the Netherlands, and Japan to impose export restrictions on China for equipment essential in the production of semiconductors (Alper & Shepardson, 2023). Additionally, developing countries may be granted special access to certain markets, and countries may impose barriers against products considered to be traded unfairly from specific nations.

In essence, the purpose of MFN treatment is to ensure that countries adhere to a level playing field in international trade, fostering transparency, fairness, and mutual benefit among WTO members. Another principle that is related to non-discrimination is the concept of national treatment (NT), which implies treating foreigners and locals equally. This principle is meant to ensure that imported and domestically produced goods receive equal treatment in

international trade. The reasoning behind the concept of NT is that it contributes to a level playing field in international trade by ensuring that foreign goods are treated equally to domestic ones, which benefits the promotion of competition, and encourages innovation to the benefit of consumers since it helps in offering a wide range of choices and possibly better-quality products. However, it is important to note that NT only applies once goods have entered the domestic market. This means that tariffs on imported goods are not considered a violation of national treatment (WTO, 2024b).

3.4.2 Gradually Freer Trade Through Negotiation

Trade barriers have long been a hindrance in the promotion of international trade and lowering these trade barriers is one of the most straightforward methods to promote trade. Trade barriers typically come in the form of customs duties (tariffs) and import bans or quotas that selectively restrict the quantity of imported goods. Since the establishment of the GATT in 1947-48, negotiations between members primarily focused on reducing tariffs on imported goods. It is also important to note that while opening markets can be beneficial it may also require adjustments which can take time to implement. Therefore, the WTO rules allow for countries to implement lower trade barriers gradually through "progressive liberalization".

Also, countries that are considered developing countries are allowed to not only implement adjustments gradually but also often receive longer timelines to fulfill their obligations to reduce trade barriers, by allowing this the WTO recognizes each country's varying levels of development and capacity to adjust to new trade rules and regulations (WTO, 2024b).

3.4.3 Predictability, Binding and Transparency

By ensuring predictability in the international trading system, the WTO helps in creating an environment where countries can engage in trade with greater confidence as commitments made by members of the WTO provide a degree of certainty regarding the future. The creation of a multilateral trading system represents governments' efforts to create a stable and predictable trade environment. For instance, within the WTO, countries commit to opening their markets for goods by "binding" their commitments. These bindings establish maximum

limits on tariff rates which in some cases, particularly regarding developing countries may be set at rates lower than the bound rates. While in developed countries, the rates charged, and the bound rates are typically the same (WTO, 2024b).

Members of the WTO are free to revise their bindings, but only after negotiating with its trading partners. One major achievement of the Uruguay Round was the increase in trade under binding commitments. The WTO system also seeks to enhance predictability and stability by discouraging quotas and other measures limiting import quantities. As such, many WTO agreements require members to publicly disclose their policies and practices within the country or by notifying the WTO. The Trade Policy Review Mechanism regularly monitors national trade policies, promoting domestic and multilateral transparency (WTO, 2024b).

3.4.4 Promoting Fair Competition

The WTO's main goal is to promote trade by reducing trade barriers, but it also allows for tariffs and other forms of protection to mitigate the effects of unfair trading practices that can distort competition in international trade. Key principles such as MFN and NT, aim to ensure fair and equal trade conditions by preventing discriminatory practices. Additionally, rules governing dumping and subsidies address unfair trade practices, seeking to establish criteria for determining fairness and providing mechanisms for members to respond, which sometimes can be achieved through the imposition of additional import tariffs to counter unfair practices such as dumping and illegal subsidies (WTO, 2024b).

3.4.5 Encouraging Development and Economic Reform

More than 75 percent of WTO members are developing countries or countries transitioning to market economies. And among the developing countries, we find China. In the conclusion of the Uruguay Round developing countries were prepared to take on most of the obligations that are required of developed countries. However, the negotiated agreements did allow them to have a transition period to adjust to some of the more difficult WTO provisions.

While developed countries were to accelerate the implementation of market access commitments on goods exported by the least-developed countries, as such developed countries have started to allow duty-free and quota-free imports for almost all products from least-developed countries (WTO, 2024b).

3.5 Rules of Origin

Rules of origin (RoO) have become a core feature of international trade and serve a fundamental role in trade by specifying the origin of products. The main objective of RoO is to ensure that specific trade benefits such as preferential market access are exclusively given to products that originate or at least have been "substantially transformed" by trading partners that are part of a trade agreement that grants such privileges, mainly to trade deflection (Inama, 2009).

This is a way to ensure that goods are not produced outside the negotiated trade agreement and then simply transshipped through a member country. In an FTA, each country is allowed to maintain its own external tariff rates in relation to outside trading partners. Countries that rely on imports from outside trading partners may choose to maintain lower tariffs on imported goods. Countries with non-competitive domestic production can choose to keep higher tariffs to shield their industries from external competition and prevent damage to domestic industry by cheap imports (Inama, 2009).

Without RoO the benefits of an FTA are substantially reduced, and to the extent that tariffs differ concerning third-party countries, the opportunity for tariff circumvention occurs, in other words, the incentive for trade deflection increases. Trade deflection refers to a situation where a product originating from a non-member of a preferential trade agreement is rerouted through a member country to take advantage of the benefits offered by the agreement, such as lower tariffs or quotas. This practice allows exporters from non-member countries to circumvent trade barriers and gain access to the markets of member countries on preferential terms (Inama, 2009).

However, if we consider that countries might increase the stringency of RoO to ensure that trade deflection does not occur it also has the potential to create trade diversion which might reduce economic efficiency. As the stringency of RoO rules increases so does the possibility of trade diversion (Inama, 2009). Trade diversion can occur when a preferential trade agreement changes the regular trade pattern by diverting trade away from efficient producers outside the agreement toward less efficient producers within the agreement.

