What if? The Effects of a Hard Decoupling from China on the German Economy*

David Baqaee,[1] Julian Hinz,[2] Benjamin Moll,[3] Moritz Schularick,[4] Feodora A. Teti,[5] Joschka Wanner,[6] and Sihwan Yang.[7]

27 November 2023

— Embargoed until Dec 12, 2023 —

Abstract

How would the German economy cope with a hard economic decoupling from China? We study a scenario where the global economy fragments into three distinct blocs: the G7 economies and their allies, China and her allies, as well as neutral countries. German trade with China would have to be entirely rerouted to countries within the "Western" block and neutral countries. We quantify the costs of such a worst-case hard decoupling using the Baqaee and Farhi (2021) multi-sector model of the world economy. Our key finding is that a total cut-off of trade relations with China would have severe but not devastating effects on the German economy. The welfare loss for Germany (relative to a no-cut-off baseline) would be around 5% of Gross National Expenditure (GNE) over the first few months and around 4% over the first year, plus additional short run costs due to business-cycle amplification effects. In the medium and long run, the costs would fall to a permanent loss in the 1-2% range. Less extreme decoupling or gradual de-risking scenarios ("small yard, high fence") would incur smaller costs. The single most influential assumption relates to the "trade elasticity,", i.e., the ease and speed with which trade can be reorganized away from China to neutral countries and within the "Western" block. Our findings, in particular the critical dependence of economic costs on the time horizon over which adjustments take place, provide some rationale for embarking on a gradual de-risking trajectory to avoid a costly and politically contentious hard decoupling dictated by geopolitical events.

Keywords: Derisking, Decoupling, Sanctions, Embargoes
JEL Classification: F13, F14, F17, F51

*This paper was prepared for the CEPR Paris Symposium in December 2023 and is an abbreviated version of a longer paper that will be published as Baqaee et al. (2023). We thank Dave Donaldson, Beatrice Weder di Mauro, and Jeromin Zettelmeyer for useful comments. Benjamin Moll acknowledges support from the Leverhulme Trust and the European Union's Horizon 2020 research and innovation programme (grant agreement No. 865227). Feodora Teti gratefully acknowledges support received from the German Research Foundation through CRC TRR 190 (project number 280092119). Moritz Schularick gratefully acknowledges support from the German Research Foundation through his Leibniz-Prize. The views expressed in this paper are those of the authors and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

[1]UCLA, CEPR, & NBER. [2] Bielefeld University, Kiel Institute for the World Economy. [3] London School of Economics & CEPR. [4] Kiel Institute for the World Economy, Sciences Po & CEPR. [5] ifo Institute for Economic Research, University of Munich & CESifo. [6] University of Würzburg, Kiel Institute for the World Economy & CESifo. [7] International Monetary Fund.

1 Introduction

Growing trade and financial integration have been a hallmark of the post-Cold War globalization era. In the past 20 years, China's meteoric economic rise has pushed global trade interdependencies to hitherto unknown levels. Since its WTO accession in 2001, China has become the world's top manufacturer not only of final goods, but also of intermediate manufactured goods (e.g. Baldwin et al., 2023), giving the country a prominent place in global supply chains. China is the most important trading partner for about 120 countries, among them Germany, Europe's biggest economy. Germany, with its large industrial sector, in particular its large automotive and chemical manufacturing industry, has found in China an important export market that has propelled the growth of German industry. At the same time, German households and firms now import consumer goods and intermediate inputs worth close to 5% of German GDP from China.

This paper seeks to explore the economic effects of a forced reversal of this trend in the form of a very hard decoupling between China and Germany. Our paper studies a hypothetical scenario akin to a "Cold War 2.0", i.e., a disintegration or fragmentation of the world economy into three distinct blocs: the G7 or "Western" economics, China and her allies, as well as neutral countries. Moreover, within this framework, we examine an extreme case: a complete cessation of trade between Germany (as well as the rest of the G7 economies and their allies) and China (and Russia). Following a hard decoupling, international trade will be entirely reoriented towards trade within the two rival blocks and between the two blocks and the neutral countries.

We are aware of the hypothetical and extreme nature of a scenario where trade between the two "cold war" blocks goes to zero, but the insights gained from this analysis offer valuable perspectives on the economic forces at play. Moreover, by examining such an extreme scenario, we aim to delineate the boundaries of possible outcomes and provide a worst case perspective on the issue. We do not speculate on what events might trigger such a hard decoupling, nor do we take a stance that this is a likely or desirable outcome.

The insights derived in this paper will come from a recent model of the global economy with many countries, sectors, and complex international production networks. This model is the Baqaee and Farhi (2021) model which has demonstrated its usefulness last year when it was used to gauge the impact of an end of Russian gas supplies to Germany (Bachmann et al., 2022; Moll et al., 2023). In our setup, the model features 43 countries in the three blocks: a block of G7 countries and their allies and a Chinese block, as well as a "rest-of-the-world" block that belongs to neither. There are 56 sectors with production interlinkages across sectors and countries. These production interdependencies are disciplined with empirical input-output matrices from the World Input-Output Database (Timmer et al., 2015).

Our main focus is on the economic costs to Germany measured by the fall in Gross National Expenditure (GNE), which is the welfare-relevant quantity in many macroeconomic and trade models including the Baqaee-Farhi model. GNE, also known as "domestic absorption," is the economy's total expenditure defined as the sum of household expenditure, government expenditure and investment, that is $GNE = C + I + G$ in the GDP accounting identity $GDP = C + I + G + X - M$. One reason for focusing on GNE rather than GDP is that GDP may not pick up terms-of-trade effects that arise following a trade shock like the decoupling scenario we consider. While GNE differs conceptually from GDP, for an economy like Germany's, its total value is similar to the more familiar GDP quantity.[1]

Our first key result is that in the event of an abrupt "cold turkey" decoupling scenario, Germany is likely to experience a GNE loss of approximately 5% on impact in the first few months and 4% over the horizon of one year. The Baqaee and Farhi (2021) model does not incorporate standard short run business cycle amplification effects, e.g. Keynesian aggregate demand amplification in the presence of nominal rigidities, so the corresponding economic costs need to be added on top.[2] With more time to adjust, for instance over a time horizon of three years during which trade and production are reorganized, the decoupling cost would drop to around 2%. In the long run, the German welfare loss from no longer being able to trade with China would be about 1.5% of GNE. From a macroeconomic standpoint, these are severe costs, reflecting China's importance in German and global trade. In the short run, they compare to the GDP falls witnessed in the global financial crisis and during the Covid pandemic. Moreover, part of the costs would be permanent, i.e. German welfare would be lower in every single year going forward. At the same time, while severe, these costs are not devastating and could be managed with appropriate policy (and crises of similar magnitudes have been successfully managed in the past).

It is also clear that for such large changes in the economy's input mix of the type that we are concerned with, natural experiments are rare and uncertainty about the right parameter choices is substantial. It seems plausible to assume, however, that the relevant elasticities of substitution, in particular so-called trade elasticities, are larger in the medium and long run, and smaller in the very short run (the "le Chatelier principle", see e.g. Samuelson,

[1] For example, in 2022, German GNE was around €3.79 trillion (see `https://data.worldbank.org/indicator/NE.DAB.TOTL.CN?locations=DE`) which was around 98% of GDP.

[2] See the discussion in Section 4.2. While quantifying these additional short run amplification effects is beyond the scope of this paper, the 2022 Russian gas cut-off again provides some guidance: analyses using HANK models to quantify these effects increased the cost estimates relative to the analysis from flexible-price models like ours by around 30% (see Bayer et al., 2022, 2023; Pieroni, 2023, and the discussion in Section 4.2) and we are not aware of empirical evidence suggesting higher amplifications effects during this episode. While one cannot simply "transport" such an amplification factor from one model/model simulation to another, a 30% higher short run cost would be 6.5% over the first few months and 5.2% over the first year.

1947, 1983; Milgrom and Roberts, 1996).[3] This time dependence of the elasticities implies that the size of economic losses stemming from a sharp reduction in trade with China depends crucially on the time frame over which adjustments take place and is the key why our model predicts smaller economic costs in the long run than in the short run.

The same time dependence also has a second key implication: a more gradual decoupling in which the trade cut-off occurs over a time horizon of several years leads to considerably smaller overall costs than a "cold turkey" decoupling scenario because it avoids the most extreme short run losses. We illustrate this point with a simple illustrative example in which a full decoupling occurs gradually over a time horizon of three years. The logic is that, in this gradual decoupling scenario, the lowest elasticities that are relevant in the very short run (over the first few months) only apply to a partial trade cut-off (say a cut in trade flows by 5%) rather than to the full cut-off as they do in the abrupt cold-turkey scenario. A related implication is that if, along this gradual decoupling trajectory, an abrupt and full decoupling becomes suddenly dictated by geopolitical events, the economic costs are lower than if firms and households had not started to adjust beforehand.

Note that irrespective of whether decoupling is gradual or abrupt and the elasticities in the model, the scenarios under investigation remain extreme ones: a total decoupling between the "West" and China bringing trade between the two blocks to zero. We are not modelling a "small yard, high fence" de-risking (Sullivan, 2023), but a radical "big yard, high fence" decoupling. By implication, the economic costs of sectoral de-risking policies are likely to be considerably smaller, particularly when introduced gradually. Nevertheless, gradual de-risking policies in critical sectors could likely reduce the costs of a possible subsequent hard decoupling.[4] The logic is again the same as before: in these sectors, a gradual reduction in trade flows would reduce interdependence with China but with the lowest elasticities only applying to a partial trade cut-off, thereby avoiding the largest losses; at the same time, the losses from a subsequent hard decoupling would be lower than if no adjustment had occurred because of reduced interdependence in the most critical sectors.

Taken together, our findings provide a rationale for Western countries to embark on a gradual de-risking trajectory rather than waiting for a much more costly "cold turkey" decoupling dictated by geopolitical events. As noted by Spillner and Wolff (2023) there is often a wide gap between political rhetoric and observed policies and actions by firms.

[3] In the past, we have made the experience that the concept of an "elasticity" is frequently misunderstood by non-economists in the popular debate. For clarity: "elasticity" is the technical term for a particular model parameter that is distinct from the colloquial use of the term (e.g. meaning ability to stretch). For example the "elasticity of substitution" of a production function is a model parameter that governs how substitutable different factors of production are with each other. It is thus incorrect to make statements like "economists assume that markets are elastic" or "the question is whether there is elasticity".

[4] To be clear and as discussed in Section 3.6, we have not conducted any simulations to capture such sectoral de-risking scenarios. So in this part of the paper, we are just thinking through the logic of the model and taking it to its logical conclusion. But we want to be clear that we are unable to make any quantitative statements about the relative costs and benefits of de-risking scenarios at this point.

