SINO-GERMAN CENTER at Frankfurt School

September 2023

SGC Working Paper Series No. 7

Making Sense of Germany's Import Dependency on China – An Empirical Analysis for the Period 2010 to 2020

Authors Horst Löchel, Frankfurt School of Finance & Management
Viktoria Krahnke, DWS

JEL-Classification: F10, F14, F15, F19, F50

Key words: Economic Dependency, China Germany Trade, Substitution Elasticity

Abstract

This paper is analysing the import dependency of Germany on China for the period 2011 to 2020. The general conclusion is that the degree of dependency depends very much on the method and subject of the analysis.

From a methodological point of view, we distinguish between so-called trivial dependency, that simply measures the share of imports from China on a certain good, and so-called strategic dependency that also considers the degree of substitution elasticity for that good. As expected, it turns out that the degree of dependency is significantly lower for the latter than for the former, which indicates a kind of voluntary dependency.

Furthermore, we are measuring both trivial and strategic dependency in terms of number of goods as well as in terms of value with the result that the latter approach shows a significantly higher degree of dependency than the former. This can be explained by a price effect, i. e. dependent imports have higher prices than non-dependent, as well as a quantity effect, which means that dependent goods are more traded than non-dependent.

Coming to the subject of the analysis, we distinguished between consumption and industrial goods with raw materials as well as critical raw materials as a subset of the latter. In principle, industrial goods show a lower degree of strategic dependency than consumption goods, however, with a rising tendency in recent years. For raw materials and critical raw materials, it is shown that the dependency level is rather low in a trivial as well as in a strategic sense using the number of goods approach, but significantly higher when applying the value approach for the reasons mentioned above. As expected, substitution elasticity plays a smaller role for raw materials than for industrial goods in general.

Finally, we show in a comparative country analysis for the year 2019 that the overall import dependency of Germany was the lowest among a relevant peer group of four countries.

Sino-German Center of Finance and Economics
Association since 2015
https://sgc.frankfurt-school.de
At **Frankfurt School of Finance & Management**
Adickesallee 32-34
60322 Frankfurt
Germany

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Horst Löchel

1. Introduction

Economic dependency on China is ongoing topic of discussion in Germany and the EU since the disruption of the international supply-chains due to the Covid19 pandemic (Pongratz, Bartsch & Brusse 2022, p. 94). Headlines such as “Germany’s fatal dependence on China” (Müller 2021), “’Dangerous dependence‘: German corporations commit to China” (Fröndhoff 2022), or “International trade: Germany’s economy clings on China” (Tagesschau 2022) have been seen across the news. The ongoing Ukraine-War, which unveiled the downside of energy dependency on Russia strongly intensified the general debate (Sackmann 2022).

Moreover, the just published ‘China-Strategie’ of German’s Federal Government stressed a variety of economic dependencies on China like business cluster risks, supply chains, critical intermediate products including raw materials and recommended a diversification strategy to companies (German Federal Government 2023). The European Union (EU) acts in the same direction. The European Commission just released a draft law to secure raw materials for their energy transition as well as defence and energy security. The Critical Raw Materials Act (CRMA) is in part a response to the US Inflation Reduction Act (Khan 2023) but more importantly it signifies a strategic realignment of the EU’s raw materials policy and the strengthening of the locations technological abilities (Levinger 2023).

When talking about the dependency of Germany, it is often meant cluster risks of German companies rather than Germany as an industrial location. For example, Germany’s car makers generate large proportions of their revenue in China. For instance, Volkswagen and BMW delivered more than 30 percent of their produced cars to China in 2020 (Volkswagen AG 2022, BMW Group 2022) and Infineon, Covestro, and Adidas generated more than 20 percent of their revenues from China (Adidas AG 2022, Covestro AG 2022, Infineon Technologies 2022). However, a recent study shows that at least in average less than 4 percent of German corporate profits for the years 2016 to 2020 were achieved from business in China (Jungbluth et al. 2023).

However, business cluster risks should not be confused with economic dependency of countries. In this regard, import dependency, especially of intermediate goods that are necessary for the domestic production, matters much more. Several studies already investigated Germany’s import dependency on China from a value-added or supply chain perspective (for instance Felbermayr et al. 2021, Matthes 2019 and 2022, Sandkamp et al. 2023). Both Matthes (2022) and Sandkamp et al. (2023) ascertain that China’s share of intermediates for German production and consumption was in the low single-digits.

This paper is applying the approach of ‘strategic dependency’ developed by Rogers et al. (2020). Rogers et al. examined the import-dependency on China on a single country-level using the trade data of goods for Australia, the United States, New Zealand, the United Kingdom, and Canada for the year 2019. Other than the value-added approach, strategic dependency uses the import and export values of single goods including raw materials of a certain country. Moreover, the approach involves quantitative testable criteria of the degree of dependency including the decisive substitution elasticity of imports (FAZ 2023, Sandkamp et al. 2023).

Zenglein (2020) already used the approach for EU-level for the year 2019. He found that the EU was strategically dependent on Chinese imports for 659 of more than 5,600 product categories, which accounted for 43 percent of total imports from China by value. Most of the strategically dependent imports were related to consumer products and consumer electronics. Overall, the EU’s critical strategic dependency, which refers to the vulnerability or disruption of a country’s economy when access to a type of good is restricted, was judged as limited (Zenglein 2020).

We are applying the concept of strategic dependency for Germany, however, not for a single year but for a consecutive time series of the years 2011 to 2020 with import data from the United Nations’ Comtrade database (United Nations 2022). To answer the question how dependent Germany is on imports from China in a more specific way, we are disaggregating the types of imports into consumption and industrial goods as well as raw materials. Furthermore, the analysis is simultaneously conducted in terms of quantity, i. e. number of goods, and in terms of trade volume measured in US-Dollar.

2. Literature Review

2.1 General Measures of Trade Dependency

It is commonly assumed that economic dependency of a country can be measured by three prominent dimensions: foreign investment, international trade, and external debt (for instance Pinto 1972, p. 262, Rubinson 1977, Bornschier & Chase-Dunn 1985, Ce & Williamson 2001, Huang & Slomczynski 2003). Furthermore, Huang & Slomczynski (2003) have provided evidence that these dimensions are interconnected.

Most prominent to measure economic dependency is the concept of international trade. In the literature, different measures of trade dependency have been used to quantify the concept (for

instance Bornschier 1982, Tyler & Wogart 1973, Kentor & Boswell 2003). The general approach is that dependency is expressed as percentage of a particular base figure, mainly some type of trade volume. However, a dominant measurement concept is still missing.

For instance, indicators used by Kaufman, Chernotsky and Geller (1975) are the ratio of the trade value of a country's largest trading partner to its Gross National Product (GNP), the ratio of the trade value of a country's largest trading partner to total trade volume (this measure is also used by Chase-Dunn 1975, p. 735), and export concentration, defined as the ratio of trade value of the two leading exports to total exports (p. 11). Ragin and Delacroix (1979) used two measures derived from the theory of competitive advantage in their analysis. Commodity concentration refers to the proportion that the top three exports represent of total merchandise exports. Primary product exports refer to the percentage of exports that are classified as one of the categories 0 to 4 in the Standard Trade Classification (Ragin & Delacroix 1979, cited in Huang & Słomczyński 2003, p. 86 & 88). Huang and Słomczyński (2003) introduced a new indicator, import prevalence, calculated as the ratio of total value of imports to total value of exports (p. 86 & 88). Finally, the German Federal Bureau of Statistics employs different measures of trade dependency. Among them is the import dependence rate, which relates "value added generated in foreign countries [to] domestic final demand" (DESTATIS 2022). Final domestic demand can be calculated as GDP minus net exports. Value added refers to the trade value of goods and services that are meant for final consumption or investment purpose, as well as intermediary goods for final domestic use.