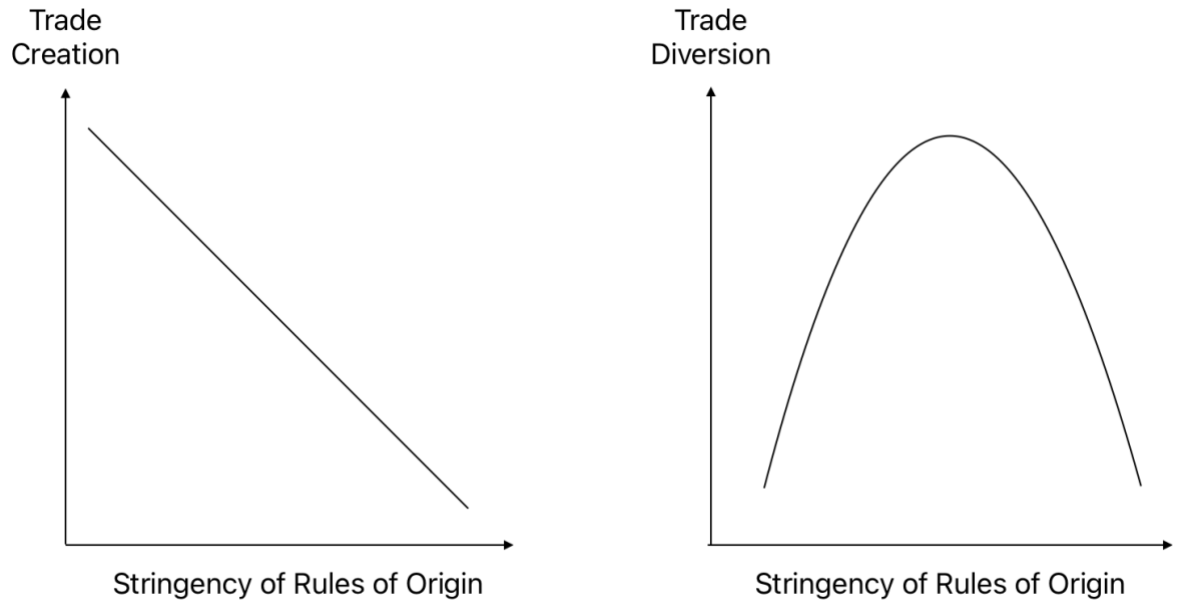

Figure 4: Effects of stringency of RoO on trade creation and trade diversion (Inama, 2009)

In the context of US-China decoupling, RoO may emerge as an important trade policy tool for the US to safeguard and counter China's recent advancement in semiconductor production which is deemed a strategic industry and commodity by the US. RoO has the potential to affect existing trade dynamics and economic efficiency as it influences the allocation of resources and sourcing of inputs. It serves as a mechanism for enforcing trade agreements, by establishing criteria's for determining the origins of a product, RoO enables governments to regulate the access to preferential trade benefits, such as reduced tariffs or quotas, based on the country of origin. This mechanism becomes particularly relevant in the context of strategic commodities like semiconductors, where countries can use RoO to safeguard their technological edge and national security interests.

Again, concerning US-China trade relations, RoO gains added significance as the US aims to reduce its economic ties with China to safeguard its strategic interests. By implementing stringent rules of origin, the US can mitigate the risk of technological dependency on China in critical sectors like semiconductor manufacturing. This highlights the role of RoO as both a regulatory and strategic policy tool in shaping international trade dynamics.

3.6 Literature Review

The concept of "decoupling" has emerged as a focal point in current economic and geopolitical discourse on the relationship between the US and CH. Rooted in the escalating trade tensions and strategic rivalries of recent years, decoupling refers to the deliberate effort to reduce economic interdependence between the two largest economies in the world. This literature review seeks to study the relevant dimensions of US-China decoupling in the semiconductor sector, exploring its origins, motivations, and implications through an analysis of existing studies.

There has been written extensively on US-CH decoupling, many papers focus on the different aspects. Some papers focus on sector-specific technological decoupling, such as Jeonghyun et al. (2021) which primarily studies the smartphone trade network through an in-depth analysis. The authors obtained data from UN Comtrade from 2017-2019, and due to members of the World Customs Organization using the harmonized system, they used this system for their analysis. Specifically, the authors used HS at the sub-heading level (6 digits) to focus their network analysis of the mobile phone (HS-8519129) trade network.

The paper adopts ideas from the production function of noncompetitive input-output to utilize the stated framework for a trade network decoupling analysis with an emphasis on the trade implications for the US, CH, Vietnam, and especially the Republic of Korea, these countries play an important role in the supply chains of the trade network for mobile phones, but this review will mainly focus on the captured effects on the US and CH (Jeonghyun et al., 2021). The study shows that in-direct trade from CH to the US increased between 2017-2019, and the study captures the effect of US-CH decoupling on the trade network under two different policy regimes and the results are visualized via multidimensional scaling (MDS).

The first policy regime of the paper considers the trade network before decoupling was a policy objection of the US (2017), then compares the trade after the actual implemented trade policy changes (2019). The results indicate changes in major nodes in the trade network, overall, they find a weakening of CH´s centrality in the network and a strengthening of Vietnam. CH's out-degree centrality of final goods direct export was about 0.66 in 2017 but dropped to 0.62 in 2019.

The node for CH indicated a decrease in the trade connections and influence in the mobile phone trade network while at the same time, no significant change was detected in the size of the node (eigenvector centrality). For indirect exports, the out-degree centrality did not change significantly, while eigenvector centrality exhibited a slight reduction, from 0.035 to 0.029. Intermediate goods exports also indicated similar results, out-degree centrality decreased from 0.178 to 0.168, and eigenvector centrality decreased, from 0.577 to 0.535.

Regarding the US, the paper finds the eigenvector centrality of final goods direct exports showed a slight reduction from 0.64 in 2017 to 0.63 in 2019, reflecting some decreased bilateral trade. While the out-degree centrality had a slight increase, from 0.018 to 0.024. However, the centrality of the US in indirect exports increased slightly in 2019 which indicates that the US still plays an important role in the trade network, despite decreased trade volumes with China. The node for Vietnam exhibited an increased centrality in all categories during the same period (2019), and out-degree centrality increased. The eigenvector centrality for final goods is rather small due to bias toward trade with specific countries, as such Vietnam does not yet occupy a central position in the trade network. But for intermediate goods trade, the eigenvector centrality is higher, the author argues this might be due to intensive trade with East Asian countries that are important in the trade network.

The results of this policy regime indicate that CH's exports to the US are significant in mobile phone trade, which is expected considering CH accounted for 19.1 percent of the entire global trade in mobile phones in 2017. The decline in CH's out-degree centrality in direct exports is likely because the size and share of exports to the US fell. The change in eigenvector centrality in the US can also be understood in similar terms. CH is the most important exporter of mobile phones not only to the US but to the entire network, therefore a strong connection with CH will yield a high Eigenvector centrality.