The logic of our model suggests that the economic costs may ultimately be lower if policy makers start taking systematic actions toward lowering dependence on China now and do so in a targeted way. One can view the relatively low economic costs of gradual de-risking as an insurance premium paid to insure against the possibility of large losses and potential political backlash associated with a hard cold-turkey decoupling.

In this paper we provide a rigorous academic foundation for the debate on the potential economic repercussions of geopolitical and security policy choices if they arise, for instance, in the context of a conflict over Taiwan. In 2022, the debate on Germany's dependence on Russian gas and the economic costs of the end of Russian gas supplies showed that interest groups become powerful players in real-time decision-making processes when uncertainty is high (Moll et al., 2023). That is why this paper aims to explore the key issues *ex ante*, without political decisions being imminent at this point in time. Taking a proactive approach can help to prepare policy makers in Germany and Europe to weigh policy options ahead of time. As in the case of the Russian gas study last year, we will discipline our model simulations with the best available empirical estimates of key parameters and openly discuss the key assumptions and influential modeling choices.

The model features various elasticities of substitution that determine the costs of a decoupling such as cross-sectoral elasticities for final and intermediate goods, and between capital and labor. Importantly, the model features a trade elasticity that determines substitution within each sector across goods from different origins. In line with the importance of this elasticity in the trade literature (e.g. Arkolakis et al., 2012), assumptions about the trade elasticity have the largest impact on our cost estimates. The question here is to which extent trade with other countries can serve as an insurance against a disruption of trade with China – and how quickly trade can be reoriented to other countries. If this elasticity is low, it is hard to find alternatives for Chinese goods and the welfare loss of cutting the trade link with China is high. If the elasticity is higher, substitution is easier and welfare costs are much lower.

Like in the case of the 2022 cut-off from Russian gas, we would expect the economic costs of a China decoupling scenario to be highly heterogeneous across industries, regions within Germany, and individual companies. So-called "cascading effects" along the supply chain did not materialize in the case of the Russian gas cut-off (Moll et al., 2023). In the Chinese case, too, we would expect individual sectors to be heavily affected, but this would not drag down the rest of the economy. We would expect individual companies to pay a higher cost from decoupling but without widespread losses across the rest of the economy.

A more systematic analysis of many of the ideas discussed in this policy paper will ultimately be published in a longer companion paper Baqaee et al. (2023). While this more systematic analysis is still work in progress, we here present those results from this other analysis that we view as robust, e.g. the dependence of the economic cost on the time horizon.

This paper is organized as follows. Section 2 takes a first look at the data, describing China's importance in German imports and exports. Section 3 introduces the model and its calibration with an emphasis on trade elasticity estimates. It then presents the results from a simulation in which the effects of a decoupling are quantified and contrasts the economic costs of an abrupt "cold turkey" decoupling with those of a more gradual decoupling scenario. We discuss caveats in Section 4, before concluding in Section 5.

2 Trade between China and Germany

In 2022 — roughly four decades after the beginning of economic opening — China's GDP accounted for 18.5 percent of the world's total, making it the largest economy in purchasing power parities, and the second largest at market exchange rates (International Monetary Fund, 2023). China's share of global trade increased dramatically since its WTO accession in 2001, and by 2019, it became the world's largest exporter and second-largest importer (World Trade Organization, 2023). The country's large consumer market and its manufacturing industries have increasingly become the workbench of the global economy, deeply integrated into global production networks. At the same time, the build-up of China's industries and the construction boom have fueled economic growth for its trading partners, not least capital goods exporting economies such as Germany. The rise of China as a global economic superpower has been an important driver of Germany's exports in the past two decades.

Germany and the People's Republic of China established diplomatic relations in 1972. Since the economic reforms initiated by Deng Xiaoping, German trade and investment flows have grown substantially. Germany's exports to China have grown from 1.5 billion euros in 1990 to around 100 billion euros in 2022, while its imports from China have grown from little more than 1 billion in 1990 to close to 200 billion in 2022 (Destatis, 2022). In 2022, China was Germany's largest trading partner overall, and its largest import partner and one of the top-5 export markets (Destatis, 2022).

2.1 Imports

In 2019, the last year before the pandemic, China's share in German imports was 7.15%.[5] Taking into account that the share of imports in Gross National Expenditure (GNE) is 32.02% — roughly one third of German income is spent on imported goods — the overall share of imports from China in Gross National Expenditure is about 2.3%.[6] While this is clearly still a macroeconomically relevant number, it is important to see it in the broader

[5]Data from the Eurostat Comext database.
[6]Data on GNE is taken from the World Bank national accounts data, indicator `NE.DAB.TOTL.CN`.

	Sector	Share of China in total sector trade (in %)	Share of total sector trade in GNE (in %)	Share in GNE (in %)
Imports	Animal & Animal Products	3.01	0.67	0.02
	Vegetable Products	1.46	1.08	0.02
	Foodstuffs	1.11	1.09	0.01
	Mineral Products	0.11	2.46	0.00
	Chemicals & Allied Industries	2.73	3.98	0.11
	Plastics / Rubbers	4.90	1.62	0.08
	Raw Hides, Skins, Leather, & Furs	22.65	0.15	0.03
	Wood & Wood Products	3.48	0.82	0.03
	Textiles	14.34	1.41	0.20
	Footwear / Headgear	17.52	0.40	0.07
	Stone / Glass	5.45	0.81	0.04
	Metals	5.92	2.59	0.15
	Machinery / Electrical	13.94	8.20	1.14
	Transportation	1.56	4.30	0.07
	Miscellaneous	13.46	2.18	0.29
	Service	4.98	0.26	0.01
	Total	7.15	32.02	2.29

Table 1: Share of China in German imports in GNE

context of the size of the German economy.[7]

Table 1 shows that China's share in imports varies significantly across different groups of products (second column) and these products' overall importance for the German economy in turn also varies greatly (third column). The groups of products in Table 1 are sections drawn from the so-called Harmonized System, the international standard of names and numbers for the classification of traded goods. The highest Chinese import share can be found in the category "Raw Hides, Skins, Leather, & Furs." Yet overall imports in this category only make up 0.15% of Germany's total expenditure.

The sector with the highest share of trade in total expenditure, as well as imports from China in this sector in terms of GNE, is "Machinery and Electrical goods" at 8.2% of German GNE, and an import share from China of about 14%, resulting in total German expenditures in this category of 1.14% of GNE. Note that this perspective does not allow us to say how easy it will be to substitute these products. Moreover, we will look in greater detail at imports of individual categories of imported metals in Section 4.1, as some imported goods — while having a small share in GNE — may be particularly hard to substitute and an important input for German production.

Figure 1 disaggregates the sectors further, with each dot representing a single product group, with the red bars denoting weighted averages and thus corresponding to the numbers in the second column in Table 1. For some products, China's share in imports

[7]See also figure 9 in the appendix, which shows that the share of imports from China in German GNE has been remarkably stable since about 2010.

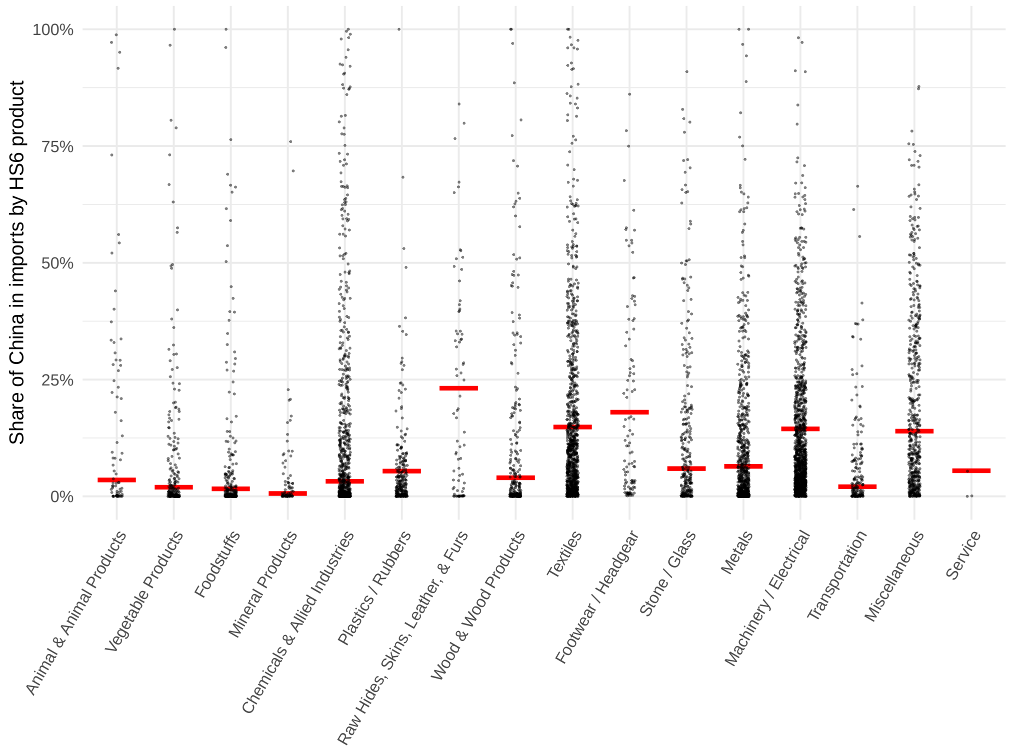

Figure 1: Share of China in German imports by HS section and HS8 code in 2019.

reaches close to 100%, while for most imported goods the share is much more modest.

2.2 Exports

The picture on the export side broadly mirrors that of the import side. Table 2 reports the equivalent breakdown of the share of China in a sector's trade flows, the sector's importance in the overall economy, and the combination of both — China's economic importance in a given sector for the German economy as a whole. Note that we use the same denominator GNE to scale exports for direct comparability to the numbers above.[8]

The overall share of exports to China in total exports stood at roughly 6.7% in 2019, which translates to 2.56% of Germany's GNE. The sectoral composition is somewhat different than on the import side. The most important sectors are "Machinery and Electrical goods", followed by "Transportation" — notably driven by the German car industry — as well as "Chemicals and Allied Industries." China is an important export market for products in these sectors, with up to almost 10% of each total sector exports. But here, too, it is important to note that the smaller shares of these sectors in the overall German economy lead to a smaller macroeconomic footprint. Even for the large automotive and chemical industries, exports to China account for less than 1% of GNE (or GDP), and slightly above

[8]As noted above, in the case of Germany using the actually more applicable indicator of production, GDP, would yields very similar numbers.

