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REMOVING CHINA FROM THE EU'S EQUATION: THE REPLACEMENT OF IMPORTS DURING COVID-19

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Removing China from the EU's equation: The replacement of imports during Covid-19

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08.04.2024.

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Abstract

This thesis investigates the European Union's capacity to diversify its import sources away from China during the Covid-19 pandemic and examines the implications for potential de-risking policies. The study employs a log-linear model to analyze trade flows between China, the EU, and its 20 most significant trade partners in the first four months of 2020. The findings reveal that the EU increased imports from alternative partners when China enforced workplace closures due to the pandemic. The effect of import substitution was more pronounced for EU countries with pre-existing reliance on Chinese homogenous and capital goods, while it was more challenging to replace heterogeneous and final consumer products.

An extension into 2023 follows, applying findings from Covid-19 and analyzing the current share of China's imports by product class. The thesis develops a Replacement Index, which acts as a proxy for determining the vulnerability of a country in case of de-risking. We conclude that many EU countries will find it difficult to shift away from China in case of de-risking - only two countries are classified as low-risk based on product differentiation; and three - based on product end-use.

Conclusively, the research highlights that the shift away from Chinese imports during workplace closures was temporary, and the ease of replacing these imports varied significantly by product type and prior dependence on Chinese goods. These results contribute to the discourse on the EU's risks associated with an over-reliance on a single external supplier, suggesting that diversification can indeed mitigate such risks but may be problematic for some product categories.

Key words: Covid-19, De-risking, China, the EU, International Trade

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1. Introduction

On 30th March 2023, the President of the European Commission Ursula von der Leyen delivered a speech on European Union [EU]-China relations, which was the first instance of the EU publicly announcing its plans to reduce its dependence on China as a trade partner (European Commission, 2023). The EU has grown increasingly concerned about its dependence on China - it was the largest goods supplier for the EU in the first half of 2023 - and has labeled the country a "systematic rival" (Romei, 2023). Since then, heated debates have emerged over the implications of the EU becoming more autonomous and self-sufficient, putting emphasis on reducing the reliance on trade with China. Ursula von der Leyen has proposed a de-risking policy to reduce the EU's dependency from its "systematic rival." This may have sounded like a compelling idea at first, yet lately concerns have surfaced regarding China's irreplaceable role as a supplier of strategic product classes. The EU has become increasingly reliant on imports from China over the past few years. Thus, de-risking and autonomy might imply the opposite of economic security - a dicey operation (Schaus and Lannoo, 2023). Generally, the debate about the consequences of potential de-risking is still ongoing, with no clear conclusion in sight. However, the EU has already experienced a stress test of its ability to stand on both feet in the recent past - the Covid-19 crisis.

In late 2019, the first case of Covid-19 was detected in Wuhan, China; and nearly four months later with the virus swiftly spreading from one country to another, the World Health Organization [WHO] declared a worldwide pandemic (WHO, 2021). Ever since then, Covid-19 has brought many challenges in health, economic, social, and fiscal fields; moreover, it has forced governments to introduce stringent containment measures and even lockdowns (OECD, 2020). The Covid-19 pandemic has been a devastating health crisis forcing people to keep a distance from one another. Yet not only people but also countries have acquired a concerning trend of isolating themselves from one another, depending on self-sufficiency and effectively disrupting Global Value Chains [GVCs] (World Bank, 2022). As a result, global trade fell by 8% in 2020. With this decline, concerns over the role of GVCs, their ability to transmit shocks and China's stake in the global economy have spurred (Brenton et al., 2022).

The recent battle with Covid-19 has uncovered a few risks related to GVCs that occur due to the interdependence of countries. Such interconnectedness can result in the transmission of demand and supply shocks and instability of the macroeconomic environment (OECD, 2021). China's role in GVCs is undeniable as it is the largest

exporter in the world (Dyvik, 2023). Additionally, China has become increasingly prominent in GVCs through establishing more forward linkages with other countries and decreasing the number of backwards linkages (Qin et al., 2020). In other words, more countries rely on China for imports (forward linkages), while China depends on its own production rather than imports from other countries (backward linkages). This is also exemplified by Woetzel et al. (2019) who find that 33 countries rely on it heavily as an export destination, but for 65 countries it is the biggest source of imports.

When the Covid-19 pandemic struck, China implemented strict restriction policies, which resulted in a steep decline in the country's exports (Hansen et al., 2023). This, in turn, created a great concern for the countries that are heavily reliant on Chinese goods due to the risk of shock transmission through GVCs. Even though the pandemic is over, the use of terms such as reshoring, decoupling, and de-risking has accelerated in the past couple of years, creating a trend that is not likely to go away any time soon. Countries are looking to reduce the risks associated with dependence on trade partners, despite the benefits that the GVCs bring to the table, such as productivity and lower production prices due to specialization and economies of scale (OECD, 2021).

Overall, GVCs seem very fragile right now due to increasing trends toward deglobalization and rising geopolitical tensions. Amid rising geopolitical tensions, and because of the "hard lesson" showcased by the EUs dependency on Russia for natural gas, (Blenkinsop, 2023), an era of "de-risking" has followed. Each of G7 countries have pledged to decrease their reliance on China (Tang, 2023). This showcases the relevance of diving deeper into the relationship between the EU and China and studying their interaction during the pandemic. That is the most recent event, where large-scale import reductions from China took place, thus providing insights as to how shocks are transmitted through GVCs, as well as how the EU readjusted its trade patterns when there was no other choice.

Thus, this thesis is dedicated to studying the possible contagion effect in GVCs due to the decline in China's exports. As mentioned before, the risk of shock transmission through GVCs has been a great concern since the start of the pandemic, and the aim of our paper is to study whether that was the case in the context of the EU's and China's relationship, namely, whether lower exports from China to the EU resulted in the EU replacing its most important trade partner. It must be noted that our analysis sheds light only on the short-term effect as the Covid-19 pandemic was quite a recent phenomenon. What is more, solely the first three months when China implemented

restriction measures and Europe continued to operate as per usual are of key interest to us. Consequently, our research questions are as follows:

First Research Question: Did the disruption of Chinese exports lead the EU to look for other trade partners?

Second Research Question: What factors determine the degree of trade partner substitution?

Third Research Question: What does Covid-19 teach us about the EU's vulnerability to a potential de-risking policy?

The thesis is structured in two parts: the first examines the EU-China trade in the context of the Covid-19 pandemic during 2020. The second section extends the analysis to 2023 to consider the implications for potential de-risking policies. Our research primarily uses trade data from the Eurostat's COMEXT database, covering January 2019 to December 2020, and includes data from 2023 for the latter part of the study. Additionally, we incorporate data on Covid-19 responses from the Oxford Covid-19 Government Response Tracker (OxCGRT) by Hale et al. (2023). The initial part employs a log-linear model to evaluate the EU's ability to diversify away from China for its import needs. We then apply these findings to the post-pandemic context, focusing on the risks of reducing reliance on Chinese imports.

Kejžar et al. (2022) have observed the negative impacts of supply chain disruptions impacting EU-China trade during Covid-19, while Baldwin and Tomiura (2020), Baldwin and Freeman (2020), as well as Friedt and Zhang (2020) have provided a theoretical framework for the supply and demand side effects on international trade caused by Covid-19. Additionally, Zhou et al. (2023), Spillner and Wolff (2023), and Bohman (2023) have theorized the outcomes of a potential de-risking policy towards China. As for the novelty of this thesis, our findings aim to provide a guideline as to (i) what countries are the most vulnerable to a sudden decrease in trade with China, (ii) which products classes are the most easily replaceable, and (iii) how the dynamics of the EU's dependency on China have evolved since 2019. All of the findings are analyzed in the context of a potential sudden de-risking policy implemented by the EU, which has not yet been explored. Thus, we fill the gap in the existing literature between theoretical papers on the outcomes and implications of de-risking policies and papers on trade dependency, and factors affecting trade.

The research begins with a review of existing literature to frame our investigation. Following this, we clarify our methodology and the data sources used for

our research. Subsequent sections state and discuss our findings for both time frames: the Covid-19 crisis and the subsequent period in 2023 when de-risking policy considerations gained momentum. The thesis concludes with our conclusions in regard to the research questions and the current trade environment

2. Literature review

2.1. Background on de-risking policies regarding trade with China

2.1.1. De-risking and decoupling.

When it comes to de-risking, there is often confusion about how the term should be interpreted. Sometimes, it is even used interchangeably with the term "decoupling", but, within the context of our thesis, it is of utmost importance to differentiate between the two.

As per Capri (2023), decoupling refers to completely severing ties between two countries. This requires breaking preexisting trade and investment agreements, severing supply chains, and establishing new trade partnerships with other countries. De-risking focuses on reducing risks associated with considerable exposure to a certain country. Similar to decoupling, de-risking is aimed at reducing reliance on a single trade partner, however, de-risking still allows for basic trade and investment activities to continue. In short, de-risking focuses on cutting trade in specific sectors to reduce the exposure to geopolitical or economic risks associated with a specific sector and trade partner.

2.1.2. EU and de-risking policies

The EU first publicly announced its plans to reduce its dependence on China as a trade partner in March of 2023 in a speech delivered by von der Leyen (European Commission, 2023). Firstly, she raised concerns about China's strategic intentions, an issue exacerbated by the increasingly close ties between Moscow and Beijing, human rights violations in Xinjiang, and concerns over regional stability in the Taiwan Strait.

Von der Leyen cited examples of China's "trade coercion," such as punitive measures against Lithuania upon the opening of the Taiwanese Representative Office in Vilnius (Lapėnienė, 2022), and trade restrictions on Australian barley and wine in response to its government questioning the origin of Covid-19 (Westcott, 2020). She described China as "becoming more repressive at home and more assertive abroad."

Von der Leyen also identified three key aspects of China's strategy: enhancing internal security and control, prioritizing these over free market principles, and aiming to reshape the global order with China at its core.

Responding to these challenges, she emphasized that while complete decoupling from China is neither viable nor desirable. Instead, she proposes the EU must strategically "de-risk through diplomacy" to maintain diplomatic stability and open communication with China.

2.1.3. Effects of de-risking policies - empirical and theoretical findings

De-risking policies are quite a recent topic, as is the concern for over-dependence on trade with China, so the literature covering the topic is scarce. However, there are some studies covering the topic that provide at least a theoretical framework of how a de-risking policy in regard to China might look and be implemented, as well as some hypotheses of the effects that would precipitate as a result of de-risking policies.

In a brief covering the consequences for the EU economy in the case of a decoupling strategy from China, Bohman (2023) outlines three important findings. Firstly, the main areas to be directly affected by the de-risking policies would be critical infrastructure, cutting-edge semiconductors, and specific raw materials and equipment needed for the green transition, as these are deemed by the EU to be the most sensitive market areas. Secondly, the implementation of barriers to trade, such as de-risking policies, does not come hand-in-hand with increased diversification of suppliers or increased trade with other trade partners. In fact, de-risking favors domestic firms over international trade partners. Therefore, the expected effect of de-risking policies from China is an overall less open global economy. Thirdly, Bohman (2023) theorizes that de-risking policies send a signal to the world and EU's trade partners that their trade with the EU is at risk and increases uncertainty for the future of trade with the EU. This is especially important for countries that do not share a "pre-existing mutual trust" with the EU - for example, Saudi Arabia, Brazil, or South Africa. Consequently, Bohman (2023) theorizes that, as a result, future investments and trade volumes might be negatively affected.

Zhou et al. (2023) provide similar conclusions as Bohman (2023) when theorizing the outcomes of de-risking policies towards China. They conclude that de-coupling and de-risking strategies will negatively affect global supply chains and the international economy. Secondly, while the authors acknowledge the strategic

importance of diversification when it comes to suppliers, they conclude that effective de-risking of supply chains comes from cooperation as well as discussions on mutually beneficial terms.

Spillner and Wolff (2023) explore how political statements about de-risking are to be translated into corporate actions, and, as a result, lay out several recommendations. These align with concerns expressed by Bohman (2023) - they suggest the EU increase the attractiveness of their domestic markets for investments to strengthen them and maintain global competitiveness. The authors also conclude that cooperation between EU member states is essential for achieving a well-functioning single market, which is in line with the conclusions of Zhou et al. (2023). Lastly, they single out Germany as the country that would be most affected by de-risking policies towards China. China is Germany's largest trading partner for trade in goods - around 5000 German companies conduct business in China, and, in 2022, investments of Chinese companies in Germany amounted to 2,5 billion euros. It is evident that out of the EU countries, Germany has the most far-reaching connections to China and thus more exposure to any of the negative effects that will come as an effect of de-risking policies.