The trade network link between the US and CH weakened due to reduced US imports from CH. CH's total exports also decreased, which led to a decline in the US eigenvector centrality. At the same time, CH's eigenvector centrality remained unchanged since there was no significant difference in global market share regardless of the decrease in exports to the US.

The second policy regime looks at three scenarios in which the authors analyze the network node centrality of the US and CH in the mobile phone trade network. Under this policy regime, the three cumulative scenarios assume stronger US regulations targeting CH that are theoretically possible in the long run, as this makes it possible to estimate the effects of different hypothetical trade environments. The results of the scenarios of this policy regime showed that CH's out-degree centrality and the US' eigenvector centrality decreased in the trade network. With stricter rules in trade, the out-degree centrality of Korea and Vietnam would become slightly smaller, the main takeaway of the results is that important nodes in the network would either see their out-degree or the eigenvector centrality decrease. And that this would probably have a greater impact on countries that are deeply involved in the trade of intermediate goods in the mobile phone industry, like the Republic of Korea and Vietnam.

There are other studies that try to estimate the effect of a technical decoupling, like the IMF working paper by Cerdeiro et al. (2021) were the authors use six different scenarios with different levels of non-trade barriers, to try and capture the potential sectoral misallocation effects of technical decoupling. The studie examins 17 sectors in 165 countries using input-outputdata and adds NTBs on OECD defined high-tech sectors a measure this is based on sectoral R&D intensity (Cerdeiro et al., 2021).

However, Liu (2023) looks at the effects of decoupling from an investor standpoint by analyzing the potential effects of decoupling can have on the US stock market. The study looks at the response of US stock markets from January 2020 to June 2021 to gauge market sentiment of US–CH decoupling by utilizing a generalised autoregressive conditional heteroskedasticity (GARCH) model. The results of the study indicate that significant variations in stock market prices can be contributed to concerns over decoupling (Liu, 2023).

This is just some of the current literature on technical decoupling as there are many others that look at different effects through various methods, however the literature review will now explore literature on different aspects of decoupling such as the political and security related and also some previous works utilizing the gravity model.

On the political aspects of decoupling Milutinović & Nikolić (2023) have writen a paper that aims to project the future dynamics of US-CH relations and examin the risks of decoupling between the two trade blocs by using the methods of explanatory research and an inductive approach for analysing the management of technological innovation and economic development (Milutinović & Nikolić, 2023). The authors conclud their paper by stating that CH's economic and rapid technological transformation with its ascension to the upper end of global industrial value chains has become a risk to US technological primacy, and that despite their commercial interconnectedness, the export sanctions by the US is trying to force a technological decoupling in domains deemed critical for CHs high-tech industries in order to slow down or curtail CH's future technological and economic rise.

Milutinović & Nikolić (2023) argue further that the US will continue its efforts to maintain primacy over China in technologies, like artificial intelligence, semiconductors, by using export bans and other kinds of sanctions, which could pose a real danger to CHs development model. However, the authors do recognize that the conditions that could potentially evolve the strained relations between the US and CH might emerge, such as if the US or CH realise that they will lose the ongoing technological competition. This might trigger them to develop a "state of cohabitation" which would create the conditions to resvolve the strained relations between the two.

4. Data and Methodology

In this part of the thesis the method and model used to analyze the trade patterns between US and CH. Since this thesis seeks to investigate trade effects of US-CH decoupling policy on trade in the semiconductor sector to examine any discernable changes, the method chosen for this objective is the gravity model, and the variables are selected and constructed for this purpose. The four data sets contain all observations for the period 2013 – 2022 are included. The data set has imports (10 obs) and export data (10 obs) for the US and China..

4.1 Variable description

Abbreviation	Name	Type	Source
X	Value of exports from the US to China		(UN Statistics Division, 2024)
M	Value of imports to the US from China		(UN Statistics Division, 2024)
GDPi	Gross domestic product		(U.S. Bureau of Economic Analysis, 2024)
GDPj	Gross domestic product		(World Bank, 2024b)
D	Distance between Washington and Beijing		(Distance Calculator, 2024)
Covid	The period of the Covid-19 pandemic where 1 is given to the years 2020 and, 0 otherwise	Dummy	(Wooldridge, 2020)
Tariffs	The period since the tariffs where 1 is given to the years after 2018, 0 otherwise	Dummy	(Wooldridge, 2020)

When creating the data sets, yearly total, and semiconductor (HS-8542) trade data for the US and CH was collected from the trade database provided by UN Comtrade. The UN Comtrade data base is the default choice for an analysis such as the one in this paper as the database allows for collection of trade data with commodity specifications with the harmonized system (HS). By following the HS, we can better an overview of what specific goods are included and their potential purposes, the data collected with HS-8542 include all sorts of integrated circuits (ICs) including most types of semiconductors . In the model with total trade, either the log value of total export or import trade is the dependent variable and is expressed in US dollars. The same goes for the model that utilizes semiconductor trade data.

The log GDP of the US and CH is an important part in the analysis as it serves as a proxy for the economic size and activity for use in the gravity model. Within the gravity model it is assumed that GDP results in positive coefficients due to the assumption that it has a positive effect on trade. The distance variable is an approximation of transportation costs in the model and is measured in kilometers and as a straight line that represents the distance between the capitals of the US and CH. Within the gravity model it is assumed that increased distance incurs increased transportation costs which has a negative effect on trade, as such the distance variable should yield a negative coefficient. A variable for “economic-distance” has also been included in the models, this variable contains the US GDP per capita and CH GDP per capita, the CH GDP per capita has been subtracted from US GDP per capita, this will give some indication on the “economic-distance” between the two countries.

The models also include a Covid dummy variable to account for any changes in trade during the Covid-19 pandemic. Since the pandemic brought with it global lockdowns and travel restrictions it is likely to have had some effect on trade patterns, a value of 1 is present in years 2020, and 0 otherwise. The coefficient of the Covid dummy is expected to take a negative sign, as travel restrictions and lockdowns would have affected the international supply chains. Also, a dummy variable for the Trump-Biden era tariffs and restrictions has been added, similar to Covid dummy a value of 1 is present in years after 2018, and 0 otherwise.

