Federal Ministry
for Economic Affairs
and Climate Action

Guard Rails to Strengthen Security of Supply

Scientific Advisory Board at the
Federal Ministry for Economic Affairs and Climate Action

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At several meetings, most recently on 12 October 2023, the Scientific Advisory Board at the Federal Ministry for Economic Affairs and Climate Action dealt with the topic of

Guard Rails to Strengthen Security of Supply

and arrived at the following statement

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I. Introduction and Motivation

In recent years, various shocks – from pandemic-related production interruptions abroad, to disruptions of maritime transport routes caused by tsunamis, to politically imposed sanctions and counter-sanctions – have led to bottlenecks in supply chains. These have impaired the supply of consumer goods and had a lasting impact on industrial production and thus on economic output in Germany and Europe.

In spring 2022, almost 92 percent of German industrial companies included in the EU Commission's business survey said they were restricted in production due to a shortage of materials.[1] The figure has fallen since, but remains well above the long-term average and above that in other EU countries.[2] The German economy, still characterised by a strong industrial core and a high degree of openness, is more strongly affected by uncertainty in international supply chains.

In particular, high shares of supplies of so-called critical goods from countries classified as untrustworthy are increasingly seen as jeopardizing the strategic autonomy of Germany and the EU, because the potential threat of supply disruptions by such countries reduces the leeway of foreign policy. Political science literature speaks of the use of asymmetric economic interdependence as a geo-economic weapon. The extent of the economic dangers became clear in 2021 and 2022, when Russia first raised uncertainty about gas supplies to Europe and eventually massively cut its exports. Before that, China's (so far largely unsuccessful) attempt to restrict the export of so-called rare earths had already caused great irritation.[3] There are also major concerns about certain active pharmaceutical ingredients, above all penicillin, which is always in short supply during waves of disease,[4] about various agricultural raw materials and key intermediate products, above all computer chips.

Supply risks are counted among the most important challenges for economic and social development.[5] Their causes are manifold. They occur as a result of extreme weather events, which can lead to production losses, crop failures or interruptions of transport routes (Suez Canal, Panama Canal). It must be assumed that the change in the world climate will cause such events to occur more frequently and be more intense. Similar effects emanate from pandemics or warlike events. The situation is exacerbated by geopolitical tensions and a resulting trend towards protectionist policies of all kinds.

A major reason for the supply risks and for high procurement prices for important raw materials and intermediate products was and still is the partly low diversification of the supplier portfolio of European companies or the supply channels through which European companies obtain their imports. Carrara et al. (2023) show that for a number of critical goods there is only one or very few suppliers. If adverse shocks of any kind occur in these supplier relationships, the EU experiences supply shortages and rapidly rising prices. In large parts, however, the EU's supplier portfolio is well diversified; see, for example, Felbermayr (2023).

1 European Commission business surveys, seasonally adjusted data.

2 In Q3 2023, the figure in Germany is around 33 percent, still very much above the long-term average of below 10 percent and above the EU average; in France, Italy and Spain, the figures are 23, 17 and 10 percent respectively.

3 China restricted exports of rare earths to Japan for seven weeks in 2010, driving up the prices of the raw materials massively. The EU and the USA appealed to the WTO and won in 2014. Since August 2023, China has required export licences for the metals gallium and germanium, which are intended to protect national security (http://english.mofcom.gov.cn/). Throughout history, from antiquity to the Napoleonic Continental Blockade to modern sanctions policy, export embargoes have been used to hinder the economic development of opposing countries (Blackwill and Harris, 2016).

4 See Klimek et al. (2023).

5 See for example World Economic Forum (2023).

Lack of availability and high prices of important raw materials and intermediate products cloud the growth prospects of the German and European economies. They have contributed significantly to high and persistent inflation in Germany and the euro area (Di Giovanni et al, 2022). The global industrial commodity price index has almost doubled from a value at 79 in December 2019 (before the start of the crisis) to 141 in April 2022. The German import price index for raw materials has increased by 240 percent from December 2019 to August 2022; imported semi-finished products have become 82 percent more expensive, intermediate products 49 percent more expensive; imported finished products, however, only 12 percent more expensive. Prices for imported raw materials have since declined again but remain at elevated levels.[6] The resulting deterioration in terms-of-trade (the average price of export goods relative to that of import goods) points to significant losses in prosperity. In addition, there are fears that uncertainties about supply chains will complicate the transformation towards a climate-neutral European economy, because raw materials for battery-electric cars, wind turbines or photovoltaic systems, amongst other things, are often sourced from a small number of non-democratic countries. Finally, there is a general concern about deindustrialisation because distortions in supply relationships, especially if they are politically induced, could change the structure of comparative advantages to the disadvantage of Germany and Europe.