2.2 Import Dependency

2022 marked the seventh consecutive year that China has been ranked as Germany most important trading partner (DESTATIS 2023a). According to the German Federal Bureau of Statistics, the total value of exports and imports between these countries amounted to EUR 297.9 billion in 2022. Germany imported the largest value of goods from China - EUR 191.1 billion - representing an import share of 12.8 percent. The largest value of exports was delivered to the United States. China followed in fourth place with an export share of 6.8 percent or EUR 106.8 billion (DESTATIS 2023a, 2023b). Considering the trade development in the past decades, the importance of Chinese imports for Germany has been increasing and even more so Germanys exports to China. Conversely, China has been reducing its imports from and exports to Germany (Matthes 2019, p. 5, Matthes 2022, p. 6 & 13).

In his analysis of trade data between 2005 and 2015, Matthes (2019) showed, that the importance of and dependency on China is less than insinuated in public debates. Overall, China's importance for German trade is like the United States, yet visibly less than the 14 core

states of the European Union (p. 3). Significant parts of the public perception are confusing cluster risks of German multinational companies in their China business with trade dependency of Germany from China (p. 32, also Dams & Kunz 2020).

The data used by Matthes (2019) was taken from the OECD's Trade-In-Value-Added (TIVA) database. It captures how much foreign and domestic value added[1] is contained in a country's overall imports, exports, and final consumption. TIVA data includes trade in goods and services but does not consider re-exports or re-imports (p. 11f.). This approach analysed how much domestic value added is included in products that are exported from Germany to China, and how much Chinese value added is included in products that Germany imports from China. This differentiation from the total trade value shows, whether a country has high own production or mostly imports intermediary products for further processing and assembly, hence acting as an export platform (p. 11, 20). Additionally, the value-added-perspective provides the ability to identify domestic value added contained in imported intermediary products that are processed further and exported again.

Germany's dependency on China is generally lower when measured by shares of trade value compared to the value-added approach (Matthes 2022, p. 4, 7, 13, 15). This might be due to two reasons. Firstly, the value-added approach also includes indirect value-added. For instance, Germany could import a good from a third country which contains Chinese value-added. Secondly, the statistics on value-added include data for services as well, whereas the trade data focuses on goods only.

In terms of Chinese imports to Germany, the analysis of Matthes (2019) showed that in 2015 China contributed to the entire foreign and domestic value added in Germans' final consumption 2 percent and 8 percent considering only the foreign value added (p. 21). A value that increased to 2.2 and 8.3 percent respectively in the year in 2018. Conversely, Germanys contribution to total value-added contained in Chinese final consumption was only 0.8 percent in 2018 (Matthes 2022, p. 8). However, also the US and the EU contributed 2.5 and 9.4 percent to the entire value added in German final consumption in 2015 and 10.3% and 38.3 percent respectively for the foreign value added alone (Matthes 2019, p.21). The relevance of China's imports for German final consumption is therefore still less than of other countries. This result was confirmed when Matthes (2022) repeated his analysis with TIVA data for the year 2018.

The results of Sandkamp et al. (2023) confirm this as well. Moreover, they found that German consumption is more reliant on Chinese value added than German production. In 2018, value added from China in German final consumption was mostly in the areas of "textiles, apparel,

[1] Value added is synonymous to production. Domestic value-added equals gross national product.

leather” and “computer and electronics”. Additionally, China contributed the most to these two sectors in German production (Sandkamp et al. 2023, p. 6).

The essence of Matthes’ (2019, 2022) and Sandkamp et al. (2023) analysis is also supported by Baur and Flach (2022), who confirmed their findings that China is a relevant trading partner but not a dominant one. China’s share in foreign intermediate products used in German production as well as in foreign demand for German products was lower than the US share in 2018. (p. 58).

However, over the past twenty years, the importance of Chinese intermediary products for German production has shown an increasing trend. In 2018 they accounted for about 1 percent of total production in Germany. This share is similar for European countries like Spain and France, and below average compared to other G-20 countries. Among the G-20 countries, South Korea imported the highest share of Chinese intermediaries with almost 3.5 percent. In contrast, German intermediary products for Chinese production have accounted for less than one percent and have shown a downward trend since the financial crisis (Baur & Flach 2022, p. 58f.).

In principle, China has reduced its important dependency, whereas Germany has been importing more from China over time (Matthes 2022, p. 4 & 24). A reason could be China’s strategy of ‘dual circulation’ that puts the focus of the economic development on the domestic rather the foreign markets with higher consumption rates and technological self-reliance (Bickenbach & Liu 2021).

The results of Matthes (2019, 2022), Baur and Flach (2022) and Sandkamp et al. (2023) are summarized in Table 1. In the latest of these studies, Sandkamp et al. (2023) found that German production is less dependent on China than German consumption. Moreover, Chinas share of value-added in Germanys economy increases when considering indirect linkages, which must be considered when striving for independence from China.

If the EU were to decouple from China, Germanys economic output would be reduced by 1 percent in the long run, albeit short-term cost would be much higher. Notwithstanding Chinas share of value added in German production and consumption being similar as in the US or French economy, individual products show high dependency on Chinese imports. Therefore, the costs of decoupling from China could be higher and procurement of essential products should be diversified (Sandkamp et al. 2023).

Source	Share of value added	In %	Year
Matthes (2019)	Share of German value-added exports to China in total (German and foreign) gross value added in Germany	2,8%	2015
	Share of China in total (German and foreign) value added in German final consumption	2%	2015
	Share of China in foreign (i.e., imported) value added in German final consumption	8%	2015
Matthes (2022)	Share of German value added in Chinese final consumption (value added exports to China) in total (German and foreign) gross value added in Germany	2,7%	2018
	Share of China in total (German and foreign) value added in German final consumption	2,2%	2018
	Share of China in foreign (imported) value added in German final consumption	8,3%	2018
Baur & Flach (2022)	Share of China in foreign intermediate inputs in German final production	7%	2018
	Share of German value-added exports to China in total foreign value-added exports (final demand)	9%	2018
	Share of Chinese intermediate inputs in German production	1%	2018
Sandkamp et al. (2023)	Share of intermediate products sourced directly from China in German production	0,6%	2018
	Share of Chinese value added (incl. indirect linkages) in German production	1,5%	2018
	Share of intermediate products sourced directly from China in German final consumption	1,4%	2018
	Share of Chinese value added (incl. indirect links) in German final consumption	2,7%	2018

Table 1: Comparison of literature on value added regarding Germany and China.
Source: Matthes (2019), Matthes (2022), Baur & Flach (2022), Sandkamp et al. (2023).

2.3 Raw Materials

A special topic is Germany's dependency on raw materials imports from China given that the country has only a few commodities and imports 90 percent of their raw materials from abroad. One of the most important suppliers is China. Figure 1 gives an overview of the situation, with Germanys import share from China on the vertical and Chinas global market share of critical raw materials in 2019 on the horizontal axis. For most of these raw materials, Chinas market share and Germanys import share from China are below thirty percent. There are two outliers, magnesium, and rare earth metals, with both shares higher than the other raw materials.