4.2 The Gravity Model

The gravity model of international which has its origins from the field of physics has become an important analytical tool for trade economists. It is a widely used economic model that explains bilateral trade flows between two countries based on their economic size and the distance between them, this concept is borrowed from Newton's law of gravitation, which predicts the gravitational force between two objects. The gravity model of international trade suggests that the trade volume between two countries is positively correlated with their economic size, measured by their GDP and that larger economies tend to trade more because they produce and consume more goods. And that geographical distance between two countries is inversely related to trade volume as the bigger the distance the greater the increases in transportation costs will be to the detriment of trade flows. Despite the simplicity of the gravity model of international trade, the model has the ability to incorporate additional variables which makes it a versatile tool for understanding and predicting trade flows such as assessing the impact of trade agreements to gauge the effects of tariffs and non-tariff barriers. The gravity model of international trade has been used by trade economists for decades, however the first mathematical formulation and empirical application of the gravity model in economics was by a group of Dutch economists headed by Jan Tinbergen (1962). Tinbergen proposed in the paper *Shaping the World Economy* that the trade volume between two countries could be modeled in a similar way to gravitational force (Bergeijk & Brakman, 2010). Arguing that trade volume would increase with the size of the economies and decrease with distance.

The empirical study by Tinbergen provided strong evidence supporting this relationship (Tinbergen, 1962), which set the groundwork for future use research of the model. Tinbergen even supervised the Ph.D. thesis of Hans Linnemann (1966) that has later become standard reference for early version of the gravity model and its equation (Bergeijk & Brakman, 2010). Even after the studies conducted by and Tinbergen and Linnemann in the 1960s there was still uncertainty around how a concept from physics could be useful for economists in economic analysis. However, later works by Krugman (1997), Eaton and Kortum (2002) and other have provided the evidence for the stability provided by the gravity model (Krugman, 1997), as well as establishing its relevance and importance for international trade theory (Eaton & Kortum, 2002).

The gravity model of international trade has continuously been iterated on since it was first employed by economists, it has evolved to include several additional non-economic factors to strengthen the results of the model, such as cultural differences, common language and religion, the presence or absence of colonial ties, institutional differences, presence of trade agreements, and so on. The gravity model of international trade is not limited to analysis of trade flows alone, it can be developed to fit other forms of flows such as, foreign direct investment, which highlights the versatility of the model.

Even though for its simplicity and versatility the gravity model of international trade is not without issues. The main problem with the model has to do with endogeneity that can occur when changes in trade volume between countries is caused by something "outside" of the model, this issue can be solved for by including more variables, also there are developed various other techniques to solved for the possibility of endogeneity.

The standard gravity model often uses cross-sectional data to consider trade relationships over a given time period, however it is also possible to include several time periods in the model. The inclusion of several time periods gives the data a panel structure and allows the model to capture time variations. The inclusion of more than one time period can help capture unobserved heterogeneity and to control for country-specific effects (Wooldridge, 2020). If any of the independent variables in the equation are correlated with the error term, the ordinary least squares (OLS) estimation can give biased results. And by increasing the number of observations on a country we can increasing the robustness of the analysis results since the result can be checked for consistency across several time periods.

Also, when we increase the number of observations it also allows the model to be more accurate, which reduces the risk of type-I and type-II errors. The use of panel data gives us the opportunity to avoid bias in the estimations by using the fixed effects (FE) and random effects (RE) models. Since this thesis examines semiconductor trade over several time periods, it will use the panel data methodology (Wooldridge, 2020).

The gravity model of international trade can be specified in several different ways, but the general gravity equation uses the value of exports or imports as a function of GDP and distance, creating the following equation:

$$T_{ij} = \beta_0 \frac{(Y_i)(Y_J}{(D_{ij})} \quad (1)$$

T_{ij} denotes the trade flow between country i and j, Y_i and Y_j is the economic size of country i and j, while D is the distance between the countries, and β is a constant. Equation (1) explains how increased GDP in either country i or j will lead to increased trade flow between the two countries. D denotes the transportation costs, defined as the distance between the two countries, and how an increase in transportation costs which approximates distance, leads to a decreased trade flow. In order to use the standard gravity equation in an empirical model, we must change the equation of the model into log-linear form. This can be achieved by taking the natural logarithm of the variables.

Transforming model (1) to log-linear form in year t gives:

$$ln(T_{ijt}) = \beta_0 + \beta_1 ln(GDP_{it}) + \beta_2 ln(GDP_{jt}) + \beta_3 ln(D_{ij}) + \varepsilon_{ij} \quad (2)$$

In log-linear form β_0 represents the intercept, while β_1, β_2 and β_3 are the coefficients of Y_i, Y_j and D for countries i and j. ε_{ij} is the error term that captures all possible factors that are not accounted for in the model. Now that the model equation is given in the natural logarithmic form, the coefficients (β_1, β_2 and β_3) are equal the elasticity, which indicates that a 1 percent increase in Y_i will cause T_{ij} to change by β_1 percentage.

4.3 Panel Unit-Root Test

For accurate result in the analysis, it is crucial that we check for stationarity in our variables. To verify that we do not have stationarity in the variables we can conduct a panel unit-root test. This is an important part of the data testing because if we are conducting a regression analysis on a non-stationary dataset the regression would give us invalid results (Gujarati, 2011). There are many different ways to test for stationarity in the data, but in this thesis the Augmented Dickey-Fuller (ADF) test will be used as the preferred method.

If we find that the tested variables are stationary, then the variables can be used in the model without further changes. However, if we find that the computed t-value of the estimated coefficient is greater (in absolute value) than the critical ADF value, we reject the unit root hypothesis, and we can conclude that the data under study is stationary. On the other hand, if it does not exceed the critical t-value, we do not reject the hypothesis of unit root and conclude that the time series is nonstationary (Gujarati, 2011).

4.4 The Gravity Model for US Trade

To make equation (2) work in my model I have made some changes, I use GDP as the economic size and distance to represent transportation costs. I also need to take the natural log of the export / import variable, GDP for country i and j, distance, and GDP_distance. Since I have chosen to analyze imports and exports separately, the dependent variable change in the two gravity equations. In addition to the standard variables,

I will be including log_gdp_distance and two of dummy variables to the models. This will potentially allow the models to pick up additional effects. By modifying and adding variables to equation (2), the export flow from the US to CH in year t can be expressed as:

$$ln(X_{ijt}) = \beta_0 + \beta_1 ln(GDP_{it}) + \beta_2 ln(GDP_{jt}) + \beta_3 ln(D_{ij}) + \beta_4 ln(GDPD_{jt}) + \beta_5 Covid_t + \beta_6 Tariff_t + \varepsilon_{ij} \quad (3)$$

And to analyze the imports to the US from CH in year t, the model is expressed as:

$$\ln(M_{ijt}) = \beta_0 + \beta_1 \ln(GDP_{it}) + \beta_2 \ln(GDP_{jt}) + \beta_3 \ln(D_{ij}) + \beta_4 \ln(GDPD_{jt}) + \beta_5 Covid_t + \beta_6 Tariff_t + \varepsilon_{ij} \quad (4)$$

Equation (3) and equation (4) specifies the model that is used for both total export and import and for semiconductor exports and import. To estimate the model, I have created a new version of all relevant variables that takes the the natural log of each. For semiconductor export and import by the US to CH, the new names for these variables are log_US-X / log_US-M, log_US-GDP$_i$, log_China-GDP$_j$, log_distance and log_GDP-distance. The variables have the same names for total exports and imports.