Against this background, many countries have begun to fundamentally rethink their foreign economic policies. Foreign economic and foreign policy considerations are moving many countries towards a much more active industrial policy than was common in the years of the Washington Consensus from 1990 to 2008 (Williamson, 2003). Above all, the perception of political risks in global supply networks has changed and led to a re-evaluation. Both the USA and the EU are stepping up efforts to secure their strategic autonomy and to reduce blackmail opportunities due to one-sided dependence.[7] The focus is on China and Russia, but the list of potentially problematic suppliers has grown longer in recent years. According to the latest data, only slightly more than one-eighth of the world's population now lives in liberal democracies, while a share of more than 70 percent lives in autocracies.[8] Research suggests that non-democratic governments are more prone to protectionist policies; however, the empirical relationship is complex.[9] Recent work emphasises the importance of populist styles of government for the opportunistic use of trade policy; see Funke et al. (2023).

As a result of these developments, ever larger shares of world trade are burdened by economic sanctions of various kinds and for various reasons (Morgan et al., 2023). In recent years, many countries have increasingly used export restrictions to obtain industrial policy or distributional advantages or to avert perceived security threats. The use of export restrictions has increased since 2020: In the three years from 2017 to 2019, 132 restrictions were imposed worldwide; from 2020 to 2022, by contrast, 839.[10]

6 Hamburg Institute of International Economics (HWWI).

7 Farrell and Newman (2019) describe the attempt by governments to use dependencies in global production networks for foreign policy purposes with the catchword "weaponised interdependence".

8 V-Dem Project (2023).

9 See for example Mansfeld et al. (2000) or Milner and Kubota (2005) for empirical studies.

10 Data from https://www.globaltradealert.org/global_dynamics/area_goods/flow_export.

These are mainly used for basic foodstuffs, basic chemicals, or medical products. However, the impact of such measures in critical raw materials seems limited so far in terms of exported quantities and price volatility (Evenett and Fritz, 2023). With significantly strengthened investment controls, foreign companies are to be barred from acquiring domestic technology, both for foreign investments at home (inbound) and vice versa (outbound) (Evenett and Fritz, 2021).

Lists of critical or strategic goods that are under special scrutiny in various countries are constantly being extended. In March 2023, for example, having the implementation of its ambitious climate policy in mind, the EU Commission published a draft raw materials directive that contains extended lists of critical raw materials. A directive on the supply of chips to the EU is in preparation. Strategic partnerships with third countries should increase security of supply. At the national level, state aid for strategic industrial policy projects is constantly increasing.[11] Grants to the global chip industry planned by various countries over the next 10 years are now expected to exceed $1 trillion.[12]

In July 2023, the German government presented a "China Strategy", which fits in with the national security strategy that was also recently adopted. The paper explains why and how Germany wants to reduce its strategic dependencies on China. A complete decoupling of the German economy from China is explicitly not aimed at; however, de-risking is to take place. What exactly is to be understood by this term, which instruments are to be used to achieve the objective, and whether the strategy is to be applied to other trading partners of the Federal Republic, however, still needs to be clarified.

In view of the challenges, numerous questions arise. What welfare-economic rationale can be used to justify subsidies or foreign trade policy measures? If market action does not lead to efficient outcomes, what targeted interventions can be used to improve security of supply at the lowest possible cost? Is it possible to define sector- or even commodity-specific programmes according to objective standards, and how can massive misallocations in the form of subsidy races, harmful influence of special interests, excessive cyclicality of capacities or prices and expensive redundancies as well as windfall profits be prevented? How can cooperation between friendly countries be established and an ever-increasing decoupling with strategic rivals be prevented? The EU and its member states have a fundamental need for clarification here. This report wants to offer orientation for economic policy makers, thus contributing to a rational, efficient policy to strengthen security of supply.