	Sector	Share of China in total sector trade (in %)	Share of total sector trade in GNE (in %)	Share in GNE (in %)
Exports	Animal & Animal Products	7.56	0.64	0.05
	Vegetable Products	0.54	0.45	0.00
	Foodstuffs	1.63	1.17	0.02
	Mineral Products	1.03	0.64	0.01
	Chemicals & Allied Industries	4.51	5.27	0.24
	Plastics / Rubbers	4.31	2.24	0.10
	Raw Hides, Skins, Leather, & Furs	3.02	0.10	0.00
	Wood & Wood Products	2.93	0.96	0.03
	Textiles	1.46	1.06	0.02
	Footwear / Headgear	0.44	0.27	0.00
	Stone / Glass	3.64	0.91	0.03
	Metals	4.53	2.88	0.13
	Machinery / Electrical	9.60	11.33	1.09
	Transportation	8.39	6.98	0.59
	Miscellaneous	8.62	2.99	0.26
	Service	2.68	0.20	0.01
	Total	6.72	38.08	2.56

Table 2: Share of China in German exports in GNE

1% for the machinery and electrical goods producing sector.[9]

There is no doubt, as this first look at German-Chinese trade relations shows, that China is a key trading partner for Germany. However, the magnitude of both exports to and imports from China is surprisingly small relative to the size of the German economy. German companies and households bought final and intermediate goods from China equal to 2.3% of total expenditures. Even in the automotive and chemical industries, German exports to China constitute less than 1% of GNE, and about 2.6% in total. The question we address in the following with the help of a quantitative model is what economic effects a hard decoupling, i.e., bringing both imports and exports from China to zero, would entail.

3 Model simulation

In this section, we provide a high-level overview of our quantitative model, a description of how we calibrate the model, and the simulation results showing the economic consequences of a hard decoupling of the German economy from China within the context of a fragmentation of the world economy into three blocks.

[9]See figure 10 in the appendix for the breakdown by product. Again, there is large heterogeneity within individual sectors, but for very few products the Chinese market accounts for 100% of exports.

3.1 Description of the model

Our quantitative results use the model of the world economy in Baqaee and Farhi (2021). We use this multi-sector model to conduct counterfactual simulations of the macroeconomic effects of cutting trade ties with China.

The Baqaee-Farhi model is a multi-sector model with rich input-output linkages. Each producer in each country combines local labor and capital with materials to produce. Materials are purchased from other sectors in the economy, and each sector in each country can source its materials from different countries. Household in each country earn income from local labor and capital, which they use to purchase final consumption goods. In response to the trade disruption, we assume that prices in each market adjust to equate supply and demand.

The model is designed to address questions in which supply chains or production networks play a key role, specifically how a shock to an upstream product propagates downstream along the supply chain. In our set-up the model features 43 countries in three blocks: a block of G7 countries and their allies and a Chinese block, as well as a neutral block with countries that belong to neither. Each country has 56 sectors with production interlinkages across sectors and countries. These production interdependencies are disciplined with empirical input-output matrices from the World Input-Output Database (Timmer et al., 2015). Each entry of the World Input-Output matrix represents a country-sector pair, e.g. how much each sector in Germany spends on inputs from each sector in China.

To calculate the consequences of decoupling, we must make a key assumption about the substitutability between different intermediate inputs in the production process, in particular between imports from China and other inputs. This degree of substitutability is disciplined by various elasticities of substitution. The model features a nested constant elasticity of substitution (CES) structure. Besides the input-output matrices, the key parameters of the model are the elasticities of substitution: σ is the elasticity of substitution across sectors for final goods (56 sectors); θ is the elasticity of substitution across value-added (labor and capital) and intermediate inputs; γ is the elasticity of substitution between labor and capital; η is the elasticity of substitution across intermediate input sectors. Finally, there is a trade elasticity ε that determines substitutability, within each sector, across goods from differing origins.[10]

The degree to which these elasticities matter depends also on the ease of reallocation of resources in the economy. A low elasticity of substitution is less of a problem if resources can be reallocated to reinforce weak links and maintain production in other sectors.

[10]The elasticity of substitution between goods from a given industry across different origin countries is $\varepsilon + 1$. We refer to ε as the trade elasticity (as in the literature, e.g. Costinot and Rodriguez-Clare, 2014). Whereas Baqaee and Farhi (2021) allow the trade elasticity to vary across sectors, we assume that it is identical across sectors and experiment with different values. That is, using the notation of Baqaee and Farhi's Appendix M, we impose that the sectoral elasticities of substitution $\theta_i = \varepsilon + 1$ for all sectors i.

For large changes in the economy's input mix of the type that we are concerned with, there is a considerable degree of uncertainty. It seems plausible to assume, however, that the elasticity of substitution is larger in the medium and long run, and smaller in the very short run (the "le Chatelier principle", see e.g. Samuelson, 1947; Milgrom and Roberts, 1996). The size of economic losses stemming from a sharp reduction in trade with China therefore depends crucially on the time frame over which adjustments take place.

Most of our results focus on economic costs of China decoupling scenarios as measured by the fall in Gross National Expenditure (GNE). GNE, also known as "domestic absorption," is the economy's total expenditure defined as the sum of household expenditure, government expenditure and investment, that is $GNE = C + I + G$ in the GDP accounting identity $GDP = C + I + G + X - M$. GNE (rather than GDP) is the welfare-relevant quantity in many macroeconomic and trade models including the Baqaee-Farhi model. One reason for focussing on GNE rather than GDP is that GDP may not pick up the terms-of-trade effect through which German consumers become poorer when the price of imported goods rises (e.g. Obstfeld and Rogoff, 1995; Mendoza, 1995).[11]

3.2 Trade elasticity

One key parameter for the magnitude of the welfare shocks of decoupling is the trade elasticity ε. It describes how strongly trade flows react to trade cost changes and is linked to the substitutability of goods from different origins. If this elasticity is low in absolute magnitude, it is hard to find alternatives for Chinese goods that are no longer available and the welfare loss of cutting the trade link with China is high. If the elasticity is higher, substitution is easier and welfare costs are lower (see Arkolakis et al., 2012, for an in-depth description of how the trade elasticity is key to the quantification of gains from trade).

For simulating the impact of de-risking from China on the German economy, ideally, we would like to have estimates of an increase in trade costs between China and Germany on trade flows using plausibly exogenous variation for different time horizons, which is unfortunately not available. For the short run, we can draw from recent developments in the literature: Fajgelbaum et al. (2020) find a trade elasticity of 1.5 using the Trump tariffs on China as well as on other trade partners.[12] This number captures the effects over a time horizon of six months to one year. The event-study results of Fajgelbaum et al. (2020) suggest coefficients that are half as large in the very short run. To be extra conservative we

[11]Theoretically the effect is easiest to see in a small open endowment economy with an exogenously given relative price of exports to imports p (which is the country's terms of trade). Real GDP is given by the endowment and therefore not affected by fluctuations in the terms of trade p. However, consumption and welfare decline when the terms of trade p declines, an effect not picked up by real GDP.

[12]In the paper, Fajgelbaum et al. (2020) report -2.5 for $-\sigma$ for the variety-level import response to import tariffs across different countries. Hence, the trade elasticity is $\varepsilon = \sigma - 1 = 1.5$. Sandkamp (2020) finds estimates in a similar ballpark using plausibly exogenous variation as the analysis focuses on the effect on trade between China and the new member states that inherited the EU's anti-dumping regime when acceding the union in 2004.

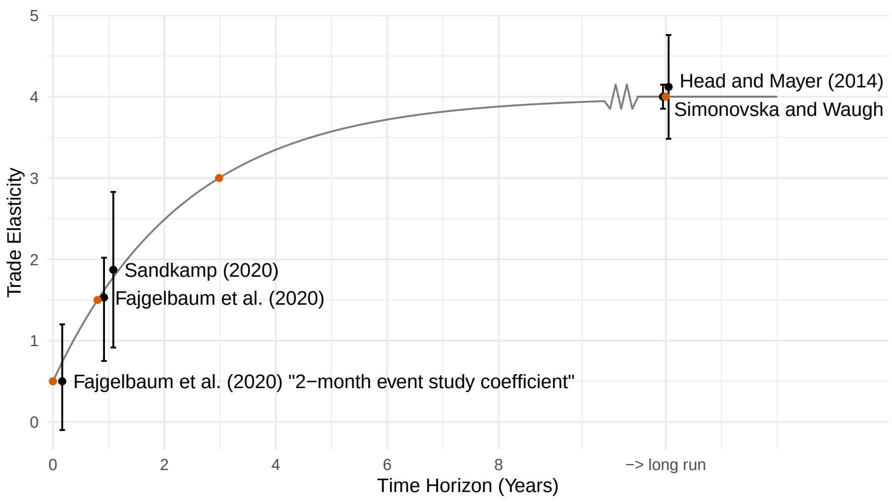

Figure 2: Trade elasticity estimates from literature for different time horizons

Notes: The figure summarizes estimates of the trade elasticity ε. Some papers in the literature do not directly report estimates of ε in which case we convert these estimates to ε. See the text for detail. As expected from the le Chatelier principle, the trade elasticity increases with the time horizon.

assume the trade elasticity in the first few months after the shock to be equal 0.5, rising to 1.5 over the horizon of one year, and to 3 over three years, as shown in Figure 2.

For the long run, we choose a trade elasticity of 4 as suggested by Simonovska and Waugh (2014) as the benchmark value, which is also in line with the results of the meta-analysis performed by Head and Mayer (2014) in their handbook chapter where they report mean and median estimates in the range of 3 to 5. An earlier survey by Anderson and van Wincoop (2004) reports estimates in the literature ranging from 5 to 10. This is also the range that Arkolakis et al. (2012) use in their quantifications. Hence, our choice of the long run trade elasticity is on the conservative end in the sense that it will generate higher estimates of welfare losses.

Figure 2 summarizes the trade elasticity estimates from the literature and how these vary with the time horizon. The figure includes 95% confidence intervals reported in the corresponding papers to illustrate the statistical uncertainty inherent in these estimates. The black solid line fits an illustrative curve through these estimates to construct a mapping from time horizon to trade elasticity. The red dots on the line are the trade elasticities we will use in our main simulation results with values ranging from 0.5 to 4.[13]

In addition to the lowest realistic value used here, we also report results for extremely low trade elasticities of 0.1 and 0.25. We are unaware of any empirical foundation for

[13]As can be seen in the figure, there is scant empirical evidence on trade elasticities for intermediate time horizons above two years which means that alternative mappings from time horizon to elasticities are possible as well. In particular the trade elasticity may converge to its long-run value more slowly, say it may reach $\varepsilon = 3$ after five years rather than three years. As is evident from Figures 3 and 6 this would not affect our main results much.

such low values, but they might still serve a useful purpose as a defence against possible "this time is different" arguments. We will see that such extremely low hypothetical trade elasticities aggravate the costs by another 1 p.p., but they do not lead to extreme losses.