4.5 Methodology

Panel data techniques have been utilized in this paper since the equations of the gravity model examines the same units over different time periods. By using panel data that combines cross-sectional and time-series data, we can investigate changes over time across multiple variables. Using panel data can increases efficiency of the models, also we can control for unobserved heterogeneity, and understand the relationship between variables and investigate whether there is causality between them.

When conducting the regression analysis, we can potentially use different models such as pooled OLS, fixed effects and/or random effects on the panel data, however the main model in this thesis is pooled ordinary least squares (OLS) regression. A pooled OLS model should be used when there are no individual effects in the data, meaning that no individual characteristics can be allowed to affect the explanatory variables. Even if the gravity model in this paper only includes the US and China, and the variables of these two countries differ in ways that could potentially affect the dependent variable, we assume it is appropriate to believe that there are country-specific characteristics in the data that will affect the dependent variable and since the OLS utilizes data by combing all observations across the objects, ignoring the panel specific effects that may be present in the data, the individual effects of the data must be accounted for, if not the pooled OLS will generate biased results.

5. Results

5.1 ADF-test for stationarity

First, the results of the panel unit root tests are presented. Table 5.1 contains the test results for US semiconductor (HS-8542) exports and imports to and from China, while Table 5.2 shows the results for total US exports and imports with China.

If we consider the results of the Augmented Dickey-Fuller tests on the different variables in table 5.1, we can see that all the p-value are relatively high, suggesting that we do not have enough evidence to reject the null hypothesis of a unit root as typically a p-value less than 0.05 is considered statistically significant to reject the null hypothesis (Wooldridge, 2020).

In table 5.2 the variables for the log of total US import/export are the only ones that have been changed, the other ones remain as they did in table 5.1 and the problem of non-stationarity persists. We find that the same issue is present in the two new variables added, log-US-semix and log-US semim. The presence of non-stationarity in the data can significantly impact the accuracy and reliability of estimations, as such we need to make transformations to the data to achieve stationarity in order improve the validity and accuracy of model estimations.

Table 5.1: Summary of stationarity test I

```
 ADF – log–US–semiM   p–value  Lags Used  Number of Observations  \
          –1.701351  0.430417          0                       9

 Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
            –4.473135             –3.289881              –2.772382
ADF – log–US–semiX  p–value  Lags Used  Number of Observations  \
          4.245438      1.0          3                       6

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
            –5.354256             –3.646238              –2.901198
ADF – log–gdp–china  p–value  Lags Used  Number of Observations  \
            4.204085      1.0          3                       6

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
            –5.354256             –3.646238              –2.901198
ADF – log–gdp–US   p–value  Lags Used  Number of Observations  \
          2.24104  0.998915          3                       6

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
            –5.354256             –3.646238              –2.901198
ADF – log–gdp–distance   p–value  Lags Used  Number of Observations  \
              2.431512  0.999024          3                       6

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
            –5.354256             –3.646238              –2.901198
```

Table 5.2: Summary of stationarity test II

```
ADF – log-totUS-export   p-value  Lags Used  Number of Observations  \
              1.152224  0.995639          2                       7

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
           -4.93869             -3.477583              -2.843868
ADF – log-totUS-import   p-value  Lags Used  Number of Observations  \
             -3.472881  0.008712          1                       8

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
           -4.665186             -3.367187              -2.802961
ADF – log-gdp-china  p-value  Lags Used  Number of Observations  \
            4.204085      1.0          3                       6

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
           -5.354256             -3.646238              -2.901198
ADF – log-gdp-US   p-value  Lags Used  Number of Observations  \
          2.24104  0.998915          3                       6

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
           -5.354256             -3.646238              -2.901198
ADF – log-gdp-distance   p-value  Lags Used  Number of Observations  \
              2.431512  0.999024          3                       6

Critical Values (1%)  Critical Values (5%)  Critical Values (10%)
           -5.354256             -3.646238              -2.901198
```

5.2 Total US export

The regressions in this analysis were conducted using pooled OLS, and to overcome any potential autocorrelation heteroskedasticity in the error terms in the models, it has been conducted using heteroskedasticity and autocorrelation consistent (HAC) covariance. Table 5.3 shows the results of the pooled OLS for total US exports and imports to China, including the R^2 which indicates the goodness of fit for the model. The R^2 for total US log-export is 0.88 which is decent and shows that about 88% of the variation of the value of exports is explained by the independent variables in the model.

Firstly, if we consider the p-values for total export presented in the results table, we can see that all the variables included in this model are significant at the 1% level. And that the coefficients exhibit odd estimation results. For instance, log-US-GDP which has a coefficient of -16.70 indicating that a one unit increase in the natural logarithm of US GDP will cause a decrease of approximately 16.70% in the dependent variable suggesting an inverse relationship between US log-GDP and the dependent variable total US log-export.

The variable log-China-GDP makes more sense, there the coefficient come in at 4.36 indicating that a one unit increase in the natural logarithm of China GDP will cause an increase of approximately 4.36% in the dependent variable. The positive coefficient suggests a positive relationship between China's GDP and the dependent variable. Another variable that that has an odd coefficient is log_distance which has a coefficient of 26.73, indicating that the distance between the US and China is associated with higher values of the dependent variable. We assumed in chapter 4 that the distance variable would yield a negative coefficient due to it being an approximation for transportation cost which should have a negative impact on trade and not positive. The variable log-GDP-distance has a coefficient of 14.40 showing that there is a positive relationship between GDP-distance and the dependent variable. The Covid Dummy has a coefficient of 0.12, this indicates that the covid pandemic had a positive effect on total US-exports, the tariff dummy however has a negative coefficient of -0.22 meaning that the Trump-Biden era tariffs and restrictions on trade reduced total US exports by 0.22%.