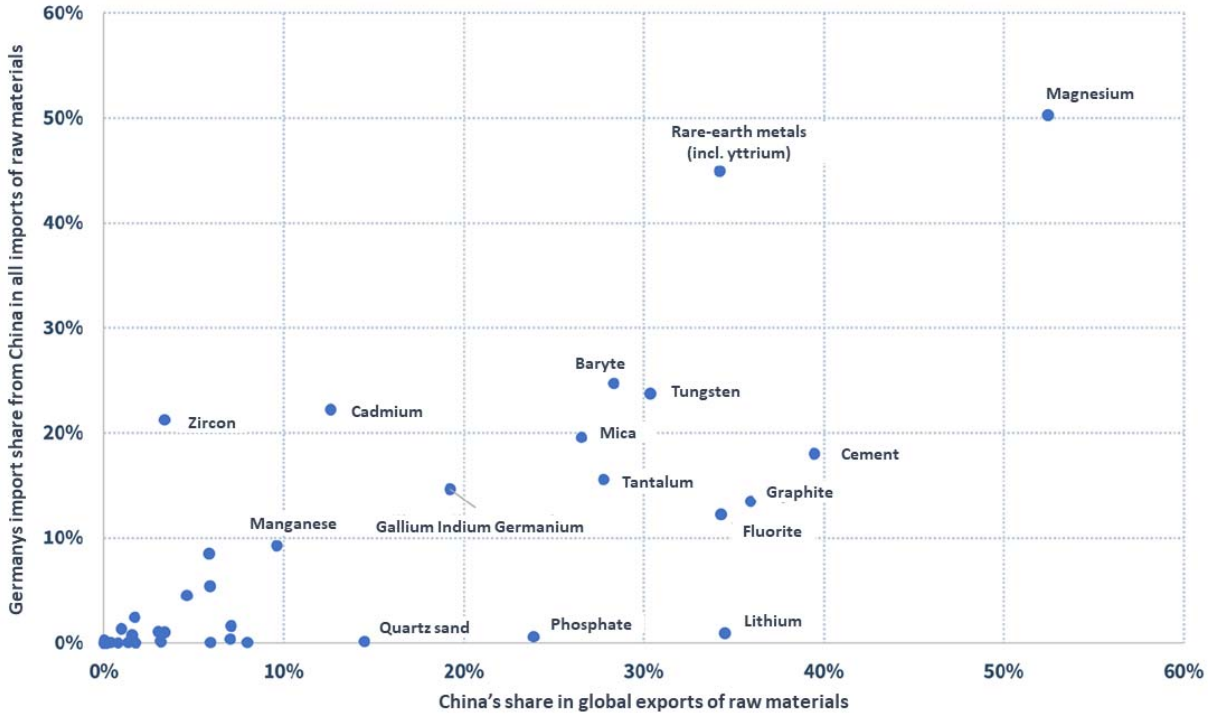

Figure 1: Germanys import share from China and Chinas global market share of raw materials in 2019. Source: Fremerey & Obst (2022, p. 2).

The European Commission (2020) defined a list of raw materials necessary to produce key technologies. From this list, Flach et al. (2022) defined a group of nine critical raw materials that fulfil two preconditions. Firstly, imports of a raw material that have a high supplier concentration, which is expressed through a Herfindahl-Hirschman index higher than 30 percent. Secondly, a raw material is used in at least five of the ten key technologies (p. 9). The resulting identified critical raw materials were boron, cobalt, graphite, lithium, magnesium, niobium, rare earth-metals, silicon, and titan (p. 2).

China is among the top five most important exporters for seven of these natural resources and Germany's most important supplier for three of these raw materials. As the study shows, in 2019, China's share of imports to Germany was 14 percent for graphite, 45 percent for rare earth-metals, and 50 percent for Magnesium. Chinas relevance as a supplier is lower for the remaining natural resources, as its import share was less than 10 percent (Flach et al. 2022, p. 13-21). The analysis of Flach et al. (2022) furthermore showed, that there are multiple other countries which supply the examined raw materials. Additionally, Germany already trades in all raw materials except raw earth-metals with at least four of the top five leading suppliers. Therefore, the possibilities to diversify Germany's supplier base are available. Moreover, in the meantime Germany established a separate Raw Materials Agency in 2010 (DERA).

The EU is also heavily relying on commodity imports from China. China is the major supplier for various raw materials used in nine of the key technologies of the EU (European Commission

2020, p. 82). For electrical motors, wind turbines, photovoltaic technology, and robotics, more than half of the imported raw materials of the EU come from China (cf. Baur & Flach 2022, p. 61). To secure the supply, the EU-Commission has been taking measures, such as establishing a raw materials initiative (RMI). In March 2023, the EU-Commission presented the Critical Raw Materials Act (CRMA), a new law aiming to secure the supply of raw materials. There are three pillars to the strategy: crisis management, funding of raw material projects along the supply chain, and improvement of competition conditions and establishment of standards including technological innovations and recycling as well (Levinger 2023, p. 1f., Menkhoff & Zeevaert 2022, p. 668f).

3. Methodology

The focus of this paper is an empirically driven analysis of the import dependency of Germany on China in terms of physical goods as well as trade value over time. Services are not included because their trade with China is not pronounced, neither on an EU (Garcia-Herrero et al. 2020), nor on a German state level (cf. BMWI 2021, p. 7).

The empirical analysis is using data classified with the Harmonized System (HS) from the Comtrade database of the United Nations Statistics Division. HS is the most detailed classification of products, in which they are segmented into 99 industries (2-digit level), each of these in-turn into 99 sectors (4-digit level) and eventually each sector is divided into 99 categories (6-digit level) (United Nations 2022).

The used data included six variables: the year (2011-2020), the commodity code[2] (HS6: category level), trade flows (imports, exports), reported countries (China, Germany), the partner country (China, Germany, World), and the value of trade in US-Dollars. Data for China excluded the special administrative zones Hong Kong and Macau. There are different versions of HS classification, for this analysis the option “as reported” was selected. This analysis only considered total trade values of imports and did not apply the value-added perspective. Re-imports and re-exports were not considered.

The data obtained from the Comtrade database contained some missing values so that the second and third test could not be conducted for every good in every year. Overall, there were 747 observations with missing results for test two, test three, or both, representing 1.8

[2] „Commodity Code“ refers to the sequence of numbers assigned to all products on their respective aggregate HS level (either HS2 for industry level, HS4 for sector-level, or HS category level. For instance: HS2 industry 01 is “Live Animals”, HS4 Sector 0104 is “Live Sheep and Goats” and HS6 Category 010410 is “Live Sheep”). It does not refer only to commodities in the sense of raw materials but to all traded products.

percent of all observations. Thereof, 288, or 0.7 percent were industrial goods and 8 were raw materials. Most of the missing values were from consumption goods.

To analyse the import dependency, we first disaggregate the imports into consumption goods, industrial goods, and raw materials as a subset of the later. Then, we test each of these product types on strategic dependency based on the concept developed by Rogers et al. (2020).

Strategic dependency is defined as “a level of reliance on imports from another country that gives the exporting country the ability to significantly impact the overall domestic availability of that imported good” (p. 21). To fulfil this definition, a good had to cumulatively pass the thresholds of three single criteria. If one of the thresholds is not met, a country is not considered strategically dependent on the imports of the respective good.