3.3 Data sources and key parameters

As mentioned, the model is disciplined by the World Input-Output Database (2016 release), i.e., the most recent version of the data set. It includes information on final goods expenditure, intermediate goods expenditure, value-added, and factor income for 43 countries and 56 sectors from the year 2000 to 2014. We designate the year 2014 as the steady state of the model and calibrate the shares of final expenditure, intermediate input, value-added, and factors for each country. These calibrated shares serve as inputs to calculate the standard form input-output matrix, following the methodology outlined in Baqaee and Farhi (2021). Subsequently, this matrix is reordered and aggregated based on the country blocks described below.

It is worth noting that an empirically-disciplined multi-sector model like the Baqaee-Farhi model reflects an important feature of modern advanced economies: manufacturing typically accounts for a moderate share of aggregate economic activity. This is true even for Germany which is often viewed as an industrial powerhouse: German manufacturing accounts for "only" about 23% of total employment and 25% of value added. This is a natural consequence of the structural transformation process during which manufacturing activity is replaced by the service sector. Put differently, some observers seem to be under the mistaken impression that the structure of the German economy is still that of earlier time periods like the 1970s.

All 43 countries are categorized into three blocks: Friends, Rivals, and Neutrals. Firstly, the Friends block includes the G7 countries (Canada, Germany, France, the United Kingdom, Italy, Japan, and the United States), two large economies in the EU (Spain and the Netherlands), and one composite country that aggregates the remaining 22 EU countries in the sample. This totals 10 countries, representing 54% of the world GDP in 2014. Secondly, the Rivals block includes China and Russia, accounting for 15% of world GDP. Lastly, the neutral block comprises the remaining 11 countries in the sample, including the rest of the world as one composite country. We set the elasticities of substitution to $(\sigma, \theta, \gamma, \eta) = (0.9, 0.5, 1, 0.2)$, following the literature in Baqaee and Farhi (2021) and Atalay (2017), but test the robustness of our key results to more extreme parameters, specifically $(\sigma, \theta, \gamma, \eta) = (0.01, 0.01, 0.01, 0.01)$.

3.4 Key results

In all simulations, we assume prohibitively high trade costs between members of the Friends block and members of the Rivals block, so that trade flows between the two blocks

Trade Elasticity	Benchmark Parameters	Very Low Elasticities
$\varepsilon = 0.5$	-5.00%	-5.83%
$\varepsilon = 1.5$	-2.97%	-3.32%
$\varepsilon = 3$	-1.65%	-1.78%
$\varepsilon = 4$	-1.26%	-1.34%
$\varepsilon = 0.1$	-5.92%	-6.15%
$\varepsilon = 0.25$	-5.62%	-6.38%

Table 3: Cold turkey decoupling: GNE change for different trade elasticities

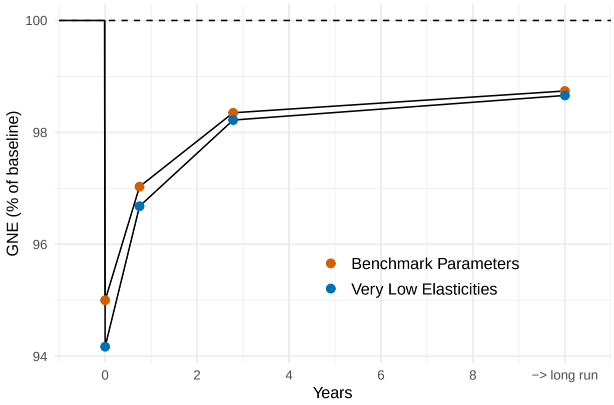

Figure 3: Cold turkey decoupling over time

Notes: Table 3 reports simulation results from the Baqaee and Farhi (2021) model for the economic costs to Germany of a cold turkey decoupling scenario (as described in the text) for different values of the trade elasticity ε. The first column labeled "Benchmark parameters" uses the benchmark values for the model's other elasticities from Baqaee and Farhi (2021) whereas the column labeled "Very Low Elasticities" uses the extreme paramterization described in Section 3.3 to probe robustness. Figure 3 uses the mapping from time horizon to trade elasticities in Figure 2 to provide an illustration of the likely time path of such a de-coupling scenario. Because the trade elasticity increases with the time horizon (le Chatelier principle), the economic costs decrease with time.

drop to zero. Other trade costs are left unaltered and trade flows within the blocks, as well as with the Neutral block will endogenously adjust.

Table 3 summarizes the German welfare losses in response to the full decoupling for a range of long run to extremely short run trade elasticities which we will now in turn discuss in detail.

As discussed in Section 3.3, plausible magnitudes of the trade elasticity crucially depend on the time horizon considered. By running our simulation with different short-run and long-run elasticities, we obtain estimates for the welfare effects over different horizons.

We begin with an extremely low trade elasticity of 0.5 for the very short run that is even lower than the elasticity that empirical studies found over 2-months horizons in the case of the Trump tariffs (Fajgelbaum et al., 2020). We consider this a conservative value even in the very short run over the period of one quarter. In this case, the German welfare loss amounts to 5.0%, rising to 5.8% if we also set the other elasticities in the model to very low levels. Lowering the trade elasticity even further to 0.25 (and the time frame of our consideration hence to the extreme short run) only adds comparatively minor additional welfare losses and puts the total loss to 5.6%. Finally, we consider an extreme case in which we put the trade elasticity close to zero, specifically to 0.1. We don't consider this value to be a realistic one even in the very short run, but see it as a useful worst-case scenario to put an upper bound to the welfare losses. Even such an extreme value does no longer substantially change the welfare loss estimate: It rises by an additional 0.3

percentage points to -5.9%.

Over the important horizon of 1 year, we consider an elasticity of 1.5 as conservative. In this case, the German welfare loss of decoupling amounts to 3-4% depending on the other parameters. Compared to other countries, this is at the high end of damages in the Friends block, but below the losses experienced by China (4.8%) and Russia (12.3%). It is important to stress that in any scenario we study, the losses are larger for China and her allies.

Figure 3 summarizes these model simulations for different trade elasticities and shows the economic costs of a de-coupling scenario over time. As already mentioned, a key idea in economics is that elasticities increase with the time horizon (le Chatelier principle). As illustrated in Figure 2, this also applies to trade elasticities which increase substantially over time. We can use this idea to convert the results in Table 3 into the time dimension and trace out the economic costs for Germany of a cold turkey decoupling from China over time. In the very short run, when the trade elasticity is low, German GNE drops by around 5% in the first few months, and 3-4% in the first year, with business cycle amplification effects coming on top.

For the new long run steady-state results, which characterizes a world with three blocks, we assume a trade elasticity of four. As the trade elasticity increases, the economic costs become more muted before settling at a permanent GNE loss. We estimate a permanent welfare loss of 1.26% in response to both losing access to an export market and the opportunity to source any products from the Rivals block. This is at the high end of the losses incurred by Friends countries, as Germany is particularly strongly integrated with the Rivals block. In Europe, only the Netherlands experiences a loss of larger magnitude, while the losses of all other European countries range between 0.47% and 0.69%. The North American Friends countries lose 0.51% (USA) and 0.86% (Canada). The only other country in the Friends block that suffers in the same magnitude with Germany in this scenario is Japan (1.24% loss) due to its proximity and resulting strong pre-shock integration with China. While our focus lies on the effects in Germany specifically and the Friends countries more generally, it is worth noting that China and Russia are affected much more severely and face welfare losses of 2.05 and 4.94%, respectively. The higher welfare losses for the Rivals block are intuitive, as a much larger share of their international trade relations is affected due to the large economic size of the Friends block.

Figures 4 and 5 illustrate the global trade adjustments in the long run. Initially (see Figure 4), the largest share of international trade takes place within the Friends block, followed by trade between the Friends and the Neutrals block. As the Rivals block is the smallest of the three, trade flows between Friends and Rivals are also of a smaller magnitude: Friends export seven to eight times more to other Friends than to Rivals and import almost five times more from other Friends than from Rivals. Nevertheless, at about 2.5% of global

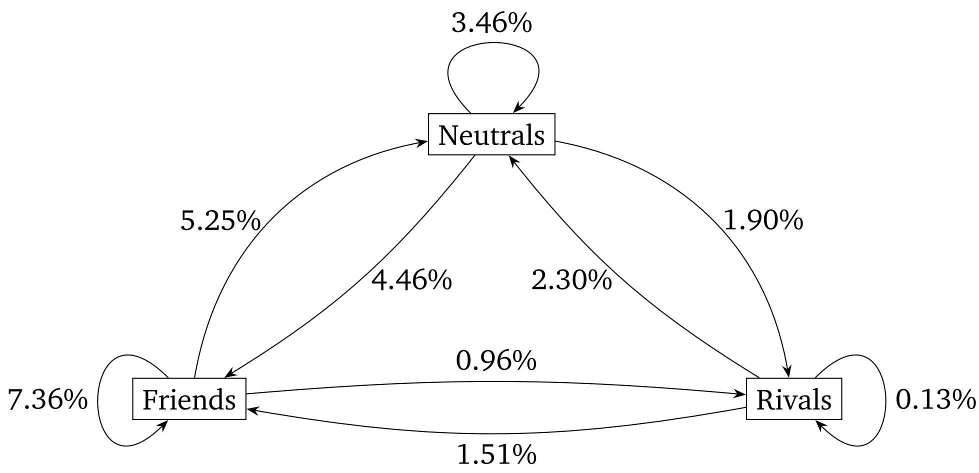

Figure 4: Trade flows among friends, rivals, and neutrals (in % of global GDP).