Table 5.3: Gravity model for tot US X/M

	US.tot log-export	US.tot log-import
log_US-GDP	-16.70***	-1.71
	(2.39)	(1.93)
log_China-GDP	4.36***	0.79
	(0.53)	(0.54)
log_distance	26.73***	4.37
	(3.83)	(3.03)
log-gdp-distance	14.40***	1.37
	(2.13)	(1.73)
COVID_Dummy	0.12***	-0.12***
	(0.02)	(0.04)
tariff_Dummy	-0.22***	-0.05
	(0.04)	(0.04)
R-squared	0.88	0.67
R-squared Adj.	0.73	0.25

Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01

5.3 Total US import

Now let's consider the estimation results for total US log-import, when we consider the p-values for total import presented in the results of table 5.3, we can see that only one of the variables included in this model are significant at the 1% level, namely the Covid dummy, all the other variables are not significant at either the 1%, 5% or the 10% level. This means that only one of the variables included has significant impact on the dependent variable, while the other ones have minimal impact on the dependent variable. The R^2 of total US log-import is fairly low at 0.67 indicating that about 67% of the variation in total US log-import is explained by the independent variables in this model.

Similar to the previous model results for total export, the estimation coefficients for total import are exhibiting odd results. For this model the log-US-GDP has come down by a big margin, showing a coefficient of -1.70 indicating that a one unit increase in the natural logarithm of US GDP will cause a decrease of approximately 1.70% in the dependent variable which again suggests an inverse relationship between US log-GDP and the dependent variable total US log-import.

For the variable log-China-GDP coefficient come in at 0.79 indicating that a one unit increase in the natural logarithm of China GDP will cause an increase of approximately 0.79% in the dependent variable. The positive coefficient suggests a positive relationship between China's GDP and the dependent variable. Again, log_distance has a coefficient positive of 4.37, indicating that the distance between the US and China is associated with higher values of imports. The variable log-GDP-distance has a coefficient of 1.37 showing that there is a positive relationship between GDP-distance and the dependent variable. This time the Covid Dummy has a negative coefficient of -0.12, which indicates that the covid pandemic had a small and negative effect on total US-imports. The tariff dummy has a negative coefficient of -0.05 meaning that the Trump-Biden era tariffs and restrictions on trade reduced total US imports by 0.05%.

5.4 Total US semiconductor export

Again, the regressions in this analysis used using pooled OLS, and like before to account for potential autocorrelation or heteroskedasticity in the error terms in the models, it has been conducted using heteroskedasticity and autocorrelation consistent (HAC) covariance. Table 5.4 shows the results of the pooled OLS for US semiconductor exports and imports to China, with the R^2 indicating the goodness of fit. The R^2 for US semiconductor log-export is 0.89 showing that about 89% of the variation in the value of semiconductor exports is explained by the independent variables in the that model. However, the R^2 of total US log-import is low at 0.42 indicating that about 42% of the variation in US semiconductor log-import is explained by the independent variables in this model. From the p-values for semiconductor export, we can see that two of the variables included in this model are significant at the 1% level, and again the some of the coefficients exhibit estimation results that are irrational.

Table 5.4: GM for US semiconductor X/M

	US semi log-export	US semi log-import
log_China-GDP	2.99***	6.30***
	(0.93)	(0.69)
log_US-GDP	-2.57	-26.92***
	(3.21)	(3.80)
log_distance	0.52	45.56***
	(4.98)	(6.62)
log-gdp-distance	0.56	21.44***
	(2.96)	(3.49)
COVID_Dummy	0.25***	0.17***
	(0.06)	(0.05)
tariff_Dummy	-0.04	0.27***
	(0.06)	(0.09)
R-squared	0.95	0.74
R-squared Adj.	0.89	0.42

Standard errors in parentheses.
* p<.1, ** p<.05, ***p<.01

Log-China-GDP has a coefficient of 2.99 indicating that a one unit increase in the natural logarithm of US GDP will cause an increase of about 3% in semiconductor export to China.

For log-US-GDP the coefficient comes in at -2.57 indicating that a one unit increase in the natural logarithm of US GDP will cause a decrease of 2.57% in log_exports.

Again, the coefficient for log_distance has a positive coefficient at 0.52, indicating that there is a positive relationship between the distance and semiconductor export by the US to China. This again like two previous models, violates on of the basic assumptions of the gravity model, that distance is considered to incur transport costs and therefore should be negative.

The variable log-GDP-distance has a coefficient of 0.56 which again shows that there is a positive relationship between GDP-distance and the dependent variable, meaning that if the difference in US and China´s GDP per capita increases by one unit the dependent variable will increase by the dependent variable will increase by 0.56%.

The Covid Dummy has a coefficient of 0.25, this indicates that the covid pandemic had a positive effect on US semiconductor exports, the tariff dummy however has a negative coefficient of -0.04 meaning that the Trump-Biden era tariffs and restrictions on trade reduced total US exports by 0.22%.

5.5 Total US semiconductor import

The R^2 of US semiconductor import is low at 0.42 meaning about 42% of the variation is explained by the independent variables in this model. But the p-values for semiconductor import, are all significant at the 1% level. Log-China-GDP has a coefficient of 6.30 indicating an increase of about 3% in semiconductor import from China per unit increase in China´s GDP. For log-US-GDP the coefficient comes in at -26.92 indicating that a one unit increase in US GDP will cause a decrease of 26.92% in US semiconductor import.

The coefficient for log_distance has a positive coefficient at 45.56, which is very high. It is unreasonable to assume that increased transport costs will lead to increased imports.

The variable log-GDP-distance in this model has a coefficient of 0 21.44 inferring that if the difference in the values of the variable increase by one unit, the dependent variable will increase by 21.44%.

The Covid Dummy has a coefficient of 0.17, this indicates that the covid pandemic had a positive effect on US semiconductor imports, the tariff dummy however has a negative coefficient of 0.27 meaning that the Trump-Biden era tariffs and restrictions on trade reduced total US exports by 0.27%.

6. Conclusion

This thesis attempted investigate whether discernible shifts have occurred in US-China trade patterns in the semiconductor industry as a result of the United States' efforts to disengage from China. In its investigation the study utilized data on total US exports and imports to China as well as semiconductor export and import. The analysis is from the period 2013 – 2022 and the gravity models are constructed based on yearly data in order to attempt to answer the research questions in this paper.