The first criterion requires that more than half of the overall volume of a product type good is imported from a certain country (Rogers et al. 2020, p. 21). If this criterion is met, dependency in a trivial sense exist. To become strategically dependency two more criteria must be fulfilled.

Secondly, the country is not exporting more than it imports of the respective product that passes the first test (Rogers et al. 2020, p. 21). If this would be the case, strategic dependency would not exist because the respective good could be easily substituted by domestic supply. (Flach et al. 2021, p. 15).

Are the first two criteria met, the third criterion becomes most important for strategic dependency: the global market share of the exporting country of the respective good is larger than 30 percent (Rogers et al. 2020, p. 21). This measure can be interpreted as substitution elasticity of the importing country. The general rule is: The higher the global market share of the exporting country the lower the substitution elasticity for the importing country and hence the more dependent the country is on the respective good and vice versa (Breyer 2015, p. 27, Flach et al. 2021, p. 15). Strategic dependency, therefore, implies a low import substitution elasticity, a criterion that is mostly overlooked in the public debate (Görg et al. 2023).

In the following we will test these criteria for the case of Germany’s imports from China, disaggregated in different product types for the period 2011 to 2020. The tests are conducted using trade values in US-Dollars.

For the first test, Germany’s trade value of imports from China was divided by Germany’s trade value of imports from the world. The second test was assessed by subtracting Germany’s trade value of exports to the world from Germany’s trade value of imports from world for the respective good. If the result was larger than zero, the test was considered passed because it confirms that Germany is a net-importer. The third test requires dividing China’s trade value of exports to the world by the aggregated world’s trade value of exports to the world for the

respective good that passes the previous criteria. The following Table 2 summarises the methodological approach.

Measuring the Import Dependency of Germany on China: Methodological Approach	
Disaggregation of product types	– Consumption goods – Industrial goods – Raw materials – Critical raw materials
Degree of dependency	– Trivial dependency: (1) Import share from China >50% – Strategic dependency: (1) + (2) Germany is a net importer + (3) Chinas global export share > 30%
Measurement approach	– Number of types of goods (cumulative; in addition, for strategic dependency: yearly) – Trade value (price *quantity)
Time period	– 2011-2020 – Country analysis for 2019

Table 2: Methodological Approach for measuring the Import Dependency of Germany on China.

4. Results and Discussion

4.1 Levels and Significance of Dependency

Over the period between 2011 and 2020, Germany imported 5,089 different types of goods from China in line with the HS6 classification.[3] Some of them were imported only in one year, others in multiple years. By adding up how many times each of these different types of goods Germany imported from China over the ten-year span, the total amounts to 42,648 imported goods[4].

In the following Table 3 we refer to them as main unit classified as “Level 0” goods, whereas ‘Level 1’ goods are the respective subset of goods that pass the criterion of trivial dependency with an import share of more than 50 percent from China. ‘Level 2’ goods additionally fulfil the criterion that Germany is as a net-importer of the respective good. ‘Level 3’ goods are a further subset of goods that passes the criterion that China has a global export share of more than 30 percent of the respective good and hence show strategic dependency due to a low substitution elasticity. Furthermore, on all levels, the goods have between disaggregated into consumption

[3] For instance, HS6 010410 is ‘live sheep’ and HS010420 ‘live goats (WITS 2023) and there are classified as two different types of goods.
[4] Here, one import refers to a single good being imported once (in one year). Two imports of live sheep would mean two occasions (years) of live sheep being imported, but only referring to one single good.

and industrial goods as well as raw materials as a subset of the latter. Obviously, the type of product matters for the degree of dependency.

	No. (10Y cumulated)	% of Total Level 0	% of Level 0 subgroup	% of Level 0 Industrial goods
Total goods				
Level 0 (all goods)	**42,648**			
Level 1 (50% import)	**3,540**	8.3%		
Level 2 (+ net importer)	**2,079**	4.9%		
Level 3 (strat. dependent)	**1,491**	3.5%		
Consumption Goods				
Level 0	**12,633**	29.6%	% of Level 0 consumption	
Level 1	**1,841**	4.3%	14.6%	
Level 2	**1,256**	2.9%	9.9%	
Level 3	**902**	2.1%	7.1%	
Industrial Goods				
Level 0	**30,015**	70.4%	% of Level 0 industrial	
Level 1	**1,699**	4.0%	5.7%	
Level 2	**823**	1.9%	2.7%	
Level 3	**589**	1.4%	2.0%	
Raw Materials				
Level 0	**2,275**	5.3%	% of Level 0 raw materials	7.6%
Level 1	**130**	0.30%	5.7%	0.43%
Level 2	**98**	0.23%	4.3%	0.33%
Level 3	**66**	0.15%	2.9%	0.22%
Critical Raw Materials				
Level 0	**672**	1.6%	% of Level 0 critical raw materials	2.2%
Level 1	**71**	0.17%	10.6%	0.24%
Level 2	**62**	0.15%	9.2%	0.21%
Level 3	**51**	0.12%	7.6%	0.17%

Table 3: Results breakdown of goods on different dependency levels.
Source: United Nations (2022), own calculations

The result of the analysis is straightforward. On the level of all goods, Germany was dependent on 8.3 percent of all imported goods from China between 2011 and 2020 in a trivial way, i.e., the import share was larger than 50 percent but only 3.5 percent of these goods fulfil the conditions of strategic dependency.

Furthermore, the disaggregation of the overall numbers of goods in consumption and industrial goods shows that around seventy percent are imports for the German industry and only thirty percent have been demanded by households. However, consumer goods have with 7.1 percent a higher share of strategic dependency than industrial goods that have only a share of 2 percent.

For raw materials as a subset of industrial goods and critical raw materials as a subset of the former, the picture looks similar for the respective period. Overall, Germany has been

strategically dependent on 2.9 percent of the imported raw materials from China and on 7.6 percent of the critical raw materials over the respective period.

In the following we conduct the same analysis based on cumulated trade values of imports instead of numbers of goods. As it turns out, dependency on all levels increases significantly.

Table 4 shows the cumulated import value in million US-Dollars over the ten-year period. When distinguishing between Level 0 consumption and industrial goods, the proportions of their trade values are similar to their share of number of goods. About 30 percent of consumption goods account for 39.4 percent and about 70 percent of industrial goods account for 60.6 percent of all import value between 2011 and 2020. A possible explanation for this is that consumption goods are imported in higher volumes than industrial goods, hence contributing more to the overall trade value. As the import value is a product of quantity and price, an alternative possibility is that the prices for consumption goods are higher, however, this is rather unlikely.

Yet, the proportions vary when looking at the different dependency levels. The number of total Level 1 and Level 3 goods account disproportionally more for the trade value of imports. More than eight percent of trivially dependent goods represent 32.7 percent of the value of Chinese imports. All strategically dependent goods, 3.5 percent of all imports, account for 18.2 of the trade value of all imports from China. This could be explained by much higher import quantities (especially for consumption goods) or rather much higher prices (especially for industrial goods) of strategically dependent goods compared to trivially dependent and total goods.

The strategically dependent consumption goods (2.1 percent of all goods by number of goods) represent 27.2 percent of all consumption goods and 10.7 percent of all imports by trade value. In contrast, strategically dependent industrial goods (1.4 percent of all goods by number of goods) represent 12.4 percent of all industrial goods and 7.5 percent of all imports by trade value.