The report is structured as follows: In the next section it presents the difficulties arising in the identification of strategic dependencies of the German and European economies. It is emphasised that not only goods and commodity markets need to be considered, but also the services sector. Then, the report derives welfare-economic justifications for a government intervention in supply chains, with the main focus on systemic risks and security externalities. The importance of the European Single Market and common EU-wide policy approaches are emphasised. General regulatory principles for

11 The EU approved €672 billion in aid in 2022 (4.2% of EU gross domestic product), with 53% going to Germany alone. However, much of this was approved to mitigate the effects of the coronal pandemic and not all of it has been disbursed.
https://www.euractiv.com/section/competition/news/eus-vestager-warns-of-fragmentation-risks-but-expands-state-aid/

12 https://fortune.com/2022/07/28/house-passes-280-billion-package-chip-production-semiconductor-industry/
https://www.emergingtechbrew.com/stories/2021/07/23/semiconductor-subsidies-skyrocketed

supply chain regulation are then discussed. Finally, the report discusses measures that should lead to an improvement in the diversification of the supplier portfolio, aiming at providing adequate framework conditions to avoid short-term ad hoc interventionism, which often operate with substantial delays and come with expensive side effects. The report explains how markets for holding capacity can be organised and proposes the creation of a European Supply Security Office (ESSO).

II. Where are the Strategic Dependencies?

How can it be determined in which areas, to what extent and regarding which supplier countries Germany and Europe exhibit strategic dependencies? It is not easy to give objective answers to this question because the available data are incomplete and circumstances are constantly changing. Therefore, there is a risk that government interventions do not take place in the right areas and are poorly calibrated. The following passages discuss data sources, methods of analysis and difficulties, but also highlight some fundamental premises for evidence-based economic policy in the supply chain context.

1. The Need for a European Perspective

The first such premise is that strategic dependencies need to be discussed at the EU level.

Germany is part of the highly integrated EU internal market and the European Customs Union, within which goods and services circulate freely. German value added is found in exports from other EU countries, and imports from neighbouring countries are found in German exports overseas. Often it is not even possible to determine empirically the exact origin of services imports, for example. Software products of US origin, for example, are imported from Ireland to Germany, but it is not possible to precisely separate American and Irish value added. Economically, it is irrelevant from which EU country imports from or exports to extra-EU countries take place. Moreover, a European perspective is legally imperative, because Germany has no independent trade policy and has ceded competences in other affected areas – such as the regulation of foreign investments – to the EU. Therefore, interdependencies should be examined at the EU level, not at the national level; economic policy responses must also be primarily sought and found at the EU level.

2. What Is Considered Scarce Depends on the Context

The second premise is that the perception of scarcity is highly context dependent.

During the pandemic, there were complaints that Germany did not have enough medical face masks. When the shortage was resolved, there was talk of shortages of reagents and glass vials for the manufacture of testing or vaccination agents. In the meantime, these specific problems have faded into the background and the public is concerned about the availability of medicines. There have also been worldwide fears about shortages of toilet paper, flour, or yeast, which have led to hoarding. Due to crop failures in Texas and Pakistan, two of the most important cotton growing regions, hygiene products have become scarce and expensive and have hit the headlines.[13] Especially for goods with high salience for households, shortages and the associated price increases are discussed particularly emotionally by the public. Based on rumours, bank-run-like effects can lead to shortages (for example, in the case of toilet paper), even if the security of supply is not actually at risk at all. In addition to sensitive communication, reliable, up-to-date, readily available real-time data can help avoid such episodes.

Besides such rather anecdotal cases, supply problems are also discussed from an industrial policy perspective. Around the introduction of battery electric vehicles, dependencies on electronic components such as chips have become apparent. The shortage of such intermediate products had a massive impact on the output of the German motor vehicle industry in 2021 and 2022; the same applied to the electronics sector. In this sector, however, the chip shortage has receded significantly and there are already warnings of oversupply – all this before the EU's

13 https://time.com/6184644/tampon-shortage-supply-chain/

Chips Act, with its multi-billion subsidies, could even take effect.[14]

In the case of rare metals, which are important to produce batteries as well as wind turbines, the focus also changes constantly when new deposits are found or developed,[15] when innovations make substitutes possible or savings achievable. Especially in metals, boom and bust cycles and high price volatility are the rule rather than the exception.[16] Due to the increasingly integrated global economy and a high simultaneity of industrial and economic policy priorities and their poor predictability, these fluctuations have become greater.