Overall, what can be gathered is that the EU will have to make changes in its trade structure and trade partners in order to de-risk from China. However, if and how that might work remains speculative. Thus, we move forward with exploring the subject of trade between the EU and China during Covid-19 and looking for evidence as to whether China can be substituted as a trade partner.

2.2. Impact of the Covid-19 pandemic on China's trade

Due to Covid-19, the global economy saw a sharp decrease in international trade in 2020. As outlined by OECD (2022), these changes in trade structure were of similar magnitude as changes that otherwise happen over 4-5 years, outlining the importance of short-term effects that can be seen when looking at Covid-19 as a case study. According to Baldwin and Freeman (2020), the impact of Covid-19 had a different effect on world manufacturing than any other pandemic for the last 100 years. The biggest manufacturing economies of the world - China, US, Japan, Germany, Korea, India, and the like - were largely affected, and what is most important - almost at the same time. Additionally, OECD (2022) concludes that the impacts across specific goods, services, and trade partners have been diverse, with some sectors, products, or countries being disproportionately more affected than others.

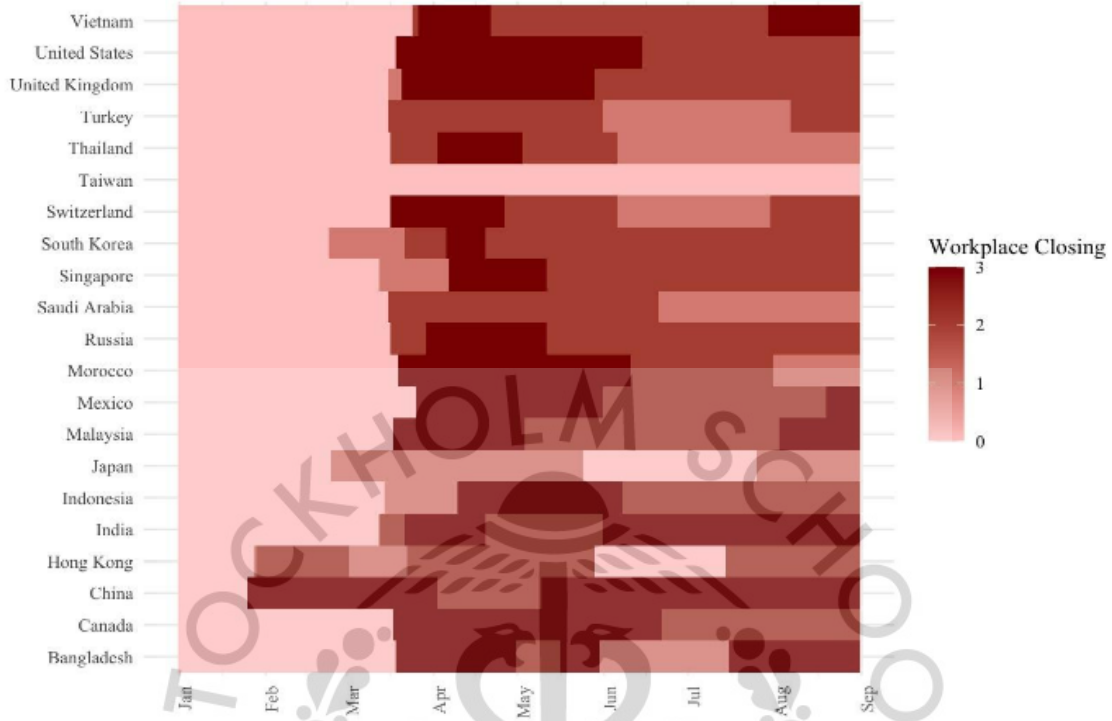
Covid-19 resulted in a significant negative hit to international trade, but not all sectors, products, or countries were affected proportionally. However, our focus is on China, as it is (and was in 2020) one of EU's largest trade partners. It follows that the EU was highly dependent on China as a trade partner (and still is), so any supply-side shocks and the resulting contagion effects of GVCs that emerge from China will have a direct impact on European trade as well.

2.3. Supply and demand shocks

China's manufacturing sector, and any changes within it, have a significant potential effect on international supply chains (Caporale et al., 2024), mostly because of the forward linkages with other countries (Qin et al., 2020). Numerous studies have covered the case of China during the Covid-19 pandemic, as well as the impacts it has had on both the exports and imports of the country. Baldwin and Tomiura (2020), Baldwin and Freeman (2020), as well as Friedt and Zhang (2020) have provided a theoretical framework for the supply and demand side effects on international trade caused by Covid-19, also referred to in literature as the "triple pandemic effect."

The first of the three pandemic effects is a supply shock caused by the containment measures that were enforced as a result of Covid-19. While they were aimed at reducing the number of infections and alleviating the strain for hospitals, it ultimately resulted in workers being kept from working. Thus, the output in countries most affected by Covid-19 was significantly reduced (Baldwin and Freeman, 2020). This is supported by Baldwin and Tomiura (2020) who explain that countries around the world rely heavily on East Asia, which just so happened to be the first ones to be hit hard by Covid-19, impacting the work capacity and output of both intermediate and final goods. This is presented in Figure 1, where it can be seen that (i) China was the first to implement workplace closure policies, with Hong Kong, Japan and South Korea not far behind, and that (ii) the containment measures in China, as represented by the measure of workplace closures, were the most stringent right from the start.

Figure 1. Workplace Closing index for EU's top 20 trade partners and China in 2020.



Note: Created by the authors, using the OxCGRT database by Hale et al. (2023) for the first eight months of 2020. The Workplace Closing Index is measured on a daily basis, on a scale of 0 - 3, where 0 stands for no workplace closures and 3 stands for a high degree of workplace closures.

Caporale et al. (2024) introduces EU to the equation, outlining the effects of Covid-19 on European trade by mostly focusing on restriction measures imposed by the governments. What is concluded is that the social distancing and movement restrictions imposed to stop the virus from spreading impacted labor supply and transportation and led to the partial or full closure of some businesses. Since EU countries have a relatively open trade regime, it was inevitable their economies would face a sharp decline in imports at the start of the pandemic.

China's radical employment of workplace closures and containment policies, as can be seen in Figure 1, echo through the global value chains, which is explained by the second pandemic effect in the framework - the supply-chain contagion caused by the disruptions of trade of intermediate goods. The world's interconnectedness through GVCs means that a supply-chain contagion effect takes place, amplifying the direct supply shocks observed in the main manufacturing countries (Baldwin and Freeman, 2020). Baldwin and Freeman (2020) suggest that countries less affected by Covid-19 will find it harder and more expensive to acquire intermediate goods needed for manufacturing final goods - both from manufacturing giants like China and also from

each other. They conclude that exports will fall in countries hit hardest by the pandemic, while imports will fall for trade partners of those countries - however, the theory remains unclear as to which effect is more significant.

This aspect, too, is explained by existing literature on the topic, such as Hancock and Mora (2023) who looked at the impact of Covid-19 on Chinese trade through processing trade flows observed between China and its two main trading partners - Japan and the US. They find that the products in the middle of the global supply chain - intermediate goods - were the ones most affected by the impacts of Covid-19, and, additionally, that the severity of the effect is dependent on a country's role in the global supply chain, which highlights the role of GVCs in transmitting supply chain shocks. Secondly, for all products (not just intermediate goods), China's exports were more impacted by the Covid-19 shock than its imports, displaying the theorized individual supply shocks experienced by countries largely impacted by Covid-19. Lastly, the study observes China's dependence on Japan as a source of inputs for production - as exports for China decreased, so did the need for the imported inputs needed for these products, hence a decrease in imports from Japan to China.

The third pandemic effect in the framework covers the demand shocks caused by Covid-19. The shock is theorized to have an effect in three dimensions - a drop in aggregate demand (a recession), delays in purchases from consumers, and investment delays by firms. Firstly, the lockdown and containment measures, such as workplace closures, inevitably lead to a drop in a country's income, which means less disposable income, and therefore decreased spending by consumers. This, in turn, leads to fewer imports from its trade partners. This means lower exports - and lower aggregate demand - for the trade partner countries (Baldwin and Freeman, 2020). Additionally, Liu et al. (2022) find that the stringency of a country's lockdown measures, and Covid-19 deaths lead to significantly reduced imports from China; however, these negative effects disappear when the sample is restricted to medical products, products associated with "work from home," capital goods, and processing trade products. This is also supported by Hansen et al. (2023) who find that countries with relatively more stringent lockdown measures saw a reduction in monthly imports from China. Moreover, stricter lockdown measures impacted the residual trade component, resulting in less residual trade. Lastly, the negative effect that was observed, while significant, was concluded to be small, as the effect disappeared after 2 months, once again exemplifying the importance of a short-term analysis when approaching this subject. Secondly, disruptions like the

Covid-19 pandemic are linked to recessions and delays in purchases of final goods from customers. As per Baldwin and Freeman (2020), manufactured goods are perceived by consumers to be more "postpone-able," which means that they are also more likely to experience a sharp decline in demand as, for example, consumer income decreases. Similar tendencies were observed in the aftermath of the GFC in 2008/2009 as consumers and firms became more conscious about their purchases, postponing or reducing purchases where possible. Thirdly, OECD (2013) has concluded that the lesson to be learned from past global crises (e.g., GFC) and natural disasters is that, in times of increased uncertainty, companies tend to react by reorienting their business and production strategies towards ones that include more diversification of risks. This is done by adjusting investing strategies - perhaps leading to delayed investments, as outlined by the triple pandemic effect framework - or making their value chains simpler and shorter to reduce the risks imposed by their dependence on other parties.

In short, Covid-19 introduced both supply and demand shocks to international trade that were amplified because of global interdependence through GVCs. When considering exports from China, Friedt and Zhang (2020) estimate that the most prominent effect that explains around 75% of total decrease in exports from China was caused by GVC contagion effects. Domestic (Chinese) supply shocks accounted for 10-15% and global demand shocks - for 5-10% of total reduction in exports from China.

However, even if trade between countries slows down, countries still need certain products to continue their manufacturing and everyday activities. While Covid-19 negatively affected exports from China, the demand for goods in its trade partner countries did not disappear (although it was highly likely to decrease), hence leading to these countries replacing imports from China with imports from other countries to decrease the risk of shortages (Freeman and Baldwin, 2020). Thus, a trade partner substitution aspect, resulting from Covid-19, which is of utmost importance to our thesis, appears, and it will be addressed in further sections.

2.4. Substitution effect

The field of international economics employs several theoretical models to explain how and why countries trade. The first one is the Ricardian model which posits that countries export the goods in which they have a comparative advantage (Deardorff, 2007). Based on the Ricardian model, the Heckscher and Ohlin model was introduced, which predicts that countries will specialize in producing and exporting the goods that

make use of the (relatively) abundant factors of production that the country possesses while importing the goods that would have required the use of the country's scarce factors of production (Leamer, 1995). Another model widely used in international economics is the gravity model of international trade which theorizes that the volume of trade between countries, directly related to the size of their economies, is inversely proportional to the distance between said countries (Chaney, 2011). Chaney (2011) also explains that one of the reasons why the gravity trade model works is that increased distance between countries hinders the initial acquisition of trade contacts.

What we can gather from the theoretical framework, looking at it from the substitution aspect, is that, firstly, countries specialize in exporting certain products. Secondly, not all countries are able to export the same goods, meaning that substitute trade partners, especially for highly specialized products, might be hard to find, as there are simply not that many trade partners to choose from. Thirdly, when substituting a trade partner, it might be easier to do so with a trade partner located geographically closer. However, while theoretical models explain the basic mechanics and logic behind international trade, they fail to account for all the variables involved in the complex GVCs, therefore, we turn to empirical evidence to provide more insights.

Freeman and Baldwin (2020) note that a drop in imports from a trade partner (associated with supply shocks and amplified by supply chain contagion) means that countries that depend on these imports now have two choices. First, to shift aggregate demand towards local products – if local firms can provide the substitutes needed – or, secondly, face shortages if local firms cannot produce them (e.g., manufactured parts). If local supply cannot meet local demand, countries must find substitutes from other trade partners to minimize the risk of shortages. In the case of the EU, these are trade partners other than China. However, when it comes to substituting China as a trade partner, countries face the deeply ingrained forward linkages in GVCs that China has. As per Qin et al. (2020), that makes the role of China in the current global economy irreplaceable.