For raw materials and critical raw materials, the picture is similar. Strategically dependent raw materials (0.15 percent of all goods and 2.9 percent of all raw materials by number of goods) account for 0.18 percent of all goods and 19.9 percent of all raw materials by trade value. Similarly, strategically dependent critical raw materials (0.12 percent of all goods and 7.6 percent of all critical raw materials by number of goods) represent 0.13 percent of all goods and 25.6 percent of all critical raw materials by value.

	Value in USD Mio. (10Y cumulated)	% of Total Level 0	% of Level 0 subgroup	% of Level 0 Industrial goods
Total goods				
Level 0 (all goods)	**1,134,462**			
Level 1 (50% import)	**371,298**	32.7%		
Level 2 (+ net importer)	**259,888**	22.9%		
Level 3 (strat. dependent)	**206,977**	18.2%		
Consumption Goods				
Level 0	**447,232**	39.4%	% of Level 0 consumption	
Level 1	**211,178**	18.6%	47.2%	
Level 2	**153,192**	13.5%	34.3%	
Level 3	**121,453**	10.7%	27.2%	
Industrial Goods				
Level 0	**687.230**	60.6%	% of Level 0 industrial	
Level 1	**160,120**	14.1%	23.3%	
Level 2	**106,696**	9.4%	15.5%	
Level 3	**85,525**	7.5%	12.4%	
Raw Materials				
Level 0	**10,046**	0.9%	% of Level 0 raw materials	1.4%
Level 1	**2,349**	0.21%	23.4%	0.33%
Level 2	**2,129**	0.19%	21.2%	0.30%
Level 3	**1,998**	0.18%	19.9%	0.28%
Critical Raw Material				
Level 0	**5,557**	0.5%	% of Level 0 critical raw materials	0.8%
Level 1	**1,600**	0.14%	28.8%	0.23%
Level 2	**1,485**	0.13%	26.7%	0.22%
Level 3	**1,424**	0.13%	25.6%	0.21%

Table 4: Results breakdown of goods on different dependency levels (based on trade value of imports). Source: United Nations (2022), own calculations

In the next step, we apply both the number and the value approach by disaggregating the strategically dependent imports from China for each year. Table 5 shows the absolute number of strategically dependent goods as a subset of the overall number of goods for each year in the respective period. Table 6 shows the import value of the respective goods from Table 5 in million US-Dollars.

According to the data, in the years 2012 and 2020 none of the imported goods fall under Level 2, that is goods from which Germany imports more than 50 percent from China and for which Germany is a net importer, except for five raw materials. Therefore, there were essentially no strategically dependent goods in those years either. However, this might be the result of missing data. As there is no data regarding other industrial or consumption goods for these two years, any interpretation would not be meaningful; hence they will be disregarded in the interpretation.

The most interesting finding is that although the numbers are rather low compared to the overall number of goods, the number of strategically dependent industrial goods has increased notably over time from 58 goods in 2011 to 88 goods in 2019, increasing the share from 2 percent in 2011 to 2.9 percent in 2019 of all industrial goods. This can be interpreted in a way that although the share of strategically dependent industrial goods is still rather low it is increasing over time. Yet, the trade value decreased almost fourfold. This might be due to two reasons. Firstly, Germany imported about USD 7.5 billion worth of photovoltaic cells and light emitting diodes (LEDs) only in 2011. Excluding these imports in 2011, the overall trade value of strategically dependent goods in 2011 would be similar to the levels of the following years. Secondly, Germany imported computers worth about USD 8 billion in each of the previous years but not in 2019. Had Germany imported them in 2019 as well, the trade value of strategically dependent goods in 2019 would be similarly high as in the previous years.

Strategically dependent goods										
No of goods	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Total	**178**	**5**	**173**	**190**	**176**	**180**	**188**	**189**	**207**	**5**
Consumption	120	0	108	120	109	110	108	108	119	0
Industrial	58	5	65	70	67	70	80	81	88	5
Raw Materials	8	5	8	8	6	6	7	7	6	5
Critical Raw Materials	5	5	5	5	5	5	6	6	4	5

Table 5: Breakdown of strategically dependent goods into type of use, for each year from 2011-2020.
Source: United Nations (2022), own calculations

Strategically dependent goods										
Import value in USD Mio.	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Total	**30,610**	**85**	**22,076**	**24,452**	**29,593**	**20,755**	**22,621**	**32,387**	**24,329**	**71**
Consumption	14,047	0	11,976	13,786	19,046	11,257	11,798	19,968	19,574	0
Industrial	16,563	85	10,100	10,666	10,547	9,497	10,822	12,419	4,755	71
Raw Materials	501	85	307	280	134	96	117	310	96	71
Critical Raw Materials	273	85	153	139	105	92	109	306	91	71

Table 6: Breakdown of strategically dependent goods into type of use, for each year from 2011-2020 (based on trade value of imported goods).
Source: United Nations (2022), own calculations

This result corresponds with a rising share of strategically dependent industrial goods in all strategically dependent imports over time. For instance, the share of strategically dependent industrial goods in 2011 was 33 percent but was roughly 43 percent in 2019. That means that although the share of strategic dependency is still higher for consumer than for industrial goods for each year the share of industrial goods is rising over time.

4.2 Raw Materials

With regards to import dependency there are especially concerns about Germany being dependent on Chinese imports of natural resources such as lithium, nickel, and cobalt, as well as rare earth-metals like yttrium, all of which are considered important for Germany's energy shift (berlin direkt 2022, Fremery & Obst 2022, Sachverständigenrat 2022, European Commission 2020). However, our analysis confirms that most of the imported raw materials neither had an import share from China larger than fifty percent, nor did China have a global market share of more than 30 percent for these goods.

Overall (on "Level 0", cumulative approach), Germany imported 2,275 different raw materials independent of how often they have been imported within the examined period, of which 672 were critical raw materials. Considering goods with an import share from China higher than fifty percent ("Level 1"), Germany imported 130 different raw materials (5.7 percent of all raw materials), of which 71 were critical (10.6 percent of all critical raw materials). On "Level 3", the strategically dependent goods included 66 raw materials (2.9 percent of all raw materials), of which 51 were critical raw materials (7.6 percent of all critical raw materials).

Out of the 130 imported raw materials with trivial dependency, 32 fulfilled the second criterion but did not qualify as being strategically dependent, demonstrating the role of substitution elasticity. As the literature shows, for some raw materials there are limited alternative trading partners, which leads to high dependency (Fremerey & Obst 2022). However, there are different exporters in the market and deepening trade relations with other countries can contribute to lower dependencies from China (Flach et al. 2022).

The ten critical raw materials that were strategically dependent in at least one year between 2011 and 2020 are listed in Table 7 with their respective import shares from China. The red numbers in Table 7 indicate strategic dependency of a good in that year ("Level 3"). The blue numbers indicate that the import share of that good from China was higher than fifty percent, but Chinas market share did not pass the thirty percent-threshold or – in the case of natural graphite – Germany was a net exporter ("Level 2"). Hence that good did not fulfil all criteria to be considered strategically dependent.

This result confirms that the concept of substitution elasticity matters (Flach et al. 2022) but less than it does compared to overall industrial goods and almost as much as for consumption goods. For instance, antimony or rare earth metals like yttrium and scandium that Germany imported had rather high import shares from China between 2011 and 2020, but in some of the years Germany did not strategically depend on China due to substitution elasticity. Other countries such as Vietnam, Brazil and India have some of the largest rare-earth metal reserves worldwide. Moreover, the U.S. and Australia are among the five largest global producers and

Malaysia and Vietnam among the most important global exporters of rare-earth metals (Flach et al. 2022, p. 16). The German industry is not importing these raw materials from China due to a lack of other suppliers but doing so because cost reasons. Rare-earth metals imported from China are cheaper than from other countries (Teufel Dreyer 2020, U.S. Department of Defense 2018).