There is a danger that hectic policy measures to curb these fluctuations are counterproductive because increasing supply typically takes time and therefore their effect often only kicks in when shortages are already decreasing. Ill-considered policies geared to short-term needs also run the risk of failing to keep future shortages in mind. Thus, a poorly designed government commodity policy would only fuel price volatility. In addition, commodity policies that are not aligned with regulatory principles become a gateway for special interests. It is therefore of great importance to have a correct empirical picture of dangerous economic dependencies and a clear regulatory compass.

3. Dependencies in Trade Statistics

In practice, the most important data source for identifying dependencies at the product level are trade statistics. They are detailed and comparatively timely, but only refer to goods (services are only recorded in the balance of payments statistics with a very rough sectoral breakdown) and can show strong volatility over time. Its granularity follows the logic of the customs survey and not the goal of identifying strategic dependencies. Nevertheless, it is often the starting point for initial investigations.[17]

In 2019 (before the distortions caused by the coronavirus crisis), the EU imported a total of 10,280 different goods recorded in the customs statistics with a value of €1,935 billion from outside the customs territory.[18] 227 of these products came from only one country. In 193 cases, the import value was less than 50,000 euros. Among the goods are many specialised foodstuffs that, by definition, can only come from a single country, such as tequila from Mexico or sake from Japan.

779 products with an import value of 3.5 billion euros came from a maximum of three different supplier countries. They accounted for 0.2 percent of the total import value. The trade statistics therefore do not indicate a high dependence on individual import countries. However, important industrial raw materials such as lead, thallium, barium, beryllium, lithium, or platinum fall into this group. Uranium ore (import value of € 74 million) came from just

14 See, for example, the reports in the Frankfurter Allgemeine Zeitung on 9.1.2023 (“Autohersteller leiden weiter unter Chipmangel “) and in Neue Zürcher Zeitung on 10.9.2022 (“Nach dem Chip-Mangel kommt das Überangebot“).

15 For example, on 16 February 2023, the British weekly magazine The Economist reported that the metal cobalt was suddenly superabundant.

16 As recently as October 2020, the EU Commission complained about high overcapacities on the global steel market and suggested multilateral measures to shut down production capacities (https://policy.trade.ec.europa.eu/news/global-forum-steel-excess-capacity-eu-calls-g20-address-excess-capacity-2020-10-26_en); shortly thereafter, the price of steel quadrupled from under 500 US dollars per tonne to almost 2000 US dollars in October 2021.

17 This is the approach taken, for example, by the German Council of Economic Experts in its annual report 2022/23 (Fig. 142) or Klimek et al. (2023) in their analysis of dependencies in the pharmaceutical sector.

18 Unfortunately, a similarly detailed database does not exist for services trade.

two supplier countries in 2019, including Russia.[19] Special substances important for the pharmaceutical industry, such as anthraquinone or fenproporex, come from no more than three countries, as do highly specialised goods (e.g., telecommunications satellites, refrigerated ships or dredgers). If we look at a measure of the degree of import concentration (Herfindahl index), we see that this measure has not increased in the EU in the last 15 years, unlike in the USA. China, on the other hand, has been able to diversify its import sources significantly and is much further ahead than the EU or the USA with its policy of de-risking.

4. Dependencies Not Only with Goods

It is important to look at *all* economic interdependencies and not just focus on goods that are relatively well recorded in trade data and are physically easily visible – for example steel and aluminium, batteries, chips, pharmaceutical products, or raw materials such as rare earths. There can also be high dependencies on various services – from operating systems to financial services – which are of key importance for production in all sectors of the German economy. Moreover, one should not only look at international trade, but also at the activities of foreign companies at home and of domestic companies abroad. And finally, dependencies can also be found in the area of intangible economic goods, for example in the use of foreign patents. For the identification and assessment of technological dependencies, however, the data situation is particularly poor.