Other findings suggest that while the bold claim of Qin et al. (2020) might ring true for some products, imports from China can be replaced - at least partially. Rauch (1999) outlines a product classification system that includes three classes of products - differentiated (heterogeneous) products, reference-priced (semi-homogeneous) products, and goods traded on an organized exchange (homogeneous). Rauch concludes that different factors, such as distance between countries, common language, or trade

agreements have a more pronounced impact on the trade of heterogeneous products than homogeneous ones. This is supported by Herman and Lee (2019) who add to the findings by concluding that the effects for factors influencing the trade of heterogeneous products are more pronounced in the short term.

Additionally, Salvador et. al. (2019) suggest that Chinese exports have become increasingly more technologically advanced, i.e., they are highly differentiated and heterogeneous. For example, some of the goods that China specializes in exporting are telephones, computers, and integrated circuits (OEC, 2024).

What this means is that when it comes to trade with China, homogeneous goods should be the easiest to substitute, especially considering the short time frame that is the focus of our thesis. However, the EU might find it challenging to replace the heterogeneous goods produced by China as they are highly specialized. This is supported by Caporale et al. (2024), who find that not all sectors in the EU were equally impacted as a result of Covid-19 and the consequent disruptions to trade. Agriculture, chemicals, as well as food and drinks were shown to be less affected than machinery, vehicles, and other manufacturing industries, indicating that the EU was able to replace some of the homogeneous goods used as inputs for production while failing to replace the highly specialized and differentiated products used as inputs in sectors such as machinery and vehicles.

2.5. Hypotheses

Considering the aggregated literature review and the context of our methodology, five main hypotheses are expected in terms of the results:

Hypothesis 1: Following a drop in China's exports to the EU, the EU's imports from other non-EU countries will increase.

Hypothesis 2: Workplace closures in the EU will lead to decline in imports from other non-EU countries, namely, to a demand shock.

Hypothesis 3: Workplace closure in the non-EU partner countries will lead to a drop in exports to the EU – a supply shock.

Hypothesis 4: Regarding Rauch classification, homogeneous goods will be the easiest to replace.

Hypothesis 5: In terms of the end-use, intermediate consumption goods will be the hardest to substitute.

3. Data

In this paper, we look at the trade relationship between China and 27 countries of the EU. The analysis is mostly based on the short period of time, namely, the first four months of 2020, when China discovered the first case of Covid-19 virus and started to implement stringent response measures while the EU continued to operate in the business-as-usual framework (Figure A.1., Appendix A). It is important to note that we are only able to measure short-term effects given that of key importance to us are the first months following the identification of the initial outbreak. In addition, the Covid-19 pandemic appeared recently, meaning that the long-term effects and implications will appear only in the years to come.

The trade data for China, the EU, and other countries at the CN 8-digit level was collected from the Eurostat COMEXT database for the period starting in January 2019 and ending in December 2020. Thus, we cover both the pre-Covid (normal or control) period and the first year of the Covid-19 pandemic. While the trade data for subsequent years is available as well, it does not add much value for our empirical analysis since the second wave of the pandemic was expected and the reaction of different countries was more homogeneous. The COMEXT is a database published by Eurostat; the data itself is handed in by the statistical agencies of the EU Member States and its trading partners. It consists of statistics on the EU's internal as well as external merchandise trade. The data is categorized according to the Combined Nomenclature (CN) system introduced by the Eurostat. This system is an eight-digit subdivision of the Harmonised System (HS), consisting of four two-digit levels, namely, HS2, HS4, HS6, and CN8. (EUI, 2023) The CN 8-digit, which is of main interest to us, consists of approximately 10,000 commodity groups. The frequency of the data is monthly, and services are not considered in our research. As HS 4-digit and 6-digit classification is too broad for us, we proceed with the CN 8-digit classification to conduct a more in-depth analysis. To make our analysis more targeted and avoid unnecessary noise in the data, we have narrowed down sample of the COMEXT database. Firstly, as mentioned in the previous sections, we look at all the 27 European Union countries. As per the partners, we have narrowed it down to the 20 biggest non-EU partners in terms of import value in euros, accounting for China separately (Table A.1 & A.2, Appendix A). We are interested in

external trade rather than internal trade as our work aims to highlight the risks associated with relying on trade partners outside the EU. Consequently, when filtering out the EU's internal trade, the 20 selected partners along with China account for 75% of the total EU's imports from external partners in 2019. With respect to products, out of approximately 10,000 products at the CN 8-digit level, we have preserved the top 1,000 products imported from China based on their import value in euros in 2019. According to our calculations, those 1,000 products form 85% of the total import value from China. For the second part of this thesis, we additionally collect data for 2023 to analyze the current landscape of the China-EU trade.

Next, data on UN Broad Economic Category (BEC 5th Revision) classification is gathered from the United Nations Statistics Division [UNSD] to aggregate goods by their end-use, namely, to determine whether the goods are for consumer or intermediate consumption, or gross fixed capital formation. (UNSD, 2024) The BEC 5th revision generally consists of 6 levels - broad economic category, product, end-use, processing, specification, and durability dimensions. For this thesis, we mainly focus on the end-use dimension, which includes final consumer goods that are used by households and communities to satisfy their specific needs; intermediate goods used during production; and gross fixed capital goods - assets utilized repeatedly or continuously in production (UN, 2016). Additionally, to conduct a more comprehensive analysis, products that are not distinctly capital, consumer, or intermediate have been excluded from our final database.

When it comes to the data related to Covid-19, we use the Oxford Covid-19 Government Response Tracker [OxCGRT] by Hale et al. (2023). The database compiles Covid-19 measures taken by governments in 185 countries and 210 subnational jurisdictions between January 2020 and December 2022. There are 25 indicators included in the dataset that are further categorized into 5 groups, i.e., closure and containment, economic, health, and vaccine indicators. One of the key metrics in the OxCGRTdatabase is the Stringency Index that the OxCGRT project has calculated based on nine Covid-19 response metrics: school closures, workplace closures, cancellation of public events, restrictions on public gatherings, closures of public transport, stay-at-home requirements, public information campaigns, restrictions on internal movements, and international travel controls. The Stringency Index is an average score of the nine previously mentioned metrics that varies from 0 to 100, the former corresponding to no response to the Covid-19 virus and the latter being the

highest degree of stringency. In addition, it is calculated depending on three categories, namely, for vaccinated, non-vaccinated populations, and the national weighted average based on the share of the vaccinated population. (Roser, 2021). Such an index has been used in other works related to trade, for instance, by Hansen et al. (2023), Liu et al. (2022), and Hayakawa and Mukonoki (2021). For our analysis, we use the Workplace Closure metric that is included as a variable in the Stringency Index as it is one of the most effective means of curbing the infection rate Deb et al. (2020). Additionally, it is one of the economically costliest measures taken to combat the spread of the Covid-19 virus. Secondly, workplace closure directly relates to the supply shock imposed by the virus. Hayakawa and Mukunoki (2021) emphasize that Covid-19 negatively impacts the scale of production and the transportation sector of the exporting country, damaging the country's supply. We tie the workplace closure metric with the supply shock and reduction in exports of partner countries due to the pandemic. The metric is measured on a scale from 0 to 3; the former stands for no workplace closures in each country, while the latter stands for a high degree of workplace closures. However, the Stringency Index is still used to check the robustness of our findings.

Similarly to Kejžar et. al. (2022), we intend to use distances between the EU countries and their trading partners as an instrumental variable that helps in explaining the trade relationship. The data for geographical variables was taken from CEPII's GeoDist database (Mayer and Zignago, 2011) which contains bilateral distances measured using city-level data, considering the geographic distribution of the population inside each of the 225 countries. Our primary interest lies in the variable *dist* that is calculated with the great circle formula, which uses latitudes and longitudes of the most populated cities/agglomerations and includes internal distances. We pursue our research by including this variable in our final database to measure the distance between the EU Member States and their non-EU trade partners. Additionally, the database provides such variables as common language, common border, internal distance, and different variables concerned with colonial ties. Yet, given that the majority of the selected partners are located outside of the EU, the previously mentioned measures are not considered useful for our consequent analysis. Moreover, most of the partners selected do not have a trade agreement with the EU, so we do not use that variable in our analysis as it does not yield any additional insights.

Lastly, our database includes Rauch classification (Rauch, 2007) which provides product classification at the Standard International Trade Classification (SITC) 4-digit

code level. SITC is a product classification by the United Nations used for external trade statistics to render international commodities and manufactured goods comparable (Eurostat, 2023). The Rauch classification splits the goods and commodities into three groups, assigning them a specific letter: differentiated products (n), reference-priced products (r), and homogeneous goods traded on an organized exchange (w). Some products may not qualify for one category; therefore, Rauch (1999) introduces two forms of aggregation: liberal and conservative. The former puts products with uncertainty in terms of categorization in the less differentiated of the two categories, while the latter places them in the more differentiated category. For our analysis, we use the conservative aggregation (Herman and Lee, 2019). As per Rauch (1999), such factors as distance, common language, and trade agreements may have a more pronounced effect on trade for heterogeneous products than for homogeneous ones. Herman and Lee (2019) conclude the same yet add that the effects are stronger for differentiated goods in the short term. This data is relevant for our models as we look at the trade between the EU countries and their partners by product, and it is crucial to take into consideration their differentiation degree. In addition, as mentioned before, our research concerns itself with short-run effects, making the product categorization using the Rauch classification ever so important.

The final version of our database consists of 3,670,257 observations with 51 variables, containing various variables from COMEXT (2024), GeoDist (2011), Rauch (2009), UNSD (2024), and OxCGRT (2021) databases, as well as lagged variables for the OxCGRT database.

4. Methodology

In order to answer our research question, we establish the following methodology that allows us to determine whether the EU substituted imports from China with imports from other countries during the first months of 2020. This methodology provides us with the effects on trade that took place when workplaces in China closed due to Covid-19 but stayed open in the rest of the countries.

The methodology was developed from Friedt (2020). We intend to test whether Covid-19 response measures and lower exports from China resulted in the EU seeking the replacement of Chinese imports with imports from other countries (Equation 1). What is more, we examine such replacement effects at the CN 8-digit product level.

$$lnM_{i,j,p,t} = \beta_1 \times CI_{CN,t} + \beta_2 \times CI_{i,t} + \beta_3 \times CI_{j,t} + \mu_{i,p} + \mu_{j,p} + \mu_{t,p} + \varepsilon_{i,j,p,t} \quad (1)$$

We model change in the EU's country i imports from country j - top 20 EU's trade partners, not including China - of a specific product p in time t (lnM_{ijpt}) as a function of the Workplace closure due to the Covid-19 in China in time t ($CI_{CN,t}$), the Workplace closure in the EU country i in time t ($CI_{i,t}$) as well as the Workplace closure in partner country j in time t ($CI_{j,t}$). Multiple fixed effects are introduced to our model, namely, importer's i country-product fixed effects and exporter's j country-product fixed effects ($\mu_{i,p}$ and $\mu_{j,p}$), which mostly capture the comparative advantages of EU countries ($\mu_{i,p}$) and top 20 partners ($\mu_{j,p}$) in terms of trade. We also include time-product fixed ($\mu_{t,p}$) effects that capture general trends in trade for specific products (e.g., quality or taste shifts). We estimate the fixed effects model by OLS using Within transformation. In general, we expect β_2 and $\beta_3$to be negative as government response and restrictions in containing the spread of Covid-19 decrease exports and imports of certain products. Yet, in Equation 2, we want to highlight β_1 that showcases whether the EU replaced imports of certain products given the restrictions in China in the short term. Everything else is captured in the error term (ε_{ijpt}).

$$lnM_{ijpt} = \Sigma_{h=0..1}\left(\beta_{1,h} + \gamma_{1,h} \times \frac{M_{i,CN,p,2019}}{M_{i,p,2019}} + \gamma_{1,h} \times Z_{j,p}\right) \times CI_{CN,t-1} + \beta_2 \times CI_{j,t} + \beta_3 \times CI_{i,t} + \mu_{i,p} + \mu_{j,p} + \mu_{t,p} + \varepsilon_{i,j,p,t} \quad (2)$$

The effect of workplaces closing in the EU and in its top 20 trade partners directly affects the value of imports; the same is true for workplace closures in China. Yet, with the interaction terms we can examine the secondary effects, namely, what product/partner factors exemplify or diminish the direct effect. Thus, we extend this model (Equation 2) by introducing various interaction terms. Firstly, we introduce interaction between the weight of imports of a product p from China in the overall EU country's i imports of the product p in 2019 ($\frac{M_{i,CN,p,2019}}{M_{i,p,2019}}$) and the Workplace Closing Index in China at the time t. The reasoning behind taking the weight is to see whether the substitution of trade partners depends on the importance of Chinese products before Covid-19 pandemic.