Raw Materials	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Unwrought Antimony powders	72,5	63,2	84,10	69,77	86,31	72,1	67,8	70,5	71,3	61,8
Bismuth; articles thereof, including waste and scrap	6,2	11,7	38,4	22,9	29,0	76,4	63,3	42,4	34,7	76,4
Boron; tellurium	8,1	4,3	9,0	28,8	7,3	2,5	0,3	54,7	2,5	0,4
Compounds of rare earth-metals yittrium and scandium, or a mixture of them	52,9	40,9	56,8	51,7	60,4	54,3	51,0	52,6	49,8	35,2
Rare earth-metals yttrium and scandium, whether or not intermixed or interalloyed	77,0	80,0	96,3	84,7	91,3	88,4	64,7	48,4	60,7	80,3
Natural graphite in other forms than powder or flakes	46,1	73,2	67,1	72,0	74,2	85,1	81,2	35,3	76,1	58,7
Natural graphite in powder form or flakes	46,5	42,4	54,1	52,5	48,4	47,3	48,9	41,3	23,7	29,6
Magnesia and magnesium oxide	39,5	34,9	31,0	25,6	22,4	24,9	26,7	51,1	31,8	33,8
Magnesium powders	58,5	64,6	68,1	67,1	61,7	62,4	61,5	61,6	70,8	61,1
Unwrought magnesium, containing at least 99.8% by weight of magnesium	73,7	67,2	67,6	65,1	65,8	68,3	71,8	75,9	76,7	77,7

Table 7: Import share from China (in %) of raw materials with strategic and import dependency from 2011 to 2020. Red: strategic dependency; Blue: trivial dependency (import share larger 50%), but Chinas global market share is less than 30% (or, only in the case of natural graphite not in powder or flakes: Germany was net exporter); black: neither trivial nor strategic dependency.
Source: United Nations (2022), own calculations.

Only unwrought magnesium and magnesium powders were strategically dependent in each of the ten years. China's global market share of magnesium varied between 35 and 44 percent. Moreover, Germany was strategically dependent on Chinese imports of natural graphite, in powder form or flakes, or in other form, in two and seven years, respectively. While the import share of natural graphite from China fluctuated between 24 and 85 percent, China's market share fluctuated between 53 and 78 percent. Hence, there were other suppliers for graphite as well as magnesium that potentially increased the substitution elasticity for the German industry.

4.3 Country Comparison

For a better interpretation of the extent of overall strategic dependency on Chinese imports to Germany, the results of this analysis are compared with the results of Rogers et al. (2020). The authors utilized data from 2019 of four countries, namely New Zealand, the United States,

Canada, and the United Kingdom.[5] The comparison reveals that Germany is strategically dependent in less goods than the other four countries (see Table 8).

Among these five countries, New Zealand had the highest strategic dependency on China in 2019 in absolute numbers, with overall 513 goods compared to Germany's 207 goods. The United States had the second-highest level of strategic dependency, with 414 strategically dependent goods, whereas Canada ranks third and the United Kingdom on the fourth position imported 229 goods with strategic dependency in 2019, only slightly more than Germany. The result in terms of shares of total goods imported is similar but Germany ranks fourth and the United Kingdom has the lowest relative strategic dependency as it imported significantly more goods overall in 2019.

	New Zealand	United States	Canada	United Kingdom	Germany
Total no. of strategically dependent (s.d.) goods (HS6 categories)	513	414	367	229	207
% of total HS6 imports	8.7%	7.0%	6.2%	3.9%	4.8%

Table 8: Comparison of goods with strategic dependency on Chinese imports of Canada, New Zealand, the United Kingdom, the United States and Germany in 2019.
Source: Rogers et al. 2020, p. 22, United Nations (2022), own calculations.

5. Concluding Remarks

In a non-trivial sense, import dependency of a country can be measured either in terms of value-added contribution or with the concept of strategic dependency. This paper is using the concept of strategic dependency because it considers import substitution elasticity as an important measure. It examined imports of physical goods disaggregated into consumption and industrial goods as well as raw materials from China to Germany for the period between 2011 and 2020 in terms of number of goods and trade value.

Grosso modo the analysis confirms the results of the value-added approach: The strategic dependency of Germany on Chinese imports in terms of the number of goods was in the single-digit percentages in the retrospective period. However, the share of strategically dependent industrial goods for Germany has increased over time from 2 percent to 2.9 percent of all imported industrial goods (number of goods approach); a result that contrasts with a low but steady number of strategically dependent imports of critical raw materials. In comparison, the strategically dependent goods account for a much larger share of Chinese imports when using the value approach. This applies to all cumulative goods as well as the subgroups of consumption goods (7.1 percent by number represent 27.2 percent by value), industrial goods

[5] The paper includes also Australia but with data from 2018.

(2 percent by number represent 12.4 percent by value), raw materials (2.9 percent by number represent 19.9 percent by value), and critical raw materials (7.6 percent by number represent 25.6 percent by value). The same is true for trivially dependent goods, which also account overproportionately for their trade value.

Furthermore, our empirical results show that the integration of import substitution elasticity into the analysis, i.e., the degree of alternative imports of the same good from other countries, is important for consumption goods, and even more so for industrial goods. However, substitution elasticity plays a smaller role for raw materials and critical raw materials in terms of absolute number of goods. Overall, about five percent of Germanys cumulatively imported goods were raw materials, accounting for less than one percent of cumulative trade value. The largest difference can be seen between the number of all imported goods and those that are dependent in a trivial sense, i.e., the import share is higher than 50 percent. Still, about one and a half percent of the imported raw materials that are dependent in a trivial sense and for which Germany is a net importer, are not strategically dependent due to substitution elasticity. In these and in other cases of industrial goods with a high import share, it seems that the German industry chooses a kind of "deliberate dependency" that is rooted in simply cost calculation: imports from China are cheaper than that for other countries for the same good or commodity (Book et al. 2023, Teufel Dreyer 2020, U.S. Department of Defense 2018).

Finally, our analysis shows that in comparison to New Zealand, the United States, Canada, and the United Kingdom – four of the geographical objects of the analysis of Rogers et al. (2020) -, Germany was the least dependent country in 2019 in absolute numbers of strategically dependent goods, and second least dependent country in terms of percentage of total goods imported.

Overall, Germanys imports from and exports to China are on the rise, whereas Chinas imports from and exports to Germany are in decline. Whether this is a trend triggered by the Covid19-policy or already a result of China's dual circulation policy that aims to strengthen the domestic market, has to been seen. The same is the case for the realised 'China-strategy' of Germany's Federal Government (2023) that is focussing very much on the concept of so-called 'de-risking', which in turn could lead to change of the supply-chain channels, i. e. imports, away from China.

This working paper is based on the master thesis of Viktoria Krahnke submitted at Frankfurt School of Finance & Management in May 2022. Supervisors have been Dr Horst Löchel, Prof. of Economics and Co-Chairman of the Sino-German Center e. V. at Frankfurt School of Finance & Management and Tim Jablonski, research assistant at the Sino-German Center e. V.