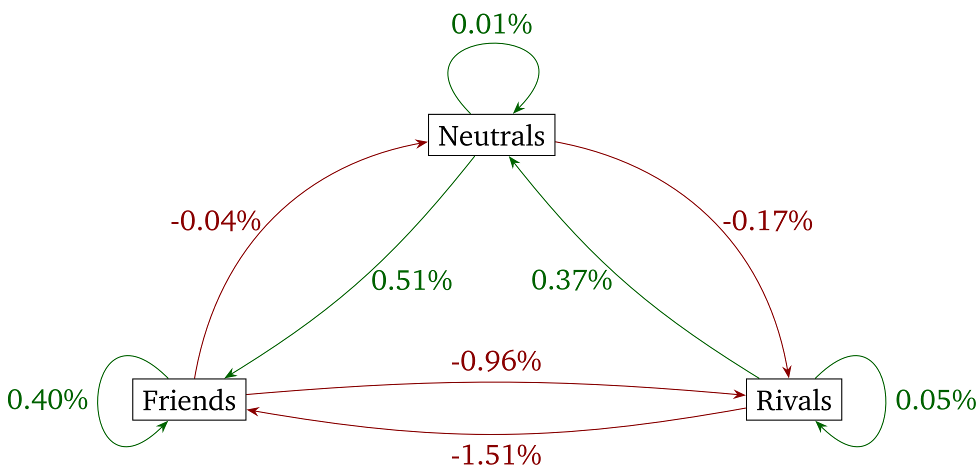

Figure 5: Change in trade flows among friends, rivals, and neutrals (in % of global GDP).

GDP, total trade between the Friends and Rivals block is non-negligible. As expected, in response to the decoupling (see Figure 5), the largest change happens in trade between Trade and Rivals, as it drops to zero. Both Friends and Rivals react by increasing trade within their blocks. They also both trade more with the Neutrals block, though in an asymmetric fashion, with Friends increasing im- and lowering exports and Rivals lowering im- and increasing exports. This asymmetry reflects the intital trade imbalance between the Friends and Rivals block: Prior to decoupling, Friends import more from than they export to the Rivals. Hence, in response to the shock, Friends primarily look for new partners to source from, while Rivals primarily look for new markets to serve.

To gain further insight into the welfare effects, we make use of a decomposition proposed by Baqaee and Farhi (2021). They decompose the total welfare change into a "technology effect" and a "reallocation effect". The former isolates the welfare effects due to the changes in imported materials while otherwise keeping the allocation in the economy constant, while the latter quantifies the effects of reallocating productive resources across producers for given technology and imported materials. The reallocation effect hence captures whether the factoral terms-of-trade change in or against the country's favor. We find that the technology effect (-0.96%) explains about three quarters of the overall welfare loss and the reallocation effect (-0.30%) contributes the remaining fourth quarter.

3.5 Discussion of magnitude

Our simulation results suggest that German welfare costs of decoupling fall in the range of 1.3% in the long run and potentially up to more than 5% in the very short run. The numbers beg the question: Are these large welfare costs?

Since WW II, the German economy shrank in only eight years (1967, 1975, 1982, 1993, 2002, 2003, 2009, 2020).[14,15] In all these cases except the two most recent ones, GDP dropped by only 1% (1993) or less (all other cases). Hence, even our lower, long run, estimate implies losses that are stronger than in the third-strongest recession the Federal Republic of Germany ever went through. These are severe costs. Also, unlike typical business cycle movements, a decoupling from China implies a permanent downward shift of welfare.

Our estimated welfare loss over the horizon of one year of 3-4% ranges at a magnitude similar to the Covid recession of 2020 (-3.7%). For comparison, Dhingra and Sampson (2022) in their survey article on Brexit conclude that in the three years from the Brexit vote till 2019, it reduced British GDP by 2-3%. As this is also a medium run assessment, our results suggest that the economic effects of a China decoupling in Germany may be of comparable magnitude to the economic effects of Brexit in the UK.

Finally, in the very short run the low trade elasticity consideration leads to a welfare loss (-5% to -5.9%) in the first few months that is approximately as strong as in the deepest recession Germany has experienced on an annual basis, namely the Great Recession induced by the Global Financial Crisis in 2008/09 (-5.7%). A hard decoupling of China would likely lead to a deep recession comparable to the experience in 2008/09.

3.6 Cold turkey decoupling vs. gradual decoupling

How important is the time horizon over which such decoupling takes place? To answer this question, we can simulate a number of such alternative scenarios. These will ultimately be presented and analyzed more systematically in the scientific version of this policy paper (Baqaee et al., 2023). In the meantime, preliminary results using this approach suggest

[14] See German Council of Economic Experts (2023).

[15] It is also projected to shrink slightly in 2023 (see European Commission, 2023).

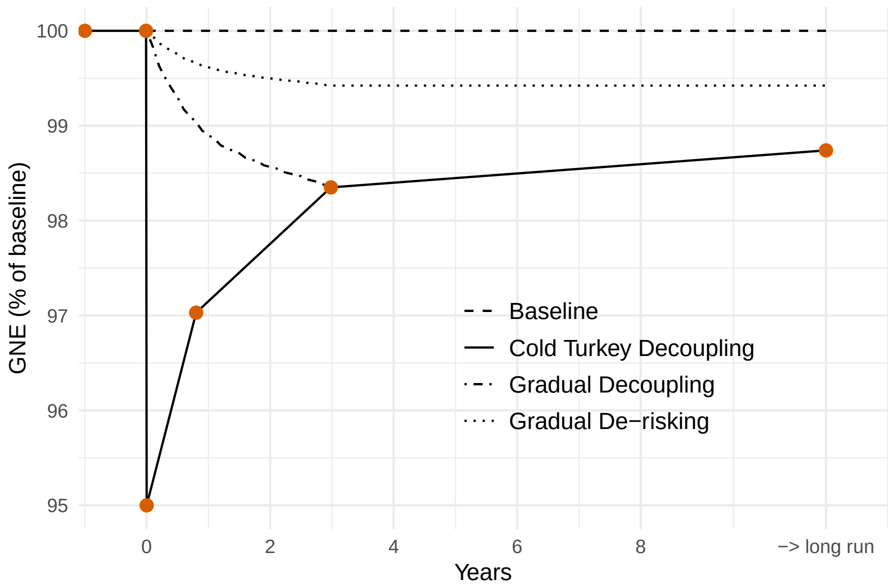

Figure 6: Cold turkey decoupling vs. gradual decoupling vs. gradual de-risking

that the time horizon is very important and that a gradual decoupling scenario is likely considerably less costly than an immediate cold turkey decoupling. This result is closely linked to the important idea of the le Chatelier principle that elasticities increase with the time horizon which applies, in particular, to the trade elasticity (see the empirical evidence in Section 3.2).

To illustrate the importance of the time horizon, Figure 6 shows the economic costs of a sudden decoupling over time (again linking the different levels of the trade elasticity considered to the different time horizons, as in Figure 2 above) and contrasts this cost path to an alternative decoupling scenario, in which the decoupling takes place more gradually over a time horizon of three years. The abrupt decoupling is illustrated by the solid line in the figure, with the red dots referring to the specific selected choices of trade elasticities discussed above. The gradual decoupling alternative is illustrated by the dotted line in Figure 6.

Matching the previous discussion, the costs of abrupt decoupling are potentially severe in the very short run, but fade considerably once the economy has had a few years time to adjust to the new situation. Importantly, however, the losses never fade completely, but stabilize at the long run value of 1.3% that we identified using the long run elasticity of 4. The sharp short term reaction to decoupling is driven by the assumption that in the short run, substitution between inputs from different source countries is very difficult. It is therefore the suddenness of the shock that drives the worst effects.

In line with this intuition, we see a very different time path of the economic costs if we consider a gradual decoupling that reduces trade with the Rivals block to zero in small steps over a span of 3 years, rather than immediately stopping any trade. In such a gradual decoupling scenario, the deep initial GNE drop can be avoided, while the losses then converge to the ones obtained for the sudden policy scenario. Hence, while gradual decoupling ends up at the same new long run equilibrium and hence the same permanent GNE losses, it reaches this new equilibrium at a much lower cumulative cost by allowing some trade to still take place in a transition period.

Our model can also be used to simulate the effects of alternative intermediate scenarios. One instructive scenario is that the Western and Chinese blocs are on a gradual decoupling trajectory of the type just discussed but then experience a cold-turkey decoupling starting from a position of partially severed trade flows. For example, suppose that halfway through a gradual decoupling, a full decoupling suddenly becomes dictated by geopolitical events (so after 1.5 years in the 3-year decoupling example we just discussed). While we do not show such a scenario in Figure 6, it is clear from the logic of the figure that the corresponding costs will be between that of the two scenarios shown there. This means, in particular, that the welfare losses from a cold-turkey decoupling which follows a period of adjustment during which trade routes and supply chains are re-organized are lower than the losses from a cold-turkey decoupling that follows a period in which no adjustment took place ("business as usual").

Throughout this paper, we have considered hard decoupling scenario in which trade between the Western and Chinese blocs drops to zero (either immediately or over several years as in this subsection). Of course, most options on the table for policy makers are considerably less extreme. For example U.S. policy makers often describe their approach as "small yard, high fence" (Sullivan, 2023) to emphasize that trade restrictions are "carefully tailored" toward specific sectors or products such as advanced semiconductor technology exports to China. Our model can in principle also be used to analyze such more targeted "de-risking" scenarios. Naturally, such less extreme scenarios would have smaller economic costs for the German economy than the hard decoupling scenarios analyzed here. That is, our scenario should be interpreted as worst-case scenario that allows us to bound the costs of alternative and less extreme de-risking scenarios.

The same logic regarding the dependence of decoupling costs on the time horizon also applies to less extreme de-risking scenarios. To illustrate both these points, Figure 6 also shows the stylized path in a hypothetical gradual de-risking scenario. While we have not conducted model simulations to quantify such de-risking policies, the key takeaways are that the costs would be (a) smaller than those of a hard decoupling scenario and (b) smaller if the de-risking is gradual rather than cold-turkey. However, it is also clear that also gradual de-risking has a price.

Taking the model's logic one step further, gradual de-risking policies in critical sectors may have the potential to substantially reduce the costs of a possible subsequent hard decoupling. In these sectors, a gradual reduction in trade flows would reduce interdependence with China but with the lowest elasticities only applying to a partial trade cut-off, thereby avoiding the largest losses; at the same time, the losses from a subsequent hard decoupling would be lower than if no adjustment had occurred because of reduced interdependence in the most critical sectors.

Note that while these qualitative statements follow relatively directly from the logic of our model, in particular the time-dependence of elasticities, their quantitative counterparts are an open question because we have not simulated the corresponding scenarios. That is, an important question for future work is *how much* various gradual de-risking scenarios would reduce the costs of a possible subsequent cold-turkey decoupling and at what economic costs.

4 Caveats

In the following section, we examine a number of potential caveats to the simulation results. While these results suggest severe but not devastating impacts of a hard decoupling on the German economy, certain subtleties and dimensions remain outside the scope of the model due to aggregation and abstraction.

Specifically, we focus on four key caveats that could magnify the impact: strategic raw material imports from China, which are integral to numerous German industries; short run business cycle amplification; long run effects on investment and capital accumulation; and finally the implications for German Foreign Direct Investment (FDI) in China, a cornerstone of economic interdependence between the two nations.