In this paper we get and overview on the background of the decoupling phenomena. We have examined China´s entry into the WTO and the subsequent trade that has cemented China as an important trading nation. The reasoning for the contentious relationship between the US and China, and the following China-policy under the former US president Donald Trump and current US president Joe Biden. Also, some of the guiding principles of the WTO to understand the potential trade breaches and the rules that shape national trade policy.

The quantitative part of this paper tries to discern changes in the semiconductor trade between the US and China. The first model was created using the value of total exports from the US to China as the dependent variable, while US GDP, China GDP, distance, economic distance, and dummies to represent the Covid pandemic and the Trump—Biden era restrictions and tariffs as the independent variables. The second model used the value of total US imports as the dependent variable and kept the same independent variables as the first model. Regressions on the models were done using pooled OLS.
For all the regressions, the variables were put through an ADF-test to determine whether the data was stationary or non-stationary.

The results of the analysis conducted seem to be flawed, the reasoning for this might be because we have not been able to account for stationarity in the panel data. When we have

non-stationary data and it is used in regression models, it can produce misleading results like high R^2 values and statistically significant t-statistics, when there in fact is no meaningful relationship between the variables in the regression. Also, the standard deviation of the explanatory variables is quite high further signaling uncertainty in the estimations.

The result for total US export and import show that GDP and distance is important to explain the value of total exports but not for total imports, in the result for semiconductor trade we get that GDP and distance is significant predictors for semiconductor imports, and that only Chinas GDP is important in semiconductor export. In regard to distance, which is used as an approximation for transportation costs. It was assumed that the coefficient would show a significant negative effect on trade in all the results, however my finding breaks with previous research using the gravity model that finds distance to be an important factor for the facilitation of trade.

The variable GDP distance that attempts at capturing the "economic" distance between the US and China, is shown to be significant for total US exports to China, and for US semiconductor imports from China and is positive across all estimations. This show that the difference in GDP per capita between the two is positively correlated with trade, but it is not always having a significant effect on trade. The dummies created for the Covid–pandemic and Trump-Biden era tariffs and restrictions in the regressions show that there exists some issue, which has not been accounted for. I was assumed that the Covid dummy would yield a negative coefficient across all results, since lockdowns and travel restrictions most likely had a negative effect on trade, but the results show that for US total export and imports the Covid dummy was significant but with a positive effect on total exports and a negative effect on total imports, the same variable for semiconductor export and import is shown to be significant again and that it had a positive effect on semiconductor trade, which goes against the initial assumption on the effects the Covid–pandemic had on trade. The tariff dummy exhibits similar traits, in the model for total exports and imports the tariff dummy has a negative coefficient which is in line with economic reasoning but is significant for total exports and not for imports, while in the semiconductor table it is significant and positive for import and not significant for exports but with a negative coefficient.

The overall conclusion of this paper is that there are many aspects that needs to be considered when tackling US–CH decoupling in semiconductor trade. Understanding the fundamental

reasons for the efforts to decouple is crucial to understanding the current trade relationship between the US and China, the policy implementation taken and considerations that must be taken when forming policy that is in line with the rules and principle of the WTO. From the research in this paper, we can infer that China has had a tremendous growth in its trade since it was aided by the US to join the WTO, and that by shifting its industrial base away from mainly labor-intensive production to more technological capital-intensive labor and utilizing its comparative advantage, China has the potential to dominate the production of strategical commodities like semiconductors. If China were to continue in its current trajectory it won't be long before they can produce chips and semiconductors that rival those of other manufacturing countries such as South Korea and Taiwan, giving China a technological edge, the US seems unwilling to allow.

The US trade policy towards China have been justified on the basis that China violates trade agreements, that the implementation of certain policies can get China to adhere to the rules-based trading system. In regard to trade issues between the US and China, it seems that the problems mostly evolve around the way the Chinese government subsidizes its national companies and the technology transfers from US companies. While, on the geopolitical front the contentiousness evolves around continued insistence on its One-China policy, in which China and the ruling Chinese Communist Party argue that there is only one sovereign state under the name China, with the PRC serving as the sole legitimate government of that China, and that Taiwan is an inalienable part of China, and it increased presence in disputed territories. Since Taiwan is an important manufacturer of semiconductors the objective of this policy would lead to China increasing its share of global chip production.

To tackle these issues and preventing further strains in the US–CH trade relationship, it is important that policy makers take these factors into consideration, and form policy that is in line with trade obligations made to the WTO. Both the US and China have benefited from economic interdependence and increased trade globalization, and the current trend of decoupling puts these benefits at risk in an attempt by the US to make China conform to its trade obligations and retain their technological edge in a commodity that is essential is hardware for goods with civilian and military applications and will be important in the development of artificial intelligence.

The models in this paper were made to determine the effectiveness of various different policy implementation. However, the regression result is assumed to be biased and unreliable so it it's difficult to make any statements on the effectiveness of any policy implemented. Potential fixes for these issues will be discussed in the next section of this paper.

6.1 Limitations of the study

There are several limitations in this study that greatly limits the findings in this paper. Firstly, the data collected for the econometric models contains only bilateral trade and the period under review is only 9 years which is a limiting factor, and handling models with few observations requires a combination of careful variable selection, manipulation techniques, and the formulation of robust estimation methods, by doing this we can mitigate the issues that arise from using small sample sizes and improve the reliability of model estimates. The first and only test conducted on the data is the ADF–test which examines whether the panel data has a unit root, in our case the data proved to be stationary and not further transformations were able to be implemented to account for this leading to unreliable results. Even if all the regressions use HAC–covariance, standalone tests for heteroscedasticity and autocorrelation would be considered appropriate in a paper such as this one.

Secondly, the study only utilizes pooled-OLS and neglects to test the poolability of the variables which is important when using panel data as poolability assumes that the relationships between the independent and dependent variables are consistent across time periods. The OLS should also have been tested against other models such as the Fixed effects (FE) model, Random effects (RE) model and potentially the Correlated Random effects (CRE) model to determine the model with the best fit. Also, more variables could have been included in the models such as, population, language, trade agreements, exchange rates, country size etc. There are many factors that affect trade and capturing their effect in the models could potentially improve the estimation results and make variable selection easier.