To get a comprehensive picture, it is useful to look at the balance of payments statistics, where trade in services as well as primary and secondary income are shown in addition to trade in goods.[20] It shows that the USA is still the most important economic partner for the EU 27, ahead of the UK. China comes third, followed relatively closely by Switzerland, which is 160 times smaller in terms of population. If we look only at trade in goods, China dominates. However, it has only very little significance in the areas of trade in services and primary income. In trade with the USA and the UK, services dominate on the import side; services also predominate in trade with offshore financial centres, which can often be assigned to the Anglo-Saxon countries in economic terms. On the export side, trade in goods dominates in all of the EU's trading partners; in many countries, however, income from exports of services and foreign investment exceeds income from exports of goods. A one-sided focus on goods trade is therefore out of place.

The comprehensive balance-of-payments perspective also reveals that the EU's trade relations are much more balanced than is often assumed. While the value of goods exports to the USA exceeds that of imports from the USA by a factor of two, the reverse is true for services (Braml and Felbermayr, 2023). The EU's deficit in goods trade with China accounts for 1.1 percent of EU GDP; the surpluses in services trade and primary income reduce the deficit by one-third to 0.7 percent of GDP, i.e., from 158 to 107 billion euros. The balance of bilateral economic relations is highly relevant from a geo-economic perspective because asymmetrical bilateral relations are particularly susceptible to political abuse (Mattoo and Staiger, 2020). However, it cannot be concluded from the financial balance of bilateral trade relations that no one-sided strategic dependencies exist, because foreign goods can have a higher criticality in domestic value networks than vice versa.

19 In the years that followed, the sourcing of uranium ore was significantly diversified.

20 Primary income refers to income from all types of foreign investment; it includes income from the posting of workers. Secondary incomes are payments without reciprocation. They are relatively insignificant in quantitative terms.

The fundamental problem of the balance of payments statistics is that no data are available at the product level and the sectoral breakdown is also not very detailed.

5. Simulation Results with Sector Data

To convincingly identify strategic dependencies, an analytical framework is needed that not only captures German or European trade and production data, but – in a harmonised form – provides global coverage of input-output relationships and production opportunities. Furthermore, information on the substitutability of goods and services by alternatives in production and consumption is needed. Such data are not available.[21] Finally, in addition to physical material flows, details about market structures are needed so that the price effects of a supply chain disruption and the resulting consequences can be modelled.

Therefore, many quantitative studies use harmonised input-output tables and embed them in quantitative models of the world economy (with many countries and sectors). In doing so, trade in services can be captured and a distinction made between final and intermediate goods trade. However, the necessary elasticities of substitution can only be estimated very imprecisely, and the analysis remains at the sector level.

The advantage of the approach is that it can be used to define clear what-if scenarios and simulate the economic implications, considering economic adjustment mechanisms and general equilibrium effects. In addition, statements can be made about effects on value added or prices.

Such a model was used, for example, to analyse Germany's decoupling from Russian gas imports (Bachmann et al., 2022). Felbermayr and Krebs (2023) have chosen a similar modelling approach to investigate at sector level what consequences supply chain disruptions in individual sectors or vis-à-vis individual trading partners would have for the German economy.[22] In such models, it is assumed that the sectoral allocation of the raw materials or intermediate products that become scarce due to supply chain interruptions takes place efficiently via the price mechanism. If rationing were to occur according to other mechanisms, much higher economic losses are likely to occur.

Felbermayr and Krebs (2023) show the magnitudes of the economic effects of different supply disruption scenarios. If, for example, the European domestic market was to be decoupled from US suppliers (and vice versa), real average income in Germany would fall by around 3 percent in the short term; decoupling from the UK or China would cause a decline of around 2 percent, and from Switzerland or Russia of 1.5 percent; in each case based on the reference year 2018. In light of these figures, the decision of the German government and the EU Commission to reject decoupling from China but to strive to reduce the risks is the right decision.

A sectoral decoupling from all possible extra-EU supplier countries would have very different macroeconomic effects depending on the sector affected. Decoupling in the fossil commodities sector (mining energy) would cost €113 billion in aggregate value added in Germany or 4.5 percent of real income in the short term; in the long term, the damage would fall to €29 billion, or a 1.1 percent loss of real income. In the short term, decoupling supplies from the trade sector, information

21 The fundamental problem is that empirically only what is actually produced is visible, but not what could potentially be produced and under what conditions (productivity, inputs).