6. List of References

adidas AG. (2022). *Geschäftsbericht 2021*. https://www.adidas-group.com/de/investoren/finanzberichte/#/2021/ (accessed May 08, 2021).

AHK Greater China. (2022). *German Company Directory*. AHK Greater China - German Chamber of Commerce - German Industry and Commerce. Retrieved May 15, 2022, from https://china.ahk.de/market-info/german-company-directory/

Baur, A., & Flach, L. (2022). Deutsch-chinesische Handelsbeziehungen: Wie abhängig ist Deutschland vom Reich der Mitte? *ifo Schnelldienst*, *75*(04), 56-65. https://www.ifo.de/publikationen/2022/aufsatz-zeitschrift/deutsch-chinesische-handelsbeziehungen-wie-abhaengig-ist (accessed on April 10, 2022).

Berlin direkt. (2022, March 20). *Deutschlands Abhängigkeit von China* [Video]. ZDFmediathek. https://www.zdf.de/politik/berlin-direkt/berlin-direkt-deutschlands-abhaengigkeit-von-china-100.html (accessed May 04, 2022).

Bickenbach, F. & Liu, W.-H. (2021). Chinas neuer Fünfjahresplan: Wirtschaftliche Kernelemente und Implikationen für Deutschland und Europa. *Kiel Focus* 04/2021. Kiel Institute for the World Economy (IfW Kiel). https://www.ifw-kiel.de/de/publikationen/kiel-focus/2021/chinas-neuer-fuenfjahresplan-wirtschaftliche-kernelemente-und-implikationen-fuer-deutschland-und-europa-0/ (accessed on April 10, 2022).

BMW Group. (2022). *BMW Group Bericht 2021*. https://www.bmwgroup.com/de/investor-relations/unternehmensberichte.html (accessed May 21, 2021).

BMWi. (2021, July). *Facts about German Foreign Trade*. Federal Ministry for Economic Affairs and Energy (BMWi). https://www.bmwk.de/Redaktion/EN/Publikationen/Aussenwirtschaft/facts-about-german-foreign-trade.pdf?__blob=publicationFile&v=6 (accessed January 20, 2022).

Book, S., Brächer, M., Giesen, C., Hage, S., Hecking, C., Hesse, M., Schulz, S. (2023). Wenn andere eine Grube graben. In Der Spiegel, Nr. 22(62-69). https://www.spiegel.de/wirtschaft/rohstoffe-warum-der-wettlauf-um-die-rohstoffe-ein-wettlauf-um-den-wohlstand-ist-a-02aeb930-0d71-4866-9f24-fa82ef0ded04

Bornschier, V. (1982). The World Economy in the World-system: Structure, Dependence, and Change. *International Social Science Journal, 34*(1), 37-59. https://unesdoc.unesco.org/ark:/48223/pf0000049158 (accessed on April 10, 2022).

Bornschier, V., Chase-Dunn, C., & Rubinson, R. (1978). Cross-National Evidence of the Effects of Foreign Investment and Aid on Economic Growth and Inequality: A Survey of Findings and a Reanalysis. *American Journal of Sociology, 84*(3), 651–683. http://www.jstor.org/stable/2778259 (accessed on April 10, 2022).

Breyer, F. (2015). Mikroökonomik - Eine Einführung. 6th Ed. Springer.

Chase-Dunn, C. (1975). The Effects of International Economic Dependence on Development and Inequality: A Cross-National Study. *American Sociological Review*, *40*(6), 720–738. https://doi.org/10.2307/2094176 (accessed January 16, 2022).

Covestro AG. (2022). *Covestro - Geschäftsbericht 2021*. https://bericht.covestro.com/geschaeftsbericht-2021/serviceseiten/downloads.html (accessed May 22, 2021).

Dams, J. & Kunz, A. (2020, June 12). Bruch mit China? So abhängig sind wir wirklich. *Welt*. https://www.welt.de/wirtschaft/article209346567/Globalisierung-So-abhaengig-sind-wir-wirklich-von-China.html (accessed on April 10, 2022).

DESTATIS. (2022). *Globalisation Indicators. Foreign Trade*. DESTATIS Statistisches Bundesamt. Retrieved January 14, 2022, from https://www.destatis.de/EN/Themes/Economy/Globalisation-Indicators/foreign-trade.html

DESTATIS. (2023a). *Die Volksrepublik China ist erneut Deutschlands wichtigster Handelspartner*. DESTATIS Statistisches Bundesamt. Retrieved March 08, 2023, from https://www.destatis.de/DE/Themen/Wirtschaft/Aussenhandel/handelspartner-jahr.html

DESTATIS. (2023b). *Rangfolge der Handelspartner im Außenhandel*. DESTATIS Statistisches Bundesamt. Retrieved March 08, 2023, from https://www.destatis.de/DE/Themen/Wirtschaft/Aussenhandel/Tabellen/rangfolge-handelspartner.html.

European Commission (2020): *Critical raw Materials for Strategic Technologies and Sectors in the EU. A Foresight Study*. European Union. Retrieved August 01, 2022, from https://ec.europa.eu/docsroom/documents/42881

Federal Office for Information Security. (n.d.). *Critical Infrastructures*. Retrieved 11 September 2022, from https://www.bsi.bund.de/EN/Themen/KRITIS-und-regulierte-Unternehmen/Kritische-Infrastrukturen/Allgemeine-Infos-zu-KRITIS/allgemeine-infos-zu-kritis_node.html

Flach, L., Gröschl, J., Steininger, M., Teti, F. & Baur., A. (2021): Internationale Wertschöpfungsketten – Reformbedarf und Möglichkeiten. Studie im Auftrag der Konrad-Adenauer-Stiftung e.V. https://www.ifo.de/publikationen/2021/monographie-autorenschaft/internationale-wertschoepfungsketten-reformbedarf-und (accessed January 20, 2022).

Flach, L., Teti, F., Gourevich, I., Scheckenhofer, L., Grandum, L., & ifo Institut – Leibniz-Institut für Wirtschaftsforschung an der Universität München e. V. (2022, June). *Wie abhängig ist Deutschland von Rohstoffimporten?* IHK für München und Oberbayern & DIHK | Deutscher Industrie- und Handelskammertag e.V. https://www.ifo.de/DocDL/ifo-Studie_Rohstoffimporte.pdf (accessed August 01, 2022).

Frankfurter Allgemeine Zeitung (FAZ). (2023, 15. Februar). Deutsche Unternehmen: Abhängigkeit von China geringer als oft angenommen. *FAZ.NET*. Abgerufen am 15. Februar 2023, von https://www.faz.net/aktuell/wirtschaft/abhaengigkeit-deutscher-unternehmen-von-china-geringer-als-oft-angenommen-18680039.html

Fremerey, Melinda / Obst, Thomas, 2022, Globalisierungskrise. Welche Abhängigkeiten bestehen bei kritischen Gütern und Rohstoffen aus China?, IW-Kurzbericht, Nr. 48, Berlin. https://www.iwkoeln.de/studien/melinda-fremerey-thomas-obst-welche-abhaengigkeiten-bestehen-bei-kritischen-guetern-und-rohstoffen-aus-china.html (accessed September 19, 2022).