Additionally, the regression is supplemented by the interaction of the Workplace Closing Index in China with various product/partner characteristics $Z_{j,p}$. In particular, we take into account the heterogeneity of substitution by distance between the EU country i and the country j that is included in our models as $Dist_{i,j}$. We also allow the substitution effect to differ depending on the Rauch product classification (R_p). What is

more, we introduce the interaction with variable BEC_p, i.e., the end use of products imported by the EU from partner countries. The BEC classification is helpful for explaining which products - consumer, capital, or intermediate - are easier to replace given the Workplace Closing Index in China.

Finally, one-month lagged effects for $CI_{CN,t}$ are brought into the model as we expect that it takes some time for the EU to switch its trade partners and shift away from China's imports. To account for the delayed effects, $CI_{CN,t}$ is replaced by $CI_{CN,t-1}$ including lags for more than one month would not be suitable for our short-term analysis as we rely on the assumption that, in extreme high-stress conditions, countries have to adapt to changes with great speed. We do not introduce lagged effects for any other variable in our model. The rest of the variables are the same as in Equation 1. For a comprehensive table that lists all the variables along with their description and sources, consult Table A.3, Appendix A.

5. Results and discussion

Firstly, we run the most simplistic fixed effects models with immediate and delayed effects. These regressions only include workplace closure measures for the EU countries, partner countries, and China. It is important to note that all of the models exclude China from the EU's trading partners; moreover, they are run for the first 4 months of 2020 as these months capture the discrepancies in Covid-19 measures - beyond that period, most of the countries had implemented workplace closure measures to contain the spread of the virus. When accounting for the delayed effect in our models, the time horizon is extended to 5 months.

The results of the first regressions (Table B.1, Appendix B) suggest that the closure of workplaces in the EU Member States and in partner countries had a negative impact on the EU's value of imports. This result is highly statistically significant for all consecutive regressions for immediate and delayed effects. Furthermore, such an outcome is in line with current literature and the first of the three pandemic effects as outlined by Baldwin and Tomiura (2020), Baldwin and Freeman (2020), and Friedt and Zhang (2020). Workplace closures are a supply shock that affects the output and consequently impacts the exports of a country. Thus, the more stringent the lockdown policies (as represented by the increase in workplace closures) in the trade partners' countries, the fewer imports the EU receives. Workplace closure in the EU itself

resulted in lower imports for the Union, which is explained by the third pandemic effect outlined by Baldwin and Tomiura (2020), Baldwin and Freeman (2020), and Friedt and Zhang (2020). Lockdown and containment measures, such as workplace closures, inevitably lead to a drop in a country's income, leading to less disposable income and, therefore, decreased spending by consumers. This, in turn, leads to decreased domestic demand in the EU and fewer imports from its trade partners. Overall, the findings suggest that the impact of the supply shock was more pronounced than that of the demand shock, which is in line with the findings of Friedt and Zhang (2020).

At first, higher degree of workplace closures in China resulted in a positive, yet insignificant effect on the EU's imports. However, when looking at the delayed effect of China's workplace closures instead of the immediate effect, the result becomes highly statistically significant. This points to an increase in the EU's imports from other trade partners in response to restrictions in China. Moreover, it suggests that we can observe a delayed replacement effect.

Next, we extend the previous models by adding the share of Chinese imports in the overall EU imports (Table B.2, Appendix B). In this case, the effect of China's workplaces closing on EU imports is negative and still lacks statistical significance. When we look at the interaction between China's workplace closures and the contribution of the Chinese imports to total EU imports, we observe that upon an increase in the weight of imports from China, the effect of workplace closures in China has a net positive and statistically significant effect on EU imports. This, in turn, means that the more reliant an EU country is on Chinese imports, the larger was the substitution to other countries in the case there are workplace closures in China. This is explained by Freeman and Baldwin (2020) who find that while Covid-19 negatively affects exports from China, the demand for goods in its trade partner countries does not disappear. It follows that the more reliant an EU country is on China as a trade partner, the bigger the risk of shortages that the country faces. This results in the country having more pressure and incentive to turn towards alternative trade partners to minimize potential shortages. When the one-month lag is introduced, the result becomes more pronounced and statistically significant, meaning that the initial reliance of a country on China plays a key role in the replacement effect.

To understand how the proximity to partners influences EU imports, we supplement our models by the interaction with the distance variable (Table B.3, Appendix B). An immediate effect regression suggests that the workplace closures in

China as well as the distance between the EU and its partners did not affect the value of imports. However, when accounting for the delayed effect, it can be said with high statistical significance that the distance does not matter in terms of trade partner replacement. This finding is contrary to the gravity trade model, as well as findings of Rauch (1999) and Herman and Lee (2019) who find that, in the short term, the proximity of two trading partners is associated with more trade of heterogeneous goods between those two countries. A likely explanation for this is that all the partner countries in the sample are located at a considerable distance from the EU. To replace its imports that previously came from China, the EU was likely prioritizing the capacity of a partner to produce that good, rather than the convenience associated with the proximity of a trade partner.

We further develop our models by interacting the workplace closing measure in China with the Rauch classification for imported products (Table 1). In the model assessing the immediate impact of China's closure measures, the findings appear to be modest, as they are mostly not statistically significant. A statistically significant effect is observed only for reference-priced products, which are semi-homogeneous. However, when introducing the delayed effects, the outcome looks highly promising, and becomes statistically significant. China's workplace closures in the previous month positively affect the magnitude of import substitution from top 20 trade partners in the current month. Unlike the models that only consider the immediate effect of workplace closures in China, this time, the impact of both - the product being semi-homogeneous (r) or homogeneous (w) - is statistically significant. In this case, we can draw more robust conclusions about the effect of product classification on the EU's degree of partner replacement if workplaces in China close. EU imports from partners tend to increase significantly more if the product is homogeneous, compared to the product being semi-homogeneous. Generally, the classification of products matters when it comes to replacing imports, which corresponds to the findings of Rauch (1999) and Herman and Lee (2019). What is more, it can be seen once again that the delayed effect is highly relevant, considering that the replacement of trade partners takes time.

Table 1. Workplace Closing effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Workplace Closing Partner	-0.067***	-0.079***
Workplace Closing Declarant	-0.045***	-0.105***
Workplace Closing CN	0.003	0.056***
Workplace Closing CN x r products	0.032 .	0.048***
Workplace Closing CN x w products	0.144	0.131*
Observations	2008111	2141420
Ajusted R squared (full model)	0.528	0.528

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The dependent variable is logarithm of imports from the EU's top 20 partners. Workplace Closing Partner stands for workplace containment measures in the partner countries, Workplace Closing Declarant - in the EU, Workplace Closing CN - in China. The interaction term is between Workplace Closing in China and the Rauch classification.

Lastly, it is crucial to gain an understanding of how the products' end-use interacts with EU imports when China is forced to implement stringent restriction measures in workplaces (Table 2). Even without accounting for the delayed effect, we detect a statistically significant negative relationship between goods for consumer consumption and the imports' substitution from other trade partners. This points towards the possibility that consumer goods are harder to replace. Therefore, when China encounters a high degree of workplace closures, the value of EU imports from other partners plummets. The same conclusion is drawn for intermediate consumption goods. However, the effect is stronger and more statistically significant for a good being for consumer rather than intermediate consumption. When introducing the delayed effect, previous findings still hold and become more pronounced, repeatedly highlighting the time aspect of trade partner replacement.

Table 2. Workplace Closing effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Workplace Closing Partner	-0.062***	-0.078***
Workplace Closing Declarant	-0.054***	-0.113***
Workplace Closing CN	0.056***	0.108***
Workplace Closing CN x Consumer Goods	-0.091***	-0.097***
Workplace Closing CN x Intermediate Goods	-0.031*	-0.018 .
Observations	2008111	2141420
Ajusted R squared (full model)	0.522	0.522

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The dependent variable is logarithm of imports from the EU's top 20 partners. Workplace Closing Partner stands for workplace containment measures in the partner countries, Workplace Closing Declarant - in the EU, Workplace Closing CN - in China. The interaction term is between Workplace Closing in China and BEC (5th Rev.) classification.

We can favor the acceptance of at least three out of the five hypotheses brought forward. The results lead us to believe that the EU did indeed venture to source alternative partners when China was trying to curb the spread of Covid-19 by introducing strict lockdown measures. Yet, when the EU and other countries began to face the same battle, the value of imports was negatively affected by an internal demand shock. With the help of the models provided above, we have also established that homogeneous goods are easier to substitute than semi-homogeneous or heterogeneous goods, which is in line with the existing literature and Hypothesis 4. Lastly, there is indeed a negative relationship between a good being for intermediate consumption and imports from partner countries. Yet, the negative effect is more pronounced if the good is for consumer consumption. When it comes to capital goods that are the benchmark in our regressions, they are the easiest to replace. Thus, they positively influence EU imports from its top 20 partners. This leads us to partially accept Hypothesis 5.

To conclude, for the first two variables in our regressions, namely, Workplace Closing in the 20 partner countries and the EU, statistical significance is persistent across all our models. When accounting for the delayed effect, the statistical significance for the Workplace Closing in China is consistent as well. Moreover, the coefficient $\beta_{1,p}$ is persistently positive, while coefficients $\beta_{2,p}$ and $\beta_{3,p}$- negative. All the regressions have similar residuals - around 2, adjusted R squared of at least 0.52 and F-statistic above 50. All of this leads us to believe that the results are stable, moreover, that at least 50% of the dependent variable's variance is explained.

5.1. Robustness and Limitations

We will assess the robustness of our results by replacing the Workplace Closing variable with Stringency index from the OxCGRT database by Hale et al. (2023).

When replacing the Workplace Closing measure with Stringency Index in all our regressions (Tables B.4, B.5, B.6, B.7, B.8, Appendix B), we achieve similar results as in our initial models. The signs before the coefficients remain consistent with our previous findings, namely, β_1 is positive, yet β_2 and β_3 - negative. The statistical significance for our three main variables - containment measures in partner countries, the EU and China - remain unchanged in all instances except one. All our previous findings still hold when using the new variable, suggesting the robustness of our results. Additionally, the residual distribution, number of observations, adjusted R squared, and

F-statistic are the same as in the models that contained Workplace Closing rather than Stringency Index, pointing to the reliance of the models used and the results obtained.

In regard to the results found in this thesis, there are some potential limitations. Firstly, we focus on the first 4 to 5 months of 2020, which makes our analysis for the Covid-19 effects very short term. Selecting such a short period of time limits our number of observations, and more important, prevents us from drawing any certain long-term conclusions. This has also restricted us from using lagged effects that exceed a one-month mark. Furthermore, during Covid-19, other factors might have influenced the substitution effect found in this thesis such us, for example, shipping bottlenecks. This could lead to underestimation or overestimation of the EU's vulnerability towards China. Secondly, we look at the logarithm of EU imports, which forces us to remove months where the value of trade is 0. This further reduces our number of observations and may introduce a selection bias into regressions. Lastly, the biggest limitation in the context of our thesis is the computer memory for big data analysis. As each month contains around 5 million observations of trade and as the capacity of our computers is limited, we had to narrow our sample to 1,000 top products and top 20 the most valuable partners.

6. Connection to De-risking Policy

To assess which countries are most vulnerable to a sudden decrease in trade with China, which would happen in the case of de-risking from China, we first look at the trade structure of all EU countries in 2023. To determine which countries were the most exposed to China in 2023, we calculate and analyze the value of imports from China (for each of the Rauch and BEC Rev.5 product categories) as a share of total imports from China and the EU's 20 largest trading partners. It follows that those countries would also be worse off in a case of de-risking from China. Next, we apply findings from the previous section and combine them with the current EU-China trade structure to derive conclusions about how the composition of products traded impact a country's ability to substitute the different product categories. Lastly, we extend this analysis to also include 2019. We examine how the composition of imports from China has changed since 2019, thus deriving conclusions about changes in the level of dependency on China as a trade partner. Additionally, we draw conclusions about where the countries stand when it comes to substituting imports from China in 2023 relative to 2019.