Thirdly, the distance variable had coefficients that were positive, and this goes against a fundamental assumption in the gravity model that distance is a hindrance in trade facilitation. This fundamental flaw should have been addressed to improve validity of the analysis results. Also, the distance between capitals is in reality not the best estimate for transportation costs

as the specific mode of transportation is not considered but can in reality significantly impact the overall costs of transporting goods.

Fourthly, the semiconductor data collected for use in this study is at the four–digit level, which includes all electronic circuits, some of which may not be relevant for the purpose for investigating US–CH decoupling. By focusing on specific part under at the six-digits level we can get a focused approach giving a better overview of decoupling in the areas of the technology sector where decoupling efforts are present.

6.2 Suggestion for further research

Efforts to decouple have come about as more of a political decision influenced by geopolitical interests, rather than purely out of economic considerations it would be interesting with further research on supply chain decoupling that investigate efforts by US and Chinese companies to reshore or diversify supply chains away from each other. Or research that look at the implications of US-China decoupling on foreign direct investment (FDI), capital flows, and financial markets.

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Appendix 1: Total US & China Export

OLS Regression Results

Dep. Variable:	log_US-X	R-squared:	0.882
Model:	OLS	Adj. R-squared:	0.734
Method:	Least Squares	F-statistic:	234.3
Date:	Sat, 15 Jun 2024	Prob (F-statistic):	5.05e-05
Time:	15:40:21	Log-Likelihood:	18.615
No. Observations:	10	AIC:	-25.23
Df Residuals:	4	BIC:	-23.41
Df Model:	5		
Covariance Type:	HAC		

	coef	std err	z	P>|z|	[0.025	0.975]
log_US-GDP	-16.7017	2.393	-6.979	0.000	-21.392	-12.011
log_China-GDP	4.3624	0.527	8.276	0.000	3.329	5.396
log_distance	26.7276	3.835	6.970	0.000	19.212	34.243
log-gdp-distance	14.4034	2.131	6.760	0.000	10.228	18.579
COVID_Dummy	0.1188	0.024	4.955	0.000	0.072	0.166
tariff_Dummy	-0.2250	0.041	-5.508	0.000	-0.305	-0.145

Omnibus:	1.121	Durbin-Watson:	1.934
Prob(Omnibus):	0.571	Jarque-Bera (JB):	0.764
Skew:	-0.598	Prob(JB):	0.682
Kurtosis:	2.365	Cond. No.	2.85e+04

Appendix 2: Total US Import

OLS Regression Results

Dep. Variable:	log_US-M	R-squared:	0.665
Model:	OLS	Adj. R-squared:	0.246
Method:	Least Squares	F-statistic:	184.7
Date:	Sat, 15 Jun 2024	Prob (F-statistic):	8.10e-05
Time:	15:39:20	Log-Likelihood:	16.638
No. Observations:	10	AIC:	-21.28
Df Residuals:	4	BIC:	-19.46
Df Model:	5		
Covariance Type:	HAC		

	coef	std err	z	P>|z|	[0.025	0.975]
log_US-GDP	-1.7114	1.933	-0.885	0.376	-5.499	2.077
log_China-GDP	0.7872	0.539	1.461	0.144	-0.269	1.843
log_distance	4.3745	3.031	1.443	0.149	-1.566	10.315
log-gdp-distance	1.3691	1.729	0.792	0.429	-2.020	4.758
COVID_Dummy	-0.1234	0.037	-3.339	0.001	-0.196	-0.051
tariff_Dummy	-0.0522	0.038	-1.364	0.173	-0.127	0.023

Omnibus:	1.673	Durbin-Watson:	2.621
Prob(Omnibus):	0.433	Jarque-Bera (JB):	0.278
Skew:	0.394	Prob(JB):	0.870
Kurtosis:	3.213	Cond. No.	2.85e+04

Appendix 3: Total US semiconductor Export

OLS Regression Results

Dep. Variable:	log_US-X	R-squared:	0.952
Model:	OLS	Adj. R-squared:	0.892
Method:	Least Squares	F-statistic:	1223.
Date:	Sat, 15 Jun 2024	Prob (F-statistic):	1.87e-06
Time:	04:29:18	Log-Likelihood:	10.954
No. Observations:	10	AIC:	-9.909
Df Residuals:	4	BIC:	-8.093
Df Model:	5		
Covariance Type:	HAC		

	coef	std err	z	P>|z|	[0.025	0.975]
log_China-GDP	2.9933	0.926	3.234	0.001	1.179	4.808
log_US-GDP	-2.5705	3.211	-0.801	0.423	-8.864	3.722
log_distance	0.5162	4.983	0.104	0.917	-9.250	10.283
log-gdp-distance	0.5650	2.964	0.191	0.849	-5.245	6.375
COVID_Dummy	0.2530	0.063	4.025	0.000	0.130	0.376
tariff_Dummy	-0.0368	0.061	-0.600	0.549	-0.157	0.084

Omnibus:	0.834	Durbin-Watson:	2.402
Prob(Omnibus):	0.659	Jarque-Bera (JB):	0.398
Skew:	-0.452	Prob(JB):	0.820
Kurtosis:	2.630	Cond. No.	2.85e+04

Appendix 4: Total US semiconductor Import

OLS Regression Results

Dep. Variable:	log_US-M	R-squared:	0.740
Model:	OLS	Adj. R-squared:	0.415
Method:	Least Squares	F-statistic:	77.17
Date:	Mon, 17 Jun 2024	Prob (F-statistic):	0.000456
Time:	08:41:00	Log-Likelihood:	10.375
No. Observations:	10	AIC:	-8.750
Df Residuals:	4	BIC:	-6.935
Df Model:	5		
Covariance Type:	HAC		

	coef	std err	z	P>|z|	[0.025	0.975]
log_China-GDP	6.2979	0.691	9.120	0.000	4.944	7.651
log_US-GDP	-26.9158	3.795	-7.092	0.000	-34.355	-19.477
log_distance	45.5551	6.620	6.881	0.000	32.579	58.531
log-gdp-distance	21.4371	3.493	6.138	0.000	14.591	28.283
COVID_Dummy	0.1696	0.047	3.600	0.000	0.077	0.262
tariff_Dummy	0.2728	0.093	2.930	0.003	0.090	0.455

Omnibus:	0.966	Durbin-Watson:	2.973
Prob(Omnibus):	0.617	Jarque-Bera (JB):	0.624
Skew:	-0.045	Prob(JB):	0.732
Kurtosis:	1.780	Cond. No.	2.85e+04

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