Fröndhoff, B. (2022, February 21). „Gefährliche Abhängigkeit“: Deutsche Firmen binden sich an China. *Handelsblatt*. Retrieved April 24, 2022, from https://www.handelsblatt.com/unternehmen/industrie/ifw-studie-gefaehrliche-abhaengigkeit-deutsche-firmen-binden-sich-stark-an-china-/28088612.html

Garcia-Herrero, A., G. Wolff, J. Xu, N. Poitiers, G. Felbermayr, W.-H. Liu, A. Sandkamp and R. Langhammer (2020. EU-China Trade and Investment Relations in Challenging Times. *European Parliament*, May. https://www.europarl.europa.eu/thinktank/en/document/EXPO_STU(2020)603492 (accessed on April 12, 2022).

German Federal Government (2023). China-Strategie der Bundesregierung. Retrieved July 20, 2023, from https://www.auswaertiges-amt.de/blob/2608578/810fdade376b1467f20bdb697b2acd58/china-strategie-data.pdf.

Görg, H., Kamin, K., Langhammer, R. J. & Liu, W.-H. (2023, 6. Januar). *Auf falscher Spur mit der China-Strategie*. F.A.Z. Abgerufen am 29. Mai 2023, von https://zeitung.faz.net/faz/wirtschaft/2023-01-06/de7f910c995a7c22fbd1c645ec104259/

Huang, J., & Słomczyński, K. M. (2003). The Dimensionality and Measurement of Economic Dependency: A Research Note. *International Journal of Sociology*, *33*(4), 82–98. http://www.jstor.org/stable/20628696 (accessed on January 16, 2022).

Infineon Technologies AG. (2021, November). *Geschäftsbericht 2021*. https://www.infineon.com/cms/de/about-infineon/investor/reports-and-presentations/#annual-reports (accessed May 22, 2021).

Jungbluth, C. F. et al. (2023), Gewinne deutscher Unternehmen in China – eine erste empirische Bestandsaufnahme, https://www.bertelsmann-stiftung.de/de/publikationen/publikation/did/gewinne-deutscher-investoren-in-china-eine-erste-empirische-bestandsaufnahme (accessed on May 23, 2023)

Kaufman, R. R., Chernotsky, H. I., & Geller, D. S. (1975). A Preliminary Test of the Theory of Dependency. *Comparative Politics*, 7(3), 303–330. https://doi.org/10.2307/421222 (accessed on April 09, 2022).

Kentor, J., & Boswell, T. (2003). Foreign Capital Dependence and Development: A New Direction. *American Sociological Review*, 68(2), 301–313. https://doi.org/10.2307/1519770 (accessed on April 10, 2022).

Khan, Y. (2023, 9. März). *EU Draft Law Sets Out Moves to Secure Supply of Critical Energy Transition Materials*. WSJ. https://www.wsj.com/articles/eu-draft-law-sets-out-moves-to-secure-supply-of-critical-energy-transition-materials-ce5d95b0 (accessed March 9, 2023).

Levinger, H. (2023, 10. März). *Der EU Critical Raw Materials Act: Weichenstellung für den Standort Europa | KfW*. KfW. Retrieved March 9, 2023, from https://www.kfw.de/%C3%9Cber-die-KfW/Newsroom/Aktuelles/News-Details_755456.html.

Matthes, J. (2019). Zur Abhängigkeit der deutschen Wirtschaft von China im Außenhandel – Eine Faktensammlung, *IW-Report*, Nr.43, Köln. https://www.iwkoeln.de/en/studies/juergen-matthes-the-german-economys-dependence-on-china-for-foreign-trade-a-collection-of-facts.html (accessed on January 23, 2022).

Matthes, J. (2022) Gegenseitige Abhängigkeit im Handel zwischen China, der EU und Deutschland. I*W-Report*, Nr. 35, Köln. https://www.iwkoeln.de/studien/juergen-matthes-gegenseitige-abhaengigkeit-im-handel-zwischen-china-der-eu-und-deutschland.html (accessed August 08, 2022.).

Menkhoff, L., & Zeevaert, M. (2022). Deutschland kann seine Versorgungssicherheit bei mineralischen Rohstoffimporten erhöhen. *DIW Wochenbericht*, *89*(50), 667-675. Retrieved March 7, 2023, from https://www.diw.de/documents/publikationen/73/diw_01.c.861649.de/22-50.pdf.

Pinto, A. (1972). NOTAS SOBRE DESARROLLO, SUBDESARROLLO Y DEPENDENCIAS. *El Trimestre Económico*, 39(154(2)), 243–264. http://www.jstor.org/stable/20856279 (accessed on April 08, 2022).

Ragin, C., & Delacroix, J. (1979). Comparative advantage, the world division of labor, and underdevelopment. *Comparative Social Research*, 2(5), 181-214.

Rogers, J., Foxall, A., Henderson, M., & Armstrong, S. (2020). *Breaking the China Supply Chain: How the" five Eyes" Can Decouple from Strategic Dependency*. Henry Jackson Society. Retrieved from https://www.dica.org.au/wp-content/uploads/2020/05/Breaking-the-China-Chain.pdf (accessed on January 20, 2022).

Sachverständigenrat zur Begutachtung der gesamtwirtschaftlichen Entwicklung (2022). *Jahresgutachten 2022/23. Energiekrise solidarisch bewältigen, neue Realität gestalten*.

Retrieved January 08, 2023, from https://www.sachverstaendigenrat-wirtschaft.de/jahresgutachten-2022.html.

Sandkamp, A. N., Stamer, V., Wendorff, F., & Gans, S. (2023). *Leere Regale made in China: Wenn China beim Handel mauert* (No. 164). Kiel Policy Brief. Retrieved March 7, 2023, from https://www.ifw-kiel.de/de/publikationen/kiel-policy-briefs/2023/leere-regale-made-in-china-wenn-china-beim-handel-mauert-0/.

Teufel Dreyer, J. (2020, October 7). *China's Monopoly on Rare Earth Elements – and Why We Should Car*e. Retrieved August 23, 2023, from https://www.fpri.org/article/2020/10/chinas-monopoly-on-rare-earth-elements-and-why-we-should-care/

Tyler, W. G., & Wogart, J. P. (1973). Economic Dependence and Marginalization: Some Empirical Evidence. *Journal of Interamerican Studies and World Affairs*, 15(1), 36–45. https://doi.org/10.2307/174908 (accessed on April 08, 2022).

U.S. Department of Defense (2018). *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*. Retrieved August 23, 2023, from https://media.defense.gov/2018/Oct/05/2002048904/-1/-1/1/ASSESSING-AND-STRENGTHENING-THE-MANUFACTURING-AND%20DEFENSE-INDUSTRIAL-BASE-AND-SUPPLY-CHAIN-RESILIENCY.PDF

United Nations (2022). Download trade data | UN Comtrade: International Trade Statistics. *UN Comtrade Database*. https://comtrade.un.org/Data/ (accessed March 31, 2022).

Volkswagen AG. (2022, March). *Geschäftsbericht 2021*. https://www.volkswagenag.com/de/InvestorRelations/news-and-publications/Annual_Reports.html (accessed May 26, 2022).

WITS. (2023). *Trade Statistics by Product (HS 6-digit)*. World Integrated Trade Solution (WITS). Abgerufen am 11. April 2023, von https://wits.worldbank.org/trade/country-byhs6product.aspx?lang=en

Zenglein, M. J. (2020, November). *Mapping and recalibrating Europe's economic interdependence with China*. MERICS Mercator Institute for China Studies. https://merics.org/en/report/mapping-and-recalibrating-europes-economic-interdependence-china (accessed April 27, 2022).