Firstly, to determine the relative weight of product categories (the Rauch classification, BEC Rev.5) imported from China, we have developed the following metric:

$$w_{i,CN,t,p} = \frac{Imports_{\,i,CN,p,t}}{Imports_{i,j,p,t} + Imports_{i,CN,p,t}} \quad (3)$$

Where $Imports_{i,CN,p,t}$ is the import value of an EU country i from China (CN) for a product category p (Rauch or BEC Rev.5) in the year t (2019 or 2023). The subscript p can take 6 categories. If the products are classified by the Rauch, the subscript refers to either homogeneous, semi-homogeneous, or heterogeneous goods. Yet, in the case if the products are categorized by the BEC 5th Revision, subscript p denotes consumer, intermediate, or capital consumption goods. $Imports_{i,j,p,t}$ is the import value of an EU country i from the EU's 20 biggest trade partners j for product class p in the year t. It follows that $w_{i,CN,t,p}$ is the share of imports from China for a EU country i in the year t for a product category p. As mentioned in the data section, the 20 chosen partner countries, along with China, constitute 75% of EU imports from external partners in 2019, which makes them a representative benchmark for the total EU imports. The weight has been created for each country and each of six product categories. According to those weights, we have created EU heatmaps, showing the endowment of each country in a specific product class.

For this analysis, we use 2019 data from the COMEXT database collected for the previous part of this thesis. In addition, we retrieve data for 2023 from the same Eurostat database. For this section, we do not filter out top 1,000 products at the CN 8-digit level. In these data samples, we have only left the EU Member States as importers, China, and the Union's 20 biggest trade partners in 2019.

6.1. Substitution – The Rauch Categories

Our previous findings suggest that out of all the product categories outlined by Rauch (1999), heterogeneous goods contribute to the substitution effect the least. It follows that the countries with the biggest share of heterogeneous goods imports are also the most vulnerable to a potential de-risking policy as they would find it relatively hard to replace China as its trade partner. In 2023, the countries most dependent on China's heterogeneous goods include Czechia and Greece, both at 59%, followed by Poland at 54%, Lithuania at 53%, and Estonia at 50%, as illustrated in Figure 2. On average, the share of heterogeneous goods imported from China by the EU countries

stands at 20%, the highest among all the Rauch classification product categories. This high dependency, coupled with the difficulty in finding substitutes for heterogeneous goods, suggests that the EU as a whole is at a significant risk under a potential de-risking policy. The countries with a high dependency on China for imports of heterogeneous goods - Czechia, Greece, Poland, Lithuania, and Estonia - would struggle to source imports of crucial inputs from alternative partners. These countries primarily import smartphones, data-processing machines, lithium-ion accumulators, photovoltaic cells, and parts for manufacturing. When it comes to rare earth material such as lithium that is used for wind power generation and storage, Europe is 98% reliant on China (Reuters, 2023). Moreover, smartphones and data-processing machines are considered to be strategic products in the digital and electronics industry. With China supplying e.g. 65% of the EU's smartphones, such concentration of power in the hands of one supplier can lead to increased vulnerability to disruptions (Vandermeeren, 2024). Taking this into account, de-risking could prove to be a costly and lengthy venture that would challenge the most dependent countries like Czechia and Greece in the pursuit of strategic product supplier diversification.

The most concerning tendency, however, is that since the pre-pandemic period, the EU's countries have not reduced their reliance on China, but rather substantially increased it. This is especially true for heterogeneous goods, deemed difficult to replace. For the whole EU, the share of this product class from China has increased by 4.3 pp since 2019. This puts even more pressure on such countries as Lithuania, Estonia, and Slovenia that, until 2023, have been increasing their share of heterogeneous product imports from China, making themselves more vulnerable to supply-side disruptions. The only country that has managed to significantly shift away from China's imports of this strategic product class is Luxemburg. Yet, as shown in Figure C.1 (Appendix C), it seems to be a great outlier. The rest of the EU have been following the opposite trajectory from that of Luxemburg's, making the possibility of successful de-risking hardly reachable.

Next, we examine semi-homogeneous products, which are comparatively easier to substitute than heterogeneous goods. The share of semi-homogeneous goods imported from China averages at 19% across EU countries, closely mirroring that of heterogeneous goods. Nonetheless, the relative ease of substitution for semi-homogeneous goods suggests a lower risk for the EU in replacing these imports. Five countries that appear to be the most reliant on China for imports of semi-homogeneous

goods are Slovenia at 49%, Italy at 27%, Poland at 24%, Lithuania at 23%, and Greece at 22%, as shown in Figure 3. Note that Poland, Lithuania, and Greece are also heavily endowed in China's heterogeneous goods imports. The primary products imported by these countries are heterocyclic compounds and other chemical compounds, iron or non-alloy steel products, pigments, cartons, boxes, and packing containers.

Since 2019, the share of imports attributed to semi-homogeneous products - a category where the EU faces less risk than for heterogeneous goods - has increased by 4.7 pp. Growth in reliance on China, and, therefore, vulnerability to de-risking policies, is observed for Slovenia, Lithuania, and Estonia, while the biggest decrease is observed for Hungary, which just as Luxembourg in terms of heterogeneous goods seems to be an outlier (Figure C.2, Appendix C.).

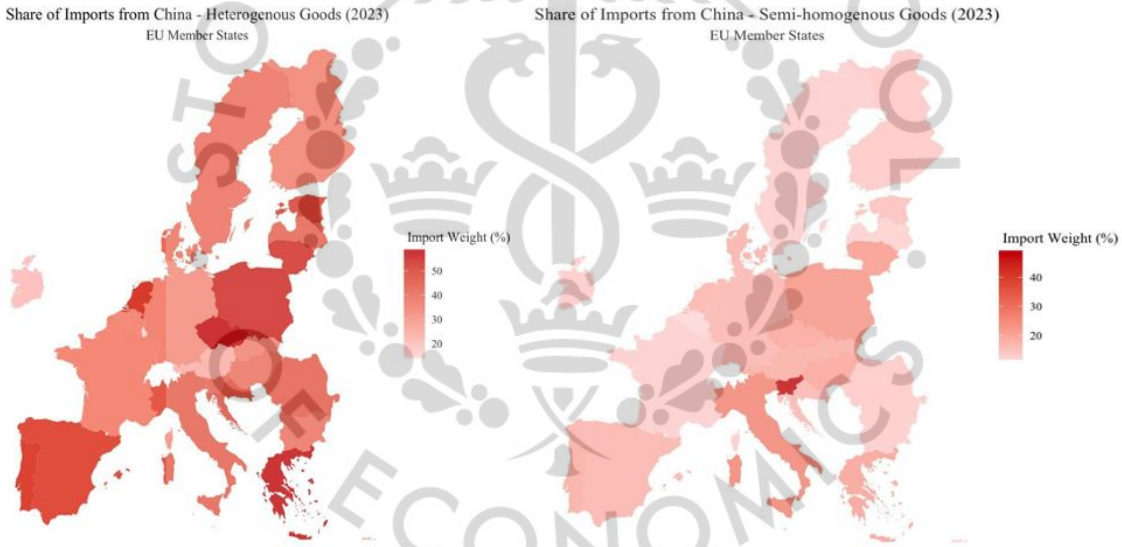
Finally, our previous findings suggest that homogeneous goods should be the easiest to replace out of the product categories outlined in the Rauch classification. EU imports of homogeneous goods from China constitute merely 4% of the total EU's imports of this product category, the lowest share among categories in the Rauch classification. Taking this into account as well as the ease substitution of this product class, any risks associated with replacing homogeneous goods from China in the event of de-risking should be negligible compared to other product categories. The principal importers of homogeneous goods from China are Slovenia at 25%, Romania at 18%, and Cyprus at 17% (Figure 4). The primary imports in this category, deemed easily replaceable, include raw silk, unwrought magnesium, and various copper products, among others. According to Reuters (2023), 93% of the EU's magnesium imports come from China. As Magnesium is considered one of the critical raw materials, its replacement may not be straightforward despite it being a homogeneous product.

Even though homogeneous goods should be the easiest to replace, since the pre-pandemic period, the EU has not diversified away from China whatsoever. The share of imports for the product category associated with the least risk has increased just as the other two product categories. The most significant increase since 2019 is observed for Romania, Malta, and Hungary, while the largest decrease - for Estonia (Figure C.3, Appendix C.). These countries run the risk of being overly vulnerable to a potential de-risking policy.

Generally, when observing the feasibility of substituting goods across all product categories outlined by Rauch (1999), it is evident that the EU faces the highest risk when it comes to substituting heterogeneous goods. It is the most difficult category

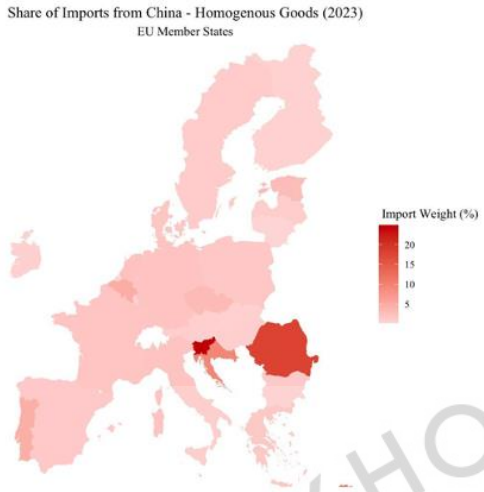
to substitute, and it represents a significant share of the imports from China. The risk associated with substituting semi-homogeneous goods, although similar in share to heterogeneous goods, is mitigated by their easier replacement. Lastly, homogeneous goods from China, which compose only a small fraction of the EU's total imports for this product category, should be the easiest to substitute. Though, no matter the product category, the more reliant the country becomes on China, the more vulnerable it is to a de-risking policy. Especially if the country imports strategic products or critical raw materials. Overall, the EU has made the pursuit of de-risking devilishly difficult as it has increased imports of all three product categories outlined by Rauch (1999). Most concerningly, in 2023, the Union made itself considerably more vulnerable in regard to heterogeneous goods, compared to 2019.

Figure 2 & 3. Share of imports from China - Heterogeneous and Semi-Homogeneous goods (2023).



Note: reated by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

Figure 4. Share of imports from China - Homogeneous goods (2023).



Note: Created by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

6.2. Substitution - Product End-use Categories

In the first part of this thesis, we find that consumer goods have a negative relationship with the partner substitution effect, meaning that this type of goods is difficult to replace. In 2023, on average, for the EU countries, the share of consumer goods imports from China is 36% - the highest out of all end-use categories. This implies that, on average, the EU is highly dependent on China as a trade partner when it comes to consumer goods. Given our previous findings, the countries that are most dependent on China for imports of consumer goods would be unable to shift away to alternative trade partners, at least in the short term. As of 2023, the countries that showed the highest reliance on China in terms of consumer goods were Hungary, Greece, Slovenia, Poland, and Portugal (Figure 5). When observing the top 3 valuable products imported for each of these countries, we find that 80% of them were heterogeneous - the Rauch classification category that is the hardest to substitute. The main products imported were air conditioning machines, household appliances, vacuum cleaners, footwear and accessories, and toys. It follows that for the five before-mentioned most vulnerable countries these would be the goods hardest to substitute in case of a de-risking.

Since 2019, the share of consumer goods imports from China has slightly increased. Given that this product category diminishes trade partner replacement effect, such a development is not beneficial for the EU especially if it strives to eventually implement a de-risking policy. Latvia, Hungary, and Ireland are the countries that have

made themselves increasingly vulnerable to this product category substitution since the pre-pandemic period. (Figure C.4, Appendix C).

Based on the previous findings, intermediate goods are the second hardest category to substitute out of all product end-use categories. In 2023, on average, for the EU countries, the share of intermediate goods imports from China is 13% - the lowest out of all end-use categories. Compared to consumer goods, the EU faces a smaller risk of not being able to substitute China as a trade partner when it comes to intermediate goods. However, some countries would be more vulnerable than others if a de-risking policy was implemented, indicated by their high share of intermediate goods imports from China - Slovenia, Cyprus, Czechia, Estonia, and Hungary (Figure 6). Generally, the top imports in these countries are chemical compounds, lithium-ion accumulators, multilayer printed circuits, integrated circuits, and parts for manufacturing. Majority of these products are considered strategic products e.g. lithium-ion accumulators are crucial for the Renewables Industry (Vandermeeren, 2024). Thus, the dependence on China for the outlined products can contribute to vulnerability to a potential de-risking policy.