4.1 Strategic raw materials

While most goods and services can be substituted in the long run, raw materials pose a unique challenge due to their inherent scarcity as natural resources. Germany heavily relies on specific raw materials crucial to key industries and shortages of these materials could significantly disrupt the economy. For instance, when China restricted magnesium exports in 2021 — an essential component for aluminum production — it raised concerns within the German automotive and aviation industries.[16] Given China's significant role in the market for raw materials, when evaluating the costs of decoupling from China, it is important to consider this mechanism as well as the fact that the sector-aggregation of our model is too aggregated to capture it.

We will next analyze how dependent Germany is on China with respect to the supply of raw materials. To identify the relevant raw materials, we adopt the European Commission's

[16] https://www.politico.eu/article/eu-leaders-alarm-china-magnesium-crunch/

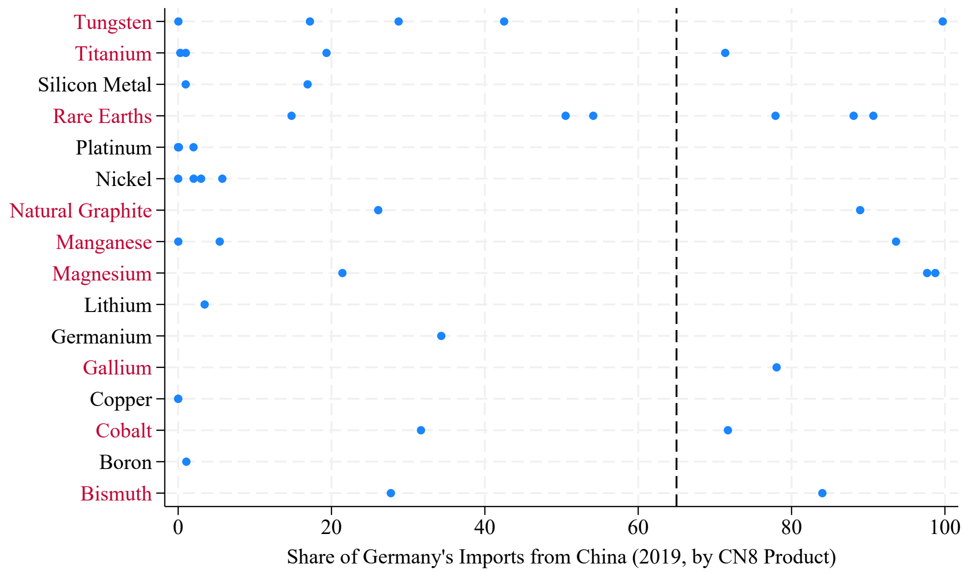

Figure 7: Germany's imports of raw materials from China (in %)

definition, focusing on the sixteen critical raw materials outlined in the EU Raw Material Act (52018PC0368, Annex 1). These raw materials are deemed critical due to their pivotal role in key technologies and strategic industries such as defense while facing a high supply risk, often due to a highly concentrated supplier market. The listed critical raw materials include Bismuth, Boron, Cobalt, Copper, Gallium, Germanium, Lithium, Magnesium, Manganese, Natural Graphite, Nickel, Platinum, Rare Earths, Silicon Metal, Titanium, and Tungsten.

To understand Germany's exposure to China, we look at the share of Germany's imports from China of total imports for the respective raw materials. To do so, we use data on imports from Eurostat's Comext database and map the CN8 product codes to the raw materials using the concordance proposed by the factsheets provided by SCRREEN.[17] In Figure 7, every dot corresponds to one CN8 product. We define dependency on China to be high whenever the import share is higher than 65%.

Several notable facts emerge: First, Germany exhibits high dependency on nine out of sixteen critical raw materials. Second, among these nine, five materials — Titanium, Natural Graphite, Manganese, Cobalt, and Bismuth — offer relatively manageable substitution options due to the availability of alternative suppliers. Third, the automotive and high-tech sectors, particularly reliant on the four critical raw materials (Gallium, Magnesium, Rare Earths, and Tungsten) with high dependency on China and little potential for short-run substitutability from other source countries due to China's dominant role in worldwide

[17] `https://scrreen.eu/crms-2023/`

production, face considerable risk when decoupling from China.[18] However, it is once again important to see even these large sectors in relation to the total German economy. E.g., the automotive industry accounts for around 5% of German GDP. Even if we were to significantly underestimate the burden put on this sector by decoupling, this is unlikely to alter the general magnitude of German welfare losses we quantified in Section 3.

As in the Russian gas cut-off of 2022, in a scenario of a sudden lack of these important and rare raw materials alternatives would likely materialize — albeit with some time lag. Recently discovered deposits of rare earths in Sweden have been heralded as a potential solution for a more diversified sourcing portfolio for Western economies.[19] Even in a pre-crisis setting, the mine operator and independent researchers suggested a time frame between 10 and 15 years to develop a fully-operational facility. However, the 2022 Russian gas cut-off has shown that in crisis times mitigation strategies often accelerate these processes: new terminals for liquefied natural gas (LNG), which had been planned for years and were forecast to take years to go online were built in just a few months time.[20] It appears likely that in a crisis scenario where certain raw materials are suddenly in short supply, alternative sourcing options would also become available sooner than current planning suggests.

We conclude this section by discussing a case studies that sheds light on how an economy was able to adjust to a shortage of a strategic raw material of the type discussed in this section: the Chinese Rare Earth embargo against Japan in 2010.[21]

In 2010 China effectively implemented an export embargo on rare earths against Japan. Superficially, this resembled a textbook example of effective sanctions: China was virtually the sole supplier of rare earths, while these were an important input for Japanese industry.[22] As noted by Gholz and Hughes (2021), in the short run, Japanese firms reduced demand both at the intensive and extensive margin: Firms that crucially needed rare earths in their input came up with ways to use raw material more effectively, thus pushing the technology frontier outwards. For example, glass manufacturing companies

[18] Information on the production as well as use of raw materials comes from SCREEN, available through `https://scrreen.eu/crms-2023/`

[19] See, e.g., https://www.dw.com/en/explainer-what-the-rare-earths-find-in-sweden-might-mean-for-the-eu/a-64375644.

[20] See, e.g., https://www.berliner-zeitung.de/wirtschaft-verantwortung/statt-in-acht-jahren-leitung-fuer-erstes-lng-terminal-in-rekordzeit-fertiggebaut-li.296981 which cites industry sources that under usual circumstances the construction of the first LNG terminal in Wilhelmshaven that was opened in December 2023, only 4 months after the final cut-off from Russian gas, "would have taken six to eight years from planning to operations."

[21] This example is taken from an online appendix to Bachmann et al. (2022) available at `https://benjaminmoll.com/RussianGas_Substitution/` which also includes other case studies regarding economies' ability to substitute in the face of adversity. Also see the 36 cases studies in the appendix of Moll et al. (2023) describing how German firms and households substituted natural gas and gas-intensive products in the aftermath of the 2022 cut-off from Russian gas.

[22] Some authors argue that the embargo was not fully effective, see e.g. Johnston (2013). However, the embargo seems to have triggered some substitution by Japanese firms so it arguably must have been effective to some extent.

started recycling cerium polish, which requires the eponymous rare earth mineral. Other firms such as headphone manufacturers that previously bought rare earths due to its low cost — rather than to them being critical for the production process — substituted away completely. In the medium to long term, Japanese firms were working on technological innovations which, too, either reduce usage of rare earths or enable substitution with different materials. Reductions on the consumer side, such as post-consumption recycling, appear to play a lesser role due to practical difficulties. On the supply side, it took two years until alternative producers entered the market, even though investments for these projects had started long prior to the embargo. The Japanese government subsequently supported one of the firms via a long-term supply contract, which ensured its survival amidst price fluctuations in the years after the embargo subsided. Overall, the economic costs of the Chinese rare earths embargo for the Japanese economy were relatively muted.

4.2 Short run business cycle amplification

The Baqaee and Farhi (2021) model is a real model with no further business cycle amplification and therefore omits some of the channels through which a large trade shock may affect the economy. In particular, the model omits standard Keynesian demand-side effects in the presence of nominal rigidities as well as amplification effects due to financial frictions. As we explain now, these may be particularly relevant in the short run and therefore for the cold turkey decoupling scenario but relatively less so for the gradual decoupling scenario, therefore further strengthening our argument that a gradual decoupling has much lower economic costs.

To be clear, our flexible-price model does include what many lay people would call "demand side effects", namely that increasing consumer prices of goods previously imported from China erode purchasing power and consumer welfare. But it omits the feedback from the drop in aggregate consumption to production and employment: rising prices of goods previously imported from China drag down consumer spending and this feeds back into production and employment which further drags down consumption, and so on.

This important mechanism is operational in standard macroeconomic models with nominal rigidities that are consistent with empirical evidence on household consumption behavior, in particular Heterogeneous Agent New Keynesian (HANK) models consistent with the large observed marginal propensities to consume. See for example Bayer et al. (2022), Bayer et al. (2023), Pieroni (2023), and Auclert et al. (2023) for analyses emphasizing this mechanism in the context of rising energy prices (e.g. following the 2022 cut-off of Germany from Russian gas).

Particularly in the case of a full and immediate cold-turkey decoupling, we would expect such amplification effects to be potent. Given that the model omits such effects, the model-implied short run GNE losses in this scenario of around 5% are therefore likely an underestimate of the true effect. Analyses of such effects for the case of the energy crisis have shown that such effects can amplify the effects substantially, for example increasing GNE losses from around 2.3% to around 3%, i.e. by around 30% (Bayer et al., 2022; Pieroni, 2023). Applying a similar 30% amplification factor to the short run GNE losses in the short run decoupling scenario, would increase these from 5% to 6.5% – a very substantial economic cost, but still not catastrophic.

In the case of the gradual decoupling scenario discussed in Section 3.6 such effects are likely more muted. This further strengthens the argument that the economic losses from a gradual decoupling strategy are considerably smaller than those from an immediate cold-turkey event.

4.3 Long run effects on investment and capital accumulation

Given that the Baqaee and Farhi (2021) model is a static model, another omission from our analysis are the standard long run effects on investment and capital accumulation (like in a neoclassical growth model). Alvarez (2017) and Kleinman et al. (2023) show how to incorporate capital accumulation into quantitative trade models of the type used here in a tractable fashion and the latter paper also analyzes a U.S.-China decoupling scenario. While they find that modeling capital accumulation changes various model predictions in interesting ways, they do not find that capital accumulation drastically amplifies the long run effects of policy counterfactuals relative to static models. In line with this result is the standard result from the neoclassical growth model that capital accumulation amplifies productivity changes by a factor of $1/(1-\alpha)$, where α is the capital share which typically takes values of around $1/3$ so that $1/(1-\alpha) = 1.5$.[23] Applying this factor to the long run GNE losses of 1.26% yields 1.89%. We are thus relatively confident that, even taking into account the effects on investment and capital accumulation, the long run welfare losses from decoupling would remain below 2% of GNE. We plan to explore these issues in more detail in the scientific version of this paper (Baqaee et al., 2023).