22 The most recent input-output data are used. These come from the OECD for the year 2018.

technology sector, or the financial services sector costs more than €50 billion each in value added. In the manufacturing sector, the most prominent sectors are metal production with value-added losses of €15 billion and chemicals (€13 billion) – followed by metal processing (€12 billion). Interestingly, Germany would be less affected in the event of an EU decoupling from mechanical or motor vehicle engineering, as the diversion of demand from other EU countries to German products compensates for the decoupling.

A decoupling of Germany would be particularly painful in electronic products such as chips from the most important Asian manufacturing countries (Taiwan, China, Japan and Korea). In the short term, this would result in a volume loss of value added of around 13 billion euros. Similar losses would occur if imports of IT services from the USA were no longer possible. According to the simulations by Felbermayr and Krebs (2023), the decoupling from Russian energy products – gas, oil – is even more expensive (around 20 billion euros).

The study shows that the German economy is not only dependent on imports of raw materials and industrial supplies, but also on imports of services. Moreover, macroeconomically relevant vulnerabilities exist not only vis-à-vis China, but also vis-à-vis other large economies. These circumstances should not be underestimated in analyses of import dependency and in the design of policy instruments.

6. Can Lists of Critical Goods Be Drawn up According to Objective Standards?

Ideally, data at the enterprise level would be available for the analysis of strategic interdependencies, showing the input-output linkages of the establishments. Official statistics are far from this. The OECD's current harmonised input-output tables, for example, contain information on 45 broadly defined sectors. But even if firm-level detail were available, it would be difficult to make reliable statements about which imported goods or services are essential, because the substitutability of imports by alternatives cannot be observed, but only roughly estimated, and substitution appears to be much more difficult in the short term than in the long term. In addition, the nodes in input-output networks at the company level are endogenous and changeable. A reliable identification of strategic goods (or even services) on an objective data basis is therefore not possible. The classification of goods, industries, or technologies as critical is therefore a deeply political decision.

However, there is now a danger that lists of industries or goods worthy of protection are drawn up based on special interests rather than public interest-oriented assessments. Based on these, the government subsidises domestic production, prohibits domestic takeovers, restricts exports of goods or technologies, or takes other protectionist measures.

It is not sensible to reject such lists outright; they are necessary for many policies. However, clear rules and processes are needed. These must set out clearly and transparently how the list entries are arrived at. It is important that policies to secure the supply of raw materials and industrial inputs are based on principles that do not take specific products of firms as starting points, but instead set a regulatory framework that is helpful for many possible configurations of potential supply crises. For this to succeed, the reasons that contribute to excessive concentration of procurement on a few suppliers (or countries) need to be well understood. More on this in Chapter IV.

III. Welfare Economic Justifications for a Government Supply Chain Policy

1. Welfare Economics and Geoeconomics

The foreign trade literature focuses on the possibility of welfare gains from trade liberalization and arising distributional consequences. However, the foreign policy implications of insufficient diversification – or, in other words, too much dependence on individual supplier countries – have hardly been addressed in the economic literature of recent decades. This was different in the older economic literature and in political science. There, the use of foreign trade policy instruments to achieve geopolitical goals (power politics) was and is analysed and the term "geoeconomics" is used for this (Blackwill and Harris, 2016; Gehrke, 2022), which can be designed offensively or defensively. However, the point always is that not only absolute but also relative gains from trade are considered (Powell, 1991). The former are considered in classical economic theory – absolute benefits (the level of welfare or real per capita incomes) from international division of labour. The political science literature also studies relative benefits (or disadvantages). These change when two countries are not affected to the same relative extent by adjustments in the international division of labour so that the economic balance of power between them changes as well. The latter obviously play a major role in the military and economic security of countries and in the international enforcement of their own values. If relative effects appear in the domestic objective function, then a different kind of external effect occurs, because one's own "benefit" can be diminished if a system rival can draw higher increases in economic output (such as real GDP) than one's own economy by exploiting the division of labour. Against this background, interventions in free trade are theoretically justifiable.