Similarly, as for the Rauch product classification, we see that the EU has entrenched its reliance on Chinese imports since 2019. The share of imports of intermediate goods from China has significantly increased since the pre-pandemic period. What is more, despite intermediate goods being easier to replace, the share of this product category imports has increased more than that of consumer goods. Slovenia, Czechia, and Greece are countries that have extended their reliance on China as a supplier of this product category, making them vulnerable to a de-risking policy. (Figure C.5, Appendix C).

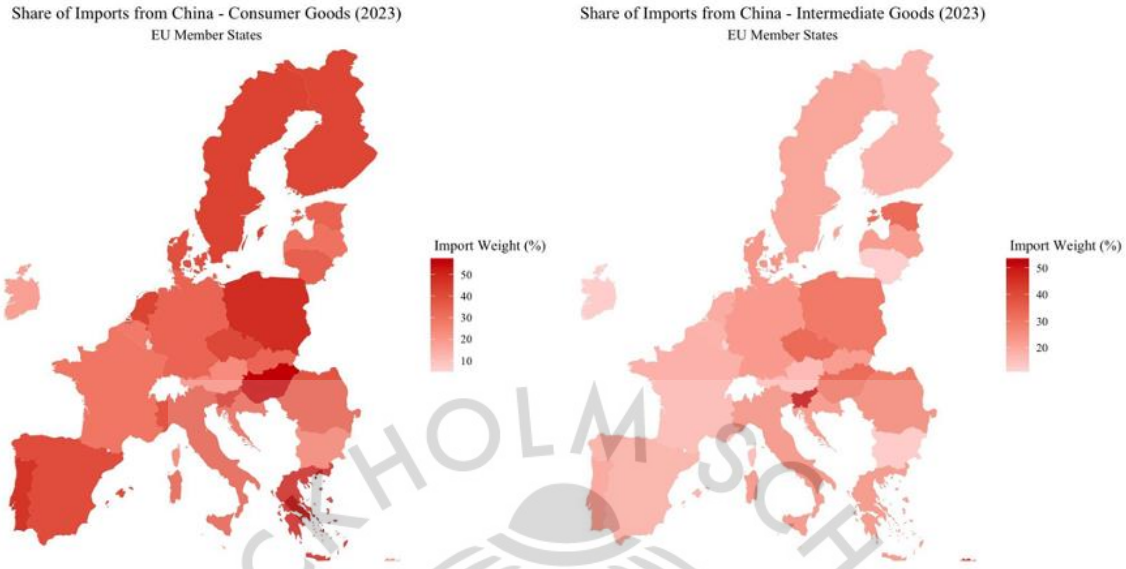
Finally, our findings suggest that capital goods are the easiest to substitute out of all product end-use categories. Capital goods from China constitute 32% of all the EU's imports of this product category - the second highest share out of all end-use categories. It follows that the EU is less vulnerable to de-risking when it comes to capital goods as opposed to consumer goods, as they constitute a slightly smaller share and are easier to substitute. The relative vulnerability between imports of capital goods and intermediate goods is unclear, as the EU imports considerably fewer intermediate goods, but they are harder to substitute. For Greece, almost one half of the total capital goods imports (52%) come from China, similar to Lithuania (43%), Spain (42%), Czechia (42%), and Poland (42%) (Figure 7). Even though capital goods are relatively easier to replace,

before-mentioned countries are extremely reliant on China for this product category, and thus are the most vulnerable to a potential de-risking policy. The top products imported by these countries are voice transmission and reception devices, static converters, transformers, aircraft, and sea-going vessels, - more than 85% of them are heterogeneous goods, i.e., hardest to replace. Such products could be critical to Space, Defence and Security industries, thus diversifying away from such a major supplier as China can prove to be challenging even despite the ease of intermediate goods substitution. (Vandermeeren, 2024)

Unsurprisingly, just as for the previous categories, capital goods imports have increased since 2019, more than that of consumer goods. The countries that have significantly extended their reliance on China for capital goods are Greece, Lithuania, and Belgium (Figure C.6, Appendix C).

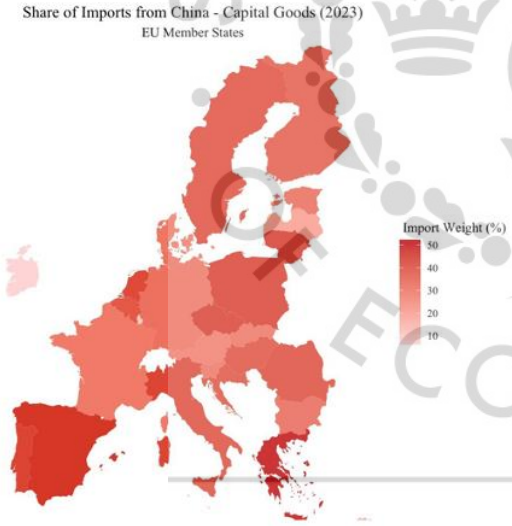
Overall, when observing the feasibility of substituting goods across all end-use categories that are imported from China, the EU should face a considerable risk when it comes to substituting consumer goods. It is the hardest category to substitute, and its imports from China constitute more than a third of all consumer goods imports to the EU. The Union should face a relatively small risk when it comes to substituting intermediate goods, and negligible for replacing capital goods. Yet the existing reliance of a country on the imports from China and the extension of this dependence plays a determining role. With the entrenchment in China's imports, a country makes itself vulnerable to any disruptions that may occur on the partner's side. Especially so if the products imported are of significant importance to strategic industries and economic security. In such circumstances, the products' end-use category plays only a marginal role in terms of risk exposure to a potential de-risking policy.

Figure 5 & 6. Share of imports from China - Consumer and Intermediate goods (2023).



Note: Created by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

Figure 7. Share of imports from China - Capital goods (2023).



Note: Created by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

6.3. Replacement Indices

To summarize our findings and categorize countries depending on their risk in regard to product substitution, we have developed two Replacement Indices (Equations 3 & 4). The first Replacement Index ($RI_{R,i,2023}$) illustrates the ease of replacement depending on the EU country's i endowment in either homogeneous, semi-homogeneous, or heterogeneous goods according to the Rauch classification (R). The

endowment refers to the reliance on China for a certain product group. The second Replacement Index ($RI_{BEC,i,2023}$) is concerned with the country's ability to replace goods categorized by their end-use given the weight imported from China of either consumer, capital, or intermediate goods (BEC). The $\gamma_{1,i,n}$, $\gamma_{1,i,r}$ and $\gamma_{1,i,w}$ are taken from the regression output with Rauch classification's interaction with Workplace Closing in China (Table C.7, Appendix C); similarly, $\gamma_{1,i,CAP}$, $\gamma_{1,i,INT}$ and $\gamma_{1,i,CONS}$ are retrieved from a model that interacts with Workplace Closing in China and the BEC 5th Rev. end-use categorisation (Table C.8, Appendix C). The coefficients from these regressions imply the replacement effect - if the coefficient is positive, the substitution of this class of goods is more feasible; if negative - the contrary. Next, we use the country's i endowment in product category p from China which is represented by the weights determined in the previous section of this thesis. The weight is the share of country's i imports from China for a specific product category R or BEC from the total country's i imports of that category from the top 20 most valuable partners along with China. By multiplying the weight of the product class by its respective coefficients before the interaction terms (Tables C.7 & C.8, Appendix C), we obtain the overall ease of reducing the reliance on China in the case that is comparable to an increase of one unit in Workplace Closure in China. The workplace closures in China can be generally considered a supply shock, which is what the EU would face in case of a sudden de-risking policy implementation. Thus, the index is used as a proxy to define the relative ease of reducing the reliance on China in the case of a de-risking policy. The larger the index, the easier it is to substitute away from China to other trade partners depending on the goods' differentiation (the Rauch classification) and end-use (BEC 5th Rev.). Finally, we have multiplied the index by 100 to make it more comprehensive.

$$RI_{R,i,2023} = (\gamma_{1,n,i} \times w_{n,p} + \gamma_{1,r,i} \times w_{r,p} + \gamma_{1,w,i} \times w_{w,p}) \times 100 \quad (4)$$

$$RI_{BEC,i,2023} = (\gamma_{1,CAP} \times w_{i,CAP} + \gamma_{1,i,INT} \times w_{i,INT} + \gamma_{1,i,CONS} \times w_{i,CONS}) \times 100 \quad (5)$$

Both Indices have helped us to group the EU Member States into three risk groups: low, medium, and high. When it comes to the Replacement Index associated with product differentiation, that is, the Rauch classification, most of the EU countries are at high or medium risk (Table 3). This means that if they were to encounter a similar supply shock from China as during Covid-19, it would be hard for them to substitute away as they are highly endowed in semi-homogeneous and heterogeneous goods from China. The clear winners in the low-risk category are Romania and Slovakia, which are

reliant mainly on imports of homogeneous goods that are relatively easier to replace than semi-homogeneous and heterogeneous goods.

Table 3. Replacement Index (the Rauch classification).

Replacement Index (Rauch classification)				
Low Risk	**Medium Risk**	**High Risk**		
5+	**4**	**2-3**		
Slovenia	Cyprus	Austria	France	Slovakia
Romania	Czechia	Belgium	Hungary	
	Greece	Bulgaria	Ireland	
	Croatia	Germany	Lithuania	
	Italy	Denmark	Luxemburg	
	Malta	Estonia	Latvia	
	Poland	Spain	Netherlands	
	Portugal	Finland	Sweden	

Note: Authors' own calculations. The 27 EU Member states are grouped into 3 risk categories, according to the Index. Low risk is assigned if the Replacement Index is higher than 5, medium risk if the Index is 4, high risk - the Index is in the range of 2-3.

Regarding the Replacement Index that takes into account the BEC classification (Table 4), the landscape is fairly similar. Though, more countries are located in the medium risk category compared to the Replacement Index with the Rauch classification. In terms of this index, Czechia, Greece, and Slovenia are the only countries in the low-risk category, meaning that they are endowed in China's exports of consumption or intermediate consumption goods. Overall, both indices are developed to raise the awareness of the countries to their risk exposure to a sudden supply-side shock. Consult Table C.9 in Appendix C to see the respective Replacement Index for each country.

Table 4. Replacement Index (BEC End-Use).

Replacement Index (BEC End-Use)				
Low Risk	**Medium Risk**		**High Risk**	
5	**4**		**1-3**	
Slovenia	Estonia	Romania	Austria	Luxemburg
Greece	Spain	Sweden	Belgium	Latvia
Czechia	Croatia		Bulgaria	Malta
	Hungary		Germany	Netherlands
	Italy		Denmark	Slovakia
	Lithuania		Finland	
	Poland		France	
	Portugal		Ireland	

Note: Authors' own calculations. The 27 EU Member States are grouped into 3 risk categories, according to the Index. Low risk is assigned if the Replacement Index is 5, medium risk if the Index is 4, high risk - the Index is in the range of 1-3.

6.4. Relevance and Novelty

As outlined previously, GVCs are very fragile right now, and given the geopolitical context in today's world it is important to provide some scenario of what would happen if GVCs broke or readjusted. There are two recent cases that must be brought up in this context.

Firstly, the possibility of a rapid shift in geopolitical relations is displayed by Russia's invasion of Ukraine, which led to the EU engaging in an unprecedented decoupling - total imports from Russia were cut by 58% from 2021 to 2022 (EEAS, 2023). Before the outbreak of the full-scale war, the EU had a deeply embedded dependency on Russian gas, crude oil, petroleum products and coal. Though whether by their own will or not, the Union had to become independent from Russia and substitute away from its imports. The EU has yet a long way to go to accomplish this. It will be a great challenge to substitute the needed supply of oil, gas, or coal from other countries as the production capacity cannot expand overnight. In effect, the transition to new trade partners will prove to be long, costly, and inevitably will bring up the issue of shortages (Kardaś, 2023).