4.4 Foreign direct investment

China and Germany are not only linked through trade, as in the past years companies from both countries have increasingly invested in the other economy. In 2019, German firms held FDI stock worth about 90 bn Euros, whereas Chinese-owned FDI stock in Germany

[23]Consider a neoclassical growth model with production function $Y = AK^{\alpha}L^{1-\alpha}$ where A is productivity, K is capital, L is labor, and α is the capital share. Then the steady state value of the capital stock is $K^* = \left(\frac{\alpha A}{\rho+\delta}\right)^{\frac{1}{1-\alpha}}$ where ρ is the discount rate and δ is the depreciation rate. It follows that steady state production $Y^* = A(K^*)^{\alpha}L^{1-\alpha}$ and consumption $C^* = Y^* - \delta K^*$ are both proportional to $A^{\frac{1}{1-\alpha}}$ meaning that any percentage change in productivity A is amplified by a factor $\frac{1}{1-\alpha}$. The final step in the argument is that gains and losses from trade effectively show up in economy-wide productivity (e.g. Alvarez, 2017).

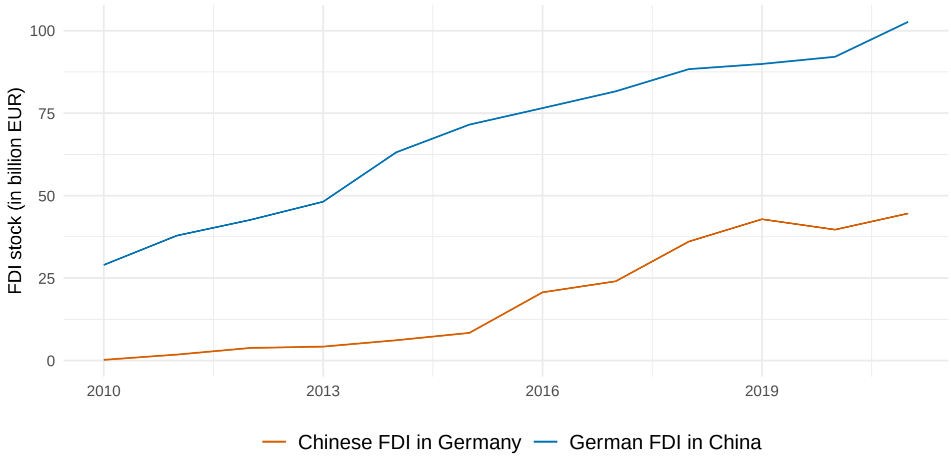

Figure 8: Bilateral FDI stock between Germany and China over time.

stood at about 43 bn Euros.[24] Figure 8 shows that since 2010, both economies have seen a persistent increase in bilateral FDI, with German FDI in China being about twice as high as vice-versa.

Table 4 breaks down these stocks by broad sectors. As in Tables 1 and 2, once taken into the bigger perspective of its share in the total economy, these seemingly large figures become quite small in terms of shares in GNE. E.g., the German car industry's share of China in its total sector FDI stock is almost a quarter. Taking into account the share of this sector's global FDI stock in total GNE (3.37%), German FDI from the automobile sector in China suddenly looses its overall economic significance, making up just 0.79% of GNE. Total FDI profits reaped by German companies in China stands at 0.44% (Bundesbank, 2023).

In an extreme scenario — as simulated above — where a complete decoupling takes place, one could argue that not only trade would be affected by sudden restrictions, but that also FDI profits could not be repatriated and even FDI stock may have to be written off. In this unlikely scenario, it would also be likely that this action takes place on both sides, i.e. Chinese FDI in Germany would also be confiscated. As the numbers above show, while not insignificant, disrupting investment would also not be catastrophic.

Another way to look at a possible impact of the investment channel is to gauge the significance of the affected German-owned companies in China in a global perspective. Table 5 shows a steady increase in the number of companies, the number of employees of those companies, as well as their annual turnover. Judging these numbers against a global comparison in 2020, where German investors owned more than 40.000 firms outside of Germany, employing more than 8 million workers, and generating an annual turnover of more than 3.1 trillion Euros, these numbers are — again — rather small.

[24] Data from Jungbluth et al. (2023) and Heritage Foundation & American Enterprise Institute (2022).

	Sector	Share of China in total sector FDI (in %)	Share of total sector FDI in GNE (in %)	Share in GNE (in %)
FDI Stock	Chemical Products	9.44	2.88	0.27
	Pharmaceutical Products	4.98	1.14	0.06
	Electromedical Devices	7.94	0.99	0.08
	Electrical Equipment	22.32	0.88	0.20
	Mechanical Engineering	14.27	1.41	0.20
	Automobile and Parts	23.50	3.37	0.79
	Energy Supply	-	1.24	-
	Motor Vehicles Maintenance	-	6.79	-
	Information and Communication	0.60	2.62	0.02
	Banking	2.12	2.21	0.05
	Investment Companies	-	3.06	-
	Insurance, Reinsurance, etc.	1.75	2.33	0.04
	Other Financial Activities	2.83	0.43	0.01
	Real Estate	1.14	1.69	0.02
	Company Management	0.01	2.28	0.00
	Other Services	1.52	0.92	0.01
	Total	6.47	42.43	2.74

Table 4: Share of China in German FDI stocks and profits in GNE in 2019

	2010	2015	2020
Number of companies	1,451	2,096	2,394
Employees (in thousands)	463	706	750
Annual turnover (in million Euros)	122,615	264,752	330,868

Source: Data from Deutsche Bundesbank & Bertelsmann Foundation (Jungbluth et al., 2023).

Table 5: Size measures for German firms in China

4.5 Other channels

Another potential mechanism that is abstracted from in the model is international migration. A decoupling between Germany and China would likely lead to a decrease in the number of Chinese migrants in Germany and vice versa. This in turn could carry implications for the labor market and human capital flows.

Chinese residents in Germany, numbering 149,550, constitute approximately 1.1% of the foreign population and a mere 0.18% of the total German population (Destatis, 2023). Conversely, Germans in China represent a small fraction of the population, with foreigners making up only about 0.06% of the total Chinese populace (Bickenbach and Liu, 2022). Among these, Germans are the second largest group of Europeans. Net migration flows between Germany and China saw a decrease of 4,159 people from 2015 to 2020. These figures highlight the relatively minor scale of human capital movement between the two countries. Consequently, while migration is an integral aspect of global economic interactions, in the specific case of Germany and China, its broader effects of decoupling appear to be minimal. This suggests that migration-related factors are unlikely to significantly magnify the impacts of economic decoupling between Germany and China.

5 Conclusion

This paper has examined the economic implications of a hypothetical “hard decoupling” of the German economy from China, in a scenario that entails a broader decoupling of a G7/Western bloc from China and her allies. Our findings show that the costs of such a decoupling scenario would be serious albeit not devastating. Particularly in a “cold turkey” situation where an immediate and total separation between Germany and other Western countries and China occurs suddenly, the potential economic contraction could be as severe as a reduction equivalent to 5% of Gross National Expenditure (GNE) in the first year alone. It is imperative, however, to recognize that these assumptions and scenarios represent the extreme end of the spectrum, likely constituting an upper bound for the potential economic fallout in less extreme scenarios.

On the analytical side, it is important to stress the dependence of our results on estimates of a key parameter, the trade elasticity. The capacity to reorient trade towards alternative countries is a key factor in mitigating the adverse effects of decoupling from China. A lower trade elasticity means it is harder to replace Chinese goods, thereby escalating the welfare losses associated with severing trade links. The time horizon is of central importance here. Long run trade elasticities of 4 or above result in welfare cost between 1-2%. Yet in the short run, the cost are likely to be higher by up to a factor of 3.

While other European countries would also face significant economic repercussions, Germany’s situation is particularly acute due to its deep trade ties with China. It is crucial to underscore that this paper does not argue that such a hard decoupling scenario is likely or desirable. Our aim is to provide the best possible estimate of the economic costs of such an outcome, however likely it may seem. Understanding the costs of choices driven by geopolitical and security policies is vital for policymakers, businesses, and the public.

References

Alvarez, Fernando, "Capital accumulation and international trade," *Journal of Monetary Economics*, 2017, *91* (C), 1–18.

Anderson, James E. and Eric van Wincoop, "Trade Costs," *Journal of Economic Literature*, 2004, *42* (3), 691–751.

Arkolakis, Costas, Arnaud Costinot, and Andrés Rodríguez-Clare, "New Trade Models, Same Old Gains?," *American Economic Review*, 2012, *102* (1), 94–130.

Atalay, Enghin, "How important are sectoral shocks?," *American Economic Journal: Macroeconomics*, 2017, *9* (4), 254–280.

Auclert, Adrien, Hugo Monnery, Matthew Rognlie, and Ludwig Straub, "Managing an Energy Shock: Fiscal and Monetary Policy," 2023. Working Paper.

Bachmann, Rüdiger et al., "What if? The Economic Effects for Germany of a Stop of Energy Imports from Russia," Technical Report 28, ECONtribute Policy Brief 2022.

Baldwin, Richard E., Rebecca Freeman, and Angelos Theodorakopoulos, "Hidden Exposure: Measuring U.S. Supply Chain Reliance," *Brookings Papers on Economic Activity*, 2023.

Baqaee, David and Emmanuel Farhi, "Networks, Barriers, and Trade," 2021. Working Paper, UCLA.

_ **, Julian Hinz, Benjamin Moll, Moritz Schularick, Feodora A. Teti, Joschka Wanner, and Sihwan Yang**, "The Impact of China De-Risking on the German Economy: A Quantitative Analysis," Technical Report, Work in Progress 2023.

Bayer, Christian, Alexander Kriwoluzky, and Fabian Seyrich, "Energieembargo gegen Russland würde Wirtschaft in Deutschland kalkulierbar belasten, Fiskalpolitik wäre in der Verantwortung," Technical Report 80, DIW Aktuell 2022.

_ **et al.**, *Makroökonomische Effekte der finanz- und wirtschaftspolitischen Maßnahmen der Entlastungspakete I – III sowie des wirtschaftlichen Abwehrschirms*, DIW Berlin, Politikberatung kompakt, 2023.

Bickenbach, Frank and Wan-Hsin Liu, "Goodbye China: What Do Fewer Foreigners Mean for Multinationals and the Chinese Economy?," *Intereconomics*, 2022, *57* (5), 306–312.

Bundesbank, "Direktinvestitionsstatistiken: Tabellen der Statistischen Fachreihe," Technical Report 2023.

Costinot, Arnaud and Andres Rodriguez-Clare, "Trade Theory with Numbers: Quantifying the Consequences of Globalization," in Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff, eds., *Handbook of International Economics*, 4 ed., Vol. 4, North Holland, 2014, chapter 4, pp. 197–261.

Destatis, "Die Volksrepublik China ist erneut Deutschlands wichtigster Handelspartner," `https://www.destatis.de/DE/Themen/Wirtschaft/Aussenhandel/handelspartner-jahr.html` 2022. Accessed: 2023-10-10.

_ , "Ausländerzentralregister," https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bevoelkerung/Migration-Integration/Tabellen/auslaendische-bevoelkerung-staatsangehoerigkeit-jahre.html 2023. Accessed: 2023-10-10.

Dhingra, Swati and Thomas Sampson, "Expecting Brexit," *Annual Review of Economics*, 2022, *14*, 495–519.

European Commission, "Summer 2023 Economic Forecast: Easing growth momentum amid declining inflation and robust labour market," `https://ec.europa.eu/commission/presscorner/detail/en/ip_23_4408` 2023. Accessed: 2023-11-20.

Fajgelbaum, Pablo D., Pinelopi K. Goldberg, Patrick J. Kennedy, and Amit K. Khandelwal, "The Return to Protectionism," *Quarterly Journal of Economics*, 2020, *135* (1), 1–55.

German Council of Economic Experts, "Business Cycles of the German Economy," `https://www.sachverstaendigenrat-wirtschaft.de/en/topics/business-cycles-and-growth/konjunkturzyklus-datierung.html` 2023. Accessed: 2023-11-20.

Gholz, Eugene and Llewelyn Hughes, "Market structure and economic sanctions: the 2010 rare earth elements episode as a pathway case of market adjustment," *Review of International Political Economy*, 2021, *28* (3), 611–634.

Head, Keith and Thierry Mayer, "Gravity Equations: Workhorse, Toolkit, and Cookbook," in Gita Gopinath, Elhanan Helpman, and Kenneth Rogoff, eds., *Handbook of International Economics*, 4 ed., Vol. 4, North Holland, 2014, chapter 3, pp. 131–195.

Heritage Foundation & American Enterprise Institute, "China Global Investment Tracker," https://www.aei.org/china-global-investment-tracker/ 2022. Accessed: 2023-11-18.

International Monetary Fund, "World Economic Outlook: Navigating Global Divergences," Technical Report October 2023 2023.

Johnston, Alastair Iain, "How New and Assertive Is China's New Assertiveness?," *International Security*, 04 2013, *37* (4), 7–48.

Jungbluth, Cora, Jürgen Matthes, Sonja Beer, Gregor Sebastian, Max J. Zenglein, Friedolin Strack, and Ferdinand Schaff, "Gewinne deutscher Investoren in China – eine erste empirische Bestandsaufnahme," Technical Report 2023.

Kleinman, Benny, Ernest Liu, Stephen J. Redding, and Motohiro Yogo, "Neoclassical Growth in an Interdependent World," Working Papers, Princeton University. Economics Department. May 2023.

Mendoza, Enrique, "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations," *Journal of International Economics*, 1995.

Milgrom, Paul and John Roberts, "The Lechatelier Principle," *The American Economic Review*, 1996, pp. 173–179.

Moll, Benjamin, Moritz Schularick, and Georg Zachmann, "The Power of Substitution: The Great German Gas Debate in Retrospect," *Brookings Papers on Economic Activity*, 2023.

Obstfeld, Mauria and Kenneth Rogoff, "The Intertemporal Approach to the Current Account," in "Handbook of International Economics" 1995.

Pieroni, Valerio, "Energy Shortages and Aggregate Demand: Output Loss and Unequal Burden from HANK," *European Economic Review*, 2023, *154*, 104428.

Samuelson, Paul A., *Foundations of Economic Analysis*, Cambridge: Harvard University Press, 1947.

Samuelson, Paul A, *Foundations of Economic Analysis*, Vol. 197, Cambridge, MA: Harvard University Press, 1983.

Sandkamp, Alexander, "The Trade Effects of Antidumping Duties: Evidence from the 2004 EU Enlargement," *Journal of International Economics*, 2020, *123*, 103307.

Simonovska, Ina and Michael E. Waugh, "The Elasticity of Trade: Estimates and Evidence," *Journal of International Economics*, 2014, *92* (1), 34–50.

Spillner, Ole and Guntram Wolff, "China "De-risking": A Long Way from Political Statements to Corporate Action," *DGAP Policy Brief*, 2023.

Sullivan, Jake, "Remarks by National Security Advisor Jake Sullivan on Renewing American Economic Leadership at the Brookings Institution," *Available at https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/04/27/remarks-by-national-security-advisor-jake-sullivan-on-renewing-american-economic-leadership-at-the-brookings-institution/*, 2023.

Timmer, Marcel P., Erik Dietzenbacher, Bart Los, Robert Stehrer, and Gaaitzen J. Vries, "An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production," *Review of International Economics*, 2015, *23* (3), 575–605.

World Trade Organization, "World Trade Report 2023 - Re-globalization for a secure, inclusive and sustainable future," Technical Report September 2023 2023.

A Additional figures

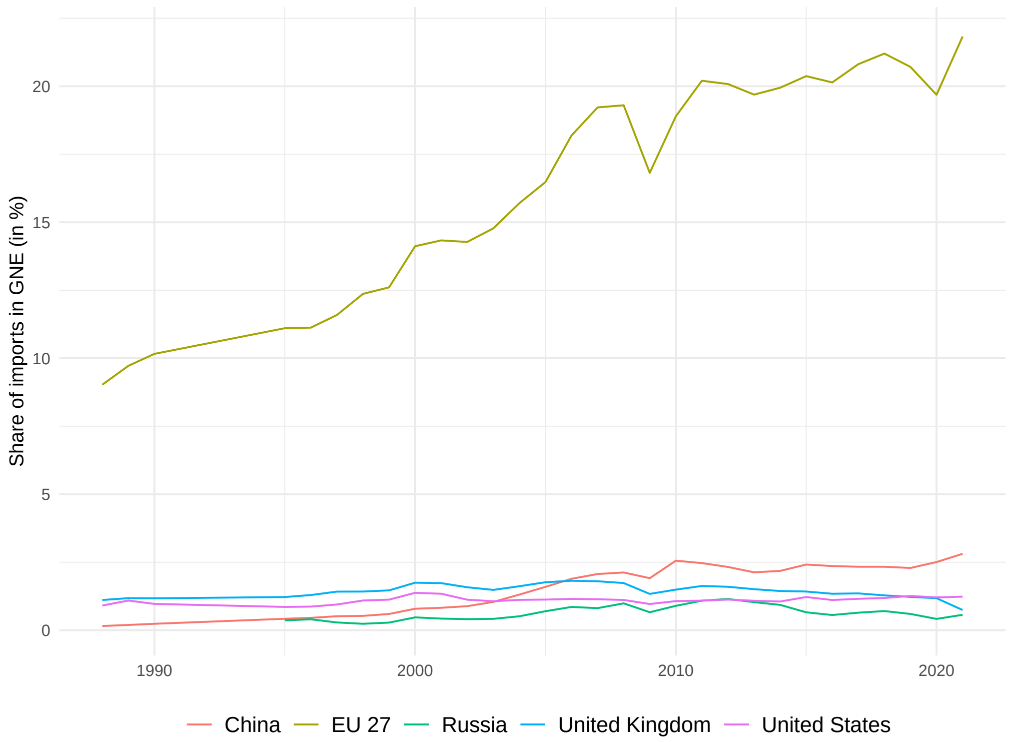

Figure 9: Share of imports from China and other countries in German GNE over time.

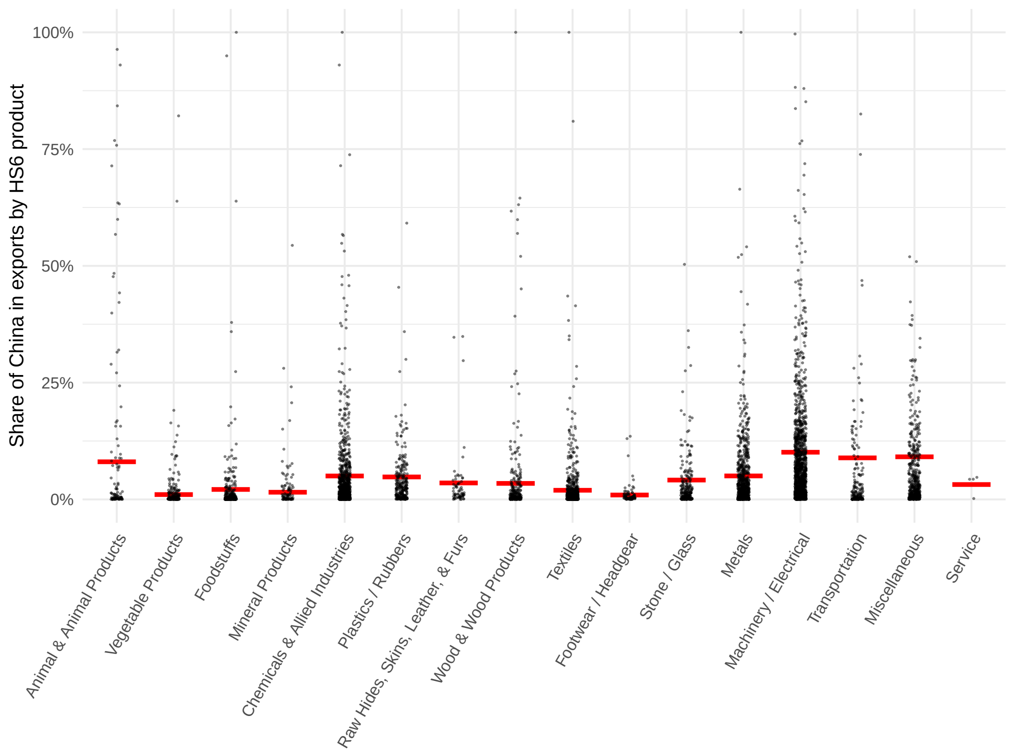

Figure 10: Share of China in German exports by HS section and HS8 code in 2019.