Secondly, there are numerous speculations circling around China's potential invasion of Taiwan. In case Beijing puts its exports to a halt, many EU industries will struggle with the shortage of crucial materials. The same scenario would follow if the US pressured the European Union to impose sanctions on China. Although many countries are putting their efforts to produce locally, such efforts would take a

significant amount of time and money. At the moment, the EU is trying to mitigate the potential risk of invasion by implementing de-risking policies. However, as mentioned before, at least a mere success in friend-shoring or on-shoring strategies requires many years, high costs and the loss of efficiency. What if the EU substitutes away from China, yet the new partners supply goods that still consist of inputs from China? In order for the Union to truly diversify its trade ties, it will have to dive deep into the complexities of GVCs and inspect every linkage. This again emphasizes the longevity of the process of de-risking. Being aware of its dependency on China and Taiwan, the EU has secured a subsidy for the chip sector given that computer chips are one of the most crucial products for digital innovation and given that this sector is dominated by the two Asian countries. The goal is to increase the market share to 20% by 2030, which is a long shot. Even if the ambition materializes, it will be tough to ensure an optimal input supply for chip production without the involvement of Beijing. Taking into account that the US and Asian countries are striking subsidies of their own on local chip production, the EU will be in a difficult position (Meyers and Todoir, 2023). Though this scenario emphasizes that de-risking will be a long, tedious, and costly process, it also gives the reason to study what would happen if the EU had to cut ties with China.

Both of these cases amplify scenarios where the EU is or will be forced to readjust its GVC linkages. Although the diversification of suppliers most definitely will take a long time, the impulse to do so can be very sudden, be it the war between Russia and Ukraine, invasion of Taiwan, or a de-risking policy. In addition, both of the provided cases point out that the EU will not be able to immediately exclude the country in question completely. Though, it will be of its own interest to shift to other trade partners as quickly as it possibly can. Bearing in mind that the EU and China are two of the main participants in the GVC and the recent concern over GVC shock transmission, it is ever so important to study a scenario where China's imports should be taken out of the EU's equation. What if the invasion of Taiwan does take place? What if there is another sudden and unexpected external shock that forces the EU to limit its exposure to China? The best proxy that can be used to answer these questions is the Covid-19 pandemic, especially in the context of the EU proceeding with a de-risking policy. The pandemic was an unexpected shock for the Union that forced it to make changes in its trade structure. Moreover, the changes had to happen as soon as possible, before the issue of shortages appeared.

During the first months of 2020, China was the first to implement stringent lockdown policies that consequently halted manufacturing and exports. Thus, we can only observe short-term effects that took place - later on, the EU and the rest of the world had to impose restrictions as well, which levelled the playing field. With the aim of our thesis to shed light on the outcomes of a possible de-risking policy implemented by the EU, conclusions about long-term effects would seem to be more desirable. However, conclusions about short-term effects can be both relevant and valuable in the context of adding to the existing literature and future trade developments.

7. Conclusion

Within the scope of our thesis, we have strived to answer three research questions: (1) whether the disruption of Chinese exports led the EU to look for other trade partners, (2) what are the factors that determine the degree of trade partner substitution, and (3) what Covid-19 tells about the EU's risk exposure to a potential de-risking policy.

We find that the EU did indeed turn towards alternative trading partners when China introduced workplace closures - a measure to contain the spread of Covid-19 and a supply shock that echoed through GVCs. However, when the EU and other countries began implementing containment measures, the value of imports was negatively affected from an internal demand shock. Thus, in the context of the first research question, the EU was able to substitute away from China when a supply side disruption emerged. In the context of de-risking, this implies that if the need occurs, imports from China can at least be partially substituted with imports from the EU's 20 most valuable trade partners.

In terms of the second research question, the ease of substitution depends on product class (differentiation and end-use) as well as previous level of dependency on China as a trade partner.

Our findings show that homogeneous and capital goods are the easiest to replace, while heterogeneous and consumer goods pose greater challenges. This is consistent with existing research which indicates that substituting homogeneous products is relatively straightforward, whereas finding replacements for differentiated products is more difficult. Implementing a de-risking policy would present the EU with notable challenges in diminishing its trade reliance on China, especially in regard to heterogeneous products.

Our analysis reveals significant challenges for the EU in reducing its reliance on China, particularly for consumer and heterogeneous goods. Over a third of the EU's consumer goods imports come from China, making it extremely difficult to source such a substantial share from elsewhere. Although semi-homogeneous goods also have a similar import share from China, they pose a lower risk due to their easier substitutability. Homogeneous products contribute less to total imports and thus carry minimal risk.

Another factor exemplifying a country's substitution of imports from China is the initial reliance of an EU country on China. This is in line with previous literature that outlines the pressure for countries heavily reliant on China to find alternative partners to avoid shortages. It follows that, in the context of de-risking, this would imply a relatively higher rate of substitution for countries with high initial dependence on China as these countries have relatively more products that have to be substituted.

Furthermore, we found that by 2023, the EU's share of imports from China had increased across all product categories compared to 2019. This implies an elevated risk of disruptions in trade with China. Implementing a de-risking policy would likely present significant difficulties, similar to those observed during the war in Ukraine, which illustrated the extreme challenges of substituting suppliers of strategic goods.

To quantify the ability of EU countries to shift away from China, we developed a Replacement Index based on the Rauch and BEC classification. This index indicates that only two to three EU countries could easily reduce their dependence on China, while most face high risks in diversifying from this strategic supplier. Countries with high initial dependence on China have relatively more products that need to be substituted, which aligns with existing literature on trade dependencies.

Interestingly, we found that the distance between countries is an insignificant factor in determining the degree of trade partner substitution. This contradicts the gravity model of international trade, suggesting that during the pandemic, the EU prioritized the production capacity of a trade partner over proximity.

The geopolitical tensions and large supply and demand shocks, such as Covid-19, have shown us that self-sufficiency might be beneficial for avoiding GVCs contagion effects and shortages. In this regard, de-risking could be a way for the EU to achieve economic security. Yet, as our findings show, the feasibility of such a policy is limited and reducing the dependency on such a large trade partner as China can prove to

be difficult across different product classes. This thesis raises the importance of product differentiation and serves as a warning for future de-risking policy considerations.

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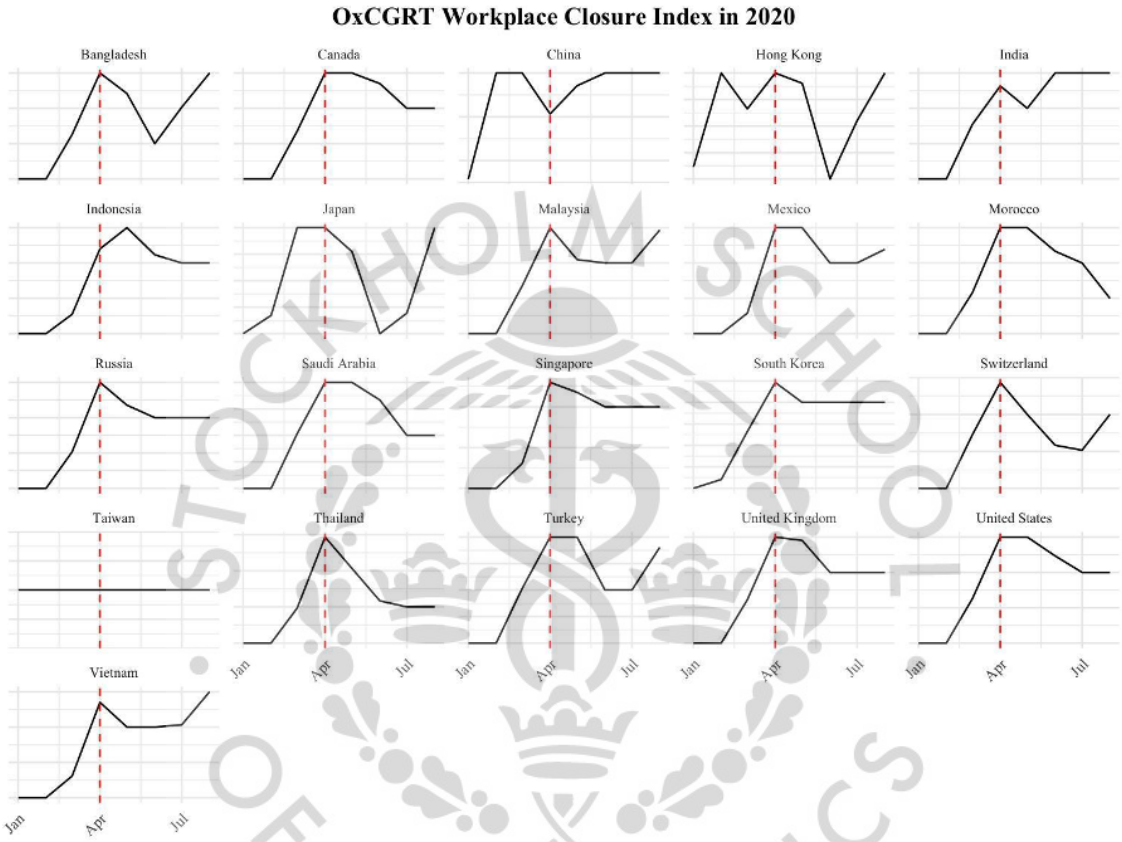
8. Appendices

Appendix A. Data

Figure A.1. Workplace Closing Index in the top 20 EU's trade partners.



Note: OxCGRT Workplace Closure Index from January until August, 2020, for the 20 chosen non-EU partner countries and China. Figure created by the authors using data from the OxCGRT database by Hale et al. (2021).

Figure A.2. List of the EU Member States and its non-EU trade partners.

European Union Members		**20 Biggest Partners + China**	
Austria	Italy	China	Mexico
Belgium	Latvia	United States	Singapore
Bulgaria	Lithuania	United Kingdom	Saudi Arabia
Croatia	Luxembourg	Switzerland	Morocco
Republic of Cyprus	Malta	Japan	Canada
Czech Republic	Netherlands	Türkiye	Hong Kong
Denmark	Poland	Viet Nam	Indonesia
Estonia	Portugal	Republic of Korea	
Finland	Romania	India	
France	Slovakia	Taiwan	
Germany	Slovenia	Malaysia	
Greece	Spain	Russian Federation	
Hungary	Sweden	Bangladesh	
Ireland		Thailand	

Note: List of the 27 EU member countries, 20 selected partner countries, and China. Table created by the authors using data from the COMEXT database by Eurostat (2024).

Figure A.3. The EU's 20 top parteners in terms of import value (2019).

Partner	**Imports (millions)**	
China	€	355,518
United States	€	140,551
United Kingdom	€	79,435
Switzerland	€	57,555
Japan	€	41,538
Türkiye	€	36,777
Viet Nam	€	32,828
Korea, Republic of	€	30,616
India	€	29,080
Taiwan	€	22,855
Malaysia	€	19,960
Russian Federation	€	18,393
Bangladesh	€	17,215
Thailand	€	15,601
Mexico	€	15,019
Singapore	€	13,629
Saudi Arabia	€	9,506
Morocco	€	8,505
Canada	€	8,066
Hong Kong	€	7,511

Note: Top 20 EU's trade partners, including China as 21st, in terms of import value in euros in 2019. Table created by the authors using data from the COMEXT database by Eurostat (2024).

Figure A.4. Description of the variables along with the sources used.

Variable	Description	Source
$lnM_{j,p,t}$	Logarithm of EU's imports in EUR terms	COMEXT by Eurostat
$CI_{CN,t}$	Workplace closing metric in China	OxCGRT
$CI_{i,t}$	Workplace closing metric in the EU	OxCGRT
$CI_{j,t}$	Workplace closing metric in partner countries	OxCGRT
$\frac{M_{i,CN,p,2019}}{M_{i,p,2019}}$	Weight of the EU's imports from China in 2019	COMEXT by Eurostat
$dist_{i,j}$	Distance between the EU country and partner country (meters)	GeoDist by CEPII
R_p	Rauch Product Classification	Rauch
BEC_p	BEC Revision 5 Product Classification	UNSD
$\mu_{i,p}$	Importer-product fixed effects	COMEXT by Eurostat
$\mu_{j,p}$	Partner-product fixed effects	COMEXT by Eurostat
$\mu_{t,p}$	Time-product fixed effects	COMEXT by Eurostat
$\varepsilon_{i,j,p,t}$	The Error term	-

Note: Created by the authors.

Appendix B. Results, robustness, and limitations

Table B.1. Workplace Closing effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Workplace Closing Partner	-0.065***	-0.081***
Workplace Closing Declarant	-0.046***	-0.105***
Workplace Closing CN	0.007	0.063***
Observations	2008111	2141420
Ajusted R squared (full model)	0.529	0.529

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The dependent variable is logarithm of imports from the EU's top 20 partners. Workplace Closing Partner stands for workplace containment measures in the partner countries, Workplace Closing Declarant - in the EU, Workplace Closing CN - in China.

Table B.2. Workplace Closing effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Workplace Closing Partner	-0.065***	-0.080***
Workplace Closing Declarant	-0.046***	-0.103***
Workplace Closing CN	-0.021**	0.040***
Workplace Closing CN x Weight of CN Imports	0.061***	0.050***
Observations	2008111	2141420
Ajusted R squared (full model)	0.529	0.529

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The dependent variable is logarithm of imports from the EU's top 20 partners. Workplace Closing Partner stands for workplace containment measures in the partner countries, Workplace Closing Declarant - in the EU, Workplace Closing CN - in China. The interaction term is between Workplace Closing in China and share of Chinese imports in the overall EU's imports in 2019.

Table B.3. Workplace Closing effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Workplace Closing Partner	-0.063***	-0.077***
Workplace Closing Declarant	-0.048***	-0.107***
Workplace Closing CN	0.004	0.057***
Workplace Closing CN x Distance	0.000	0.000 .
Observations	2008111	2141420
Ajusted R squared (full model)	0.532	0.532

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The dependent variable is logarithm of imports from the EU's top 20 partners. Workplace Closing Partner stands for workplace containment measures in the partner countries, Workplace Closing Declarant - in the EU, Workplace Closing CN - in China. The interaction term is between Workplace Closing in China and distance between the EU declarant and partner country.

Table B.4. Stringency Index effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Stringency Partner	-0.003***	-0.005***
Stringency Declarant	-0.001**	-0.004***
Stringency CN	0.001***	0.004***
Observations	2008111	2141420
Ajusted R squared (full model)	0.529	0.529

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The regression is used for the robustness check. The dependent variable is logarithm of imports from the EU's top 20 partners. Stringency Partner stands for Stringency Index in the partner countries, Stringency Declarant - in the EU, Stringency CN - in China.

Table B.5. Stringency Index effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Stringency Partner	-0.003***	-0.005***
Stringency Declarant	-0.001**	-0.004***
Stringency CN	0.000	0.004***
Stringency CN x Weight of CN Imports	0.002***	0.002***
Observations	2008111	2141420
Ajusted R squared (full model)	0.529	0.529

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The regression is used for the robustness check. The dependent variable is logarithm of imports from the EU's top 20 partners. Stringency Partner stands for Stringency Index in the partner countries, Stringency Declarant - in the EU, Stringency CN - in China. The interaction term is between Stringency Index in China and share of Chinese imports in the overall EU's imports in 2019.

Table B.7. Stringency Index effect on the EU's imports from non-EU countries.

	Immediate effect	Delayed effect
	Estimate	Estimate
Stringency Partner	-0.003***	-0.004***
Stringency Declarant	-0.001**	-0.004***
Stringency CN	0.001*	0.004***
Stringency CN x Distance	0.000*	0.290
Observations	2008111	2141420
Ajusted R squared (full model)	0.532	0.532

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The regression is used for the robustness check. The dependent variable is logarithm of imports from the EU's top 20 partners. Stringency Partner stands for Stringency Index in the partner countries, Stringency Declarant - in the EU, Stringency CN - in China.The interaction term is between Stringency Index in China and the distance between EU and its non-EU partners.

Table B.8. Stringency Index effect on the EU's imports from non-EU countries.

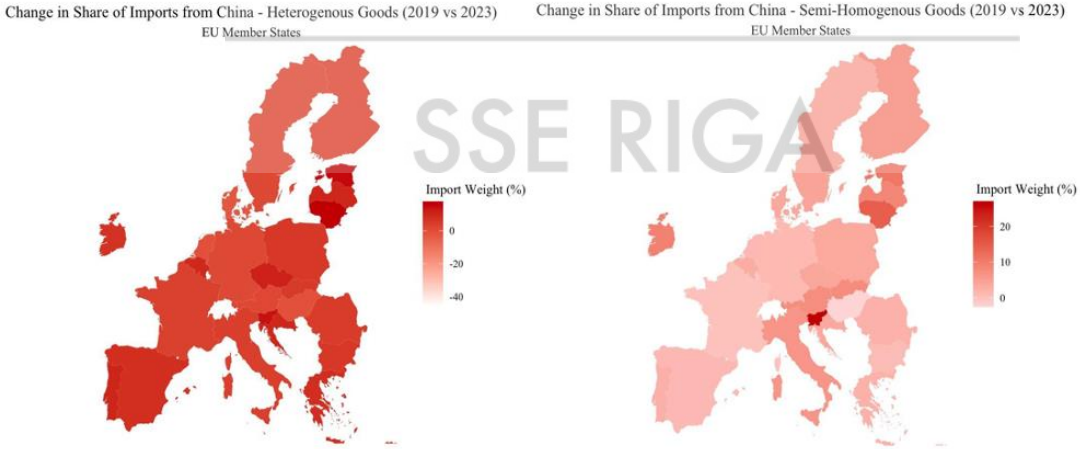
	Immediate effect	Delayed effect
	Estimate	Estimate
Stringency Partner	-0.003***	-0.005***
Stringency Declarant	-0.001**	-0.004***
Stringency CN	0.003***	0.006***
Stringency CN x Consumer Goods	-0.004***	-0.004***
Stringency CN x Intermediate Goods	-0.001*	-0.001*
Observations	2008111	2141420
Ajusted R squared (full model)	0.522	0.522

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The regression is used for the robustness check. The dependent variable is logarithm of imports from the EU's top 20 partners. Stringency Partner stands for Stringency Index in the partner countries, Stringency Declarant - in the EU, Stringency CN - in China. The interaction term is between Stringency Index in China and BEC (5th Rev.) classification.

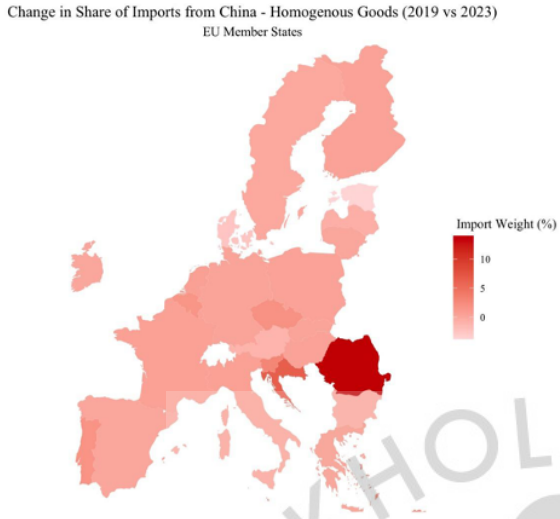
Appendix C. Connection to De-risking Policy

Figure C.1. & 2. Change in Share of Imports from China - Heterogeneous/Semi-Homogeneous goods (from 2019 to 2023).



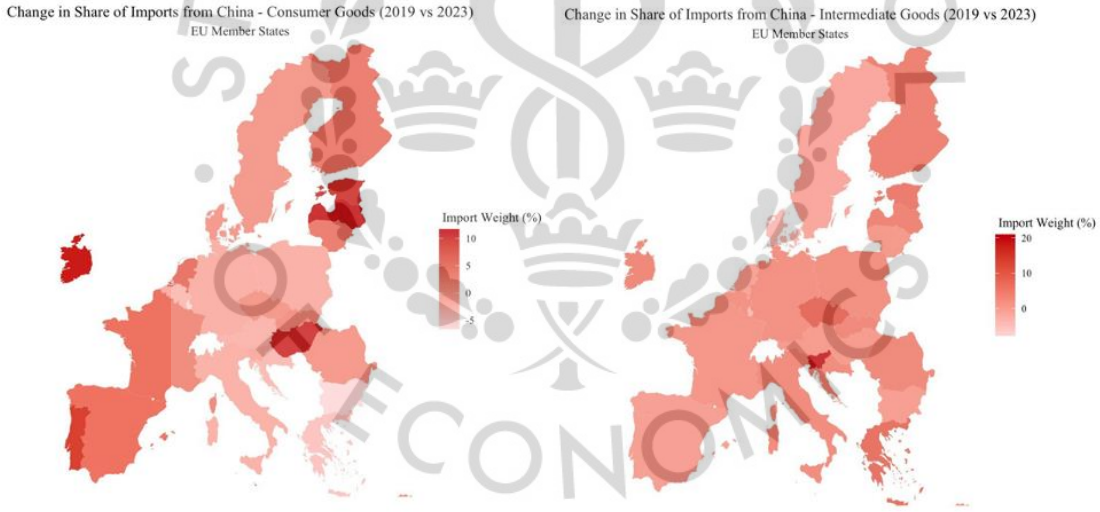
Note: reated by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

Figure C.3. Change in Share of imports from China - Homogeneous goods (from 2019 to 2023).



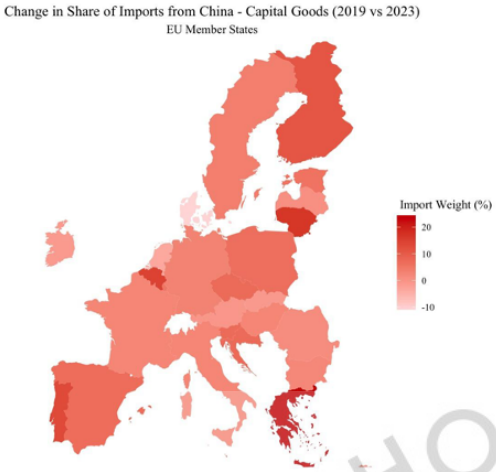
Note: reated by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

Figure C.4. & 5. Change in Share of imports from China - Consumer/Intermediate goods (from 2019 to 2023).



Note: reated by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

Figure C.6. Change in Share of imports from China - Capital goods (from 2019 to 2023).



Note: reated by the authors, using authors' own calculations based on data from the COMEXT database by Eurostat (2024).

Table C.7. The Rauch classification coefficients.

	Delayed effect
	Estimate
Workplace Closing Partner	-0,076***
Workplace Closing Declarant	-0,069***
Workplace Closing CN x n products	0,029***
Workplace Closing CN x r products	0,079***
Workplace Closing CN x w products	0,146*
Observations	2141420
Ajusted R squared (full model)	0.528

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The dependent variable is logarithm of imports from the EU's top 20 partners. Workplace Closing Partner stands for workplace containment measures in the partner countries, Workplace Closing Declarant - in the EU, Workplace Closing CN - in China. The interaction terms are between Workplace Closing in China and the Rauch classification.

Table C.8. The BEC end-use coefficients.

	Delayed effect
	Estimate
Workplace Closing Partner	-0,07***
Workplace Closing Declarant	-0,081***
Workplace Closing CN x Capital Goods	0,079***
Workplace Closing CN x Consumer Goods	-0,017*
Workplace Closing CN x Intermediate Goods	0,061***
Observations	2141420
Ajusted R squared (full model)	0.522

*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

Note: The dependent variable is logarithm of imports from the EU's top 20 partners. Workplace Closing Partner stands for workplace containment measures in the partner countries, Workplace Closing Declarant - in the EU, Workplace Closing CN - in China. The interaction term is between Workplace Closing in China and BEC (5th Rev.) classification.

Table C.9. Replacement Indices for the EU Mmember States.

	Differention Index	*End-use Index*
Slovenia	8.7	4.7
Romania	5.0	4.2
Cyprus	4.2	3.4
Croatia	4.1	3.9
Greece	3.9	4.9
Czechia	3.8	4.6
Malta	3.8	1.1
Poland	3.7	4.3
Italy	3.7	4.1
Portugal	3.6	3.7
Lithuania	3.4	3.6
Netherlands	3.2	3.4
Estonia	3.1	3.9
Spain	2.9	3.9
Hungary	2.9	4.0
Denmark	2.8	2.9
Slovakia	2.6	3.1
Germany	2.6	3.0
Belgium	2.5	3.3
Bulgaria	2.4	3.0
Latvia	2.4	2.4
Austria	2.3	2.7
Sweden	2.3	3.5
Finland	2.2	3.1
France	2.2	2.7
Ireland	1.7	0.9
Luxemburg	1.5	1.3

Note: Differentiation Index represents Replacement Index based on the Rauch classification, while End-Use Index considers the BEC 5th Rev. classification. The higher the index, the better the substitution prospects.

Acknowledgement on the use of AI

Generative AI has not been used for creating the main text of the Thesis. In some parts of the Thesis Chat GPT 4 was used to improve flow and readability of the text created by the authors. Chat GPT 4 was used for data filtering and formatting in R, moreover, assisted in chart and graph development.

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