Systematic thinking about geoeconomics started at least with Adam Smith's "Wealth of Nations" from 1776, the work that was so fundamental to the emergence of modern economics. As is well known, the author shows how the division of labour – within and between nations – can increase prosperity in such a way that everyone is better off. Smith warns against protectionism and against the attempt to exploit trading partners by means of *"beggar-thy-neighbour"* policies. Nevertheless, he is very aware that the division of labour also creates dependencies that can be exploited opportunistically. He illustrates this with the example of the competition between England and Holland, writing *"... defence, however, is of much more importance than opulence"* (Book IV, Chapter II). For reasons of security policy, it might therefore be necessary to restrict foreign trade. He therefore considers the "Navigation Acts", which denied Dutch ships access to English ports, to be *"... perhaps, the wisest of all commercial regulations of England"*.

It is largely undisputed that the dismantling of trade barriers in recent decades has been able to unlock considerable gains in prosperity; see, for example, the model-based quantifications by Ossa (2015) for many countries or by Felbermayr et al. (2017) specifically for Germany, or econometric analyses based on country data, for example by Feyrer (2019). At the same time, however, it has become increasingly clear that trade liberalisation produces losers in those sectors and regions that are strongly affected by additional imports. There is good evidence for this on the so-called China shock (Autor et al., 2013; Dauth et al., 2014, 2021). The inability of many democracies to compensate the losers of globalisation has led to a high level of scepticism of globalisation, although this is largely driven by distributional politics (Frieden, 2019; Colantone et al., 2022).

This chapter focuses on possible welfare-economic motivations for restrictions on free trade.[23]

2. Strategic Industries

The "old" strategic trade and industrial policy is about the distribution of rents in oligopolistic markets (Brander and Spencer, 1985) or between "big" countries that can manipulate the terms of trade or the location of firms through tariff policy or with subsidies. There is a rich theoretical literature on this, but it has hardly produced any empirically testable implications. Hence, there is reason to be sceptical about attempts at strategic trade policy in the "old" sense, because they can lead to prisoners' dilemmas in which all countries involved are worse off than in a situation of free trade. To avoid such outcomes, the rules of the World Trade Organisation or the EU Single Market are supposed to curb opportunistic behaviour. In the past decades, these institutions have not functioned badly, despite regularly recurring disputes (such as the long-simmering dispute over subsidies in the aircraft industry) (Bagwell and Staiger, 2004).

Generally speaking, if externalities are present, restricting free trade may be the second-best measure if the first-best instruments to remove market distortions are not available. For example, global pricing of greenhouse gas emissions combined with free trade is better than climate tariffs; see, for example, the Scientific Advisory Board's report on CO_2 border adjustment from 2021. If the first-best policy measure is not possible, on the other hand, climate tariffs may make sense. However, this need not be the case. It is always necessary to clearly identify the market distortions and develop policies that address them as precisely as possible (targeting principle).

Colantone et al. (2022) examine externalities that emanate from specific sectors, so-called "strategic industries" on productivity in other sectors, on consumer benefits, or on the security of the state. These effects can be thought of as increasing in the size of these sectors. The authors show that in such a situation free trade is typically not optimal; import tariffs or production subsidies may be useful, at least temporarily. Theoretically, then, the arguments in Colantone et al. (2022) can justify certain industrial policy measures. However, the study does not yield operationalizable instructions for economic policy. More detailed considerations are needed for this. Recommendations will depend on the structure of the comparative advantages as well as on the type and strength of the externality.

The fundamental externality for this report is that profit-oriented companies do not sufficiently consider the systemic effects of their decisions. Specifically, this is a matter of decentralised procurement by a large number of independent actors, which together can lead to a situation where an entire economy becomes dependent on the supplies of a few suppliers or supplier countries, resulting in systemic risks. Decentralised companies regularly ignore the impact of their actions on aggregate variables because they are each too insignificant in themselves for a different – typically more expensive – procurement policy to make a difference to the economy or society.

23 Protectionist measures with a distributional motivation are generally second-best measures at best, which the Scientific Advisory Board rejects. Reference should be made to targeted social or regional policy instruments with which adverse distributional effects of the international division of labour can be appropriately addressed.

3. Optimal Diversification without Security Externality

Do companies have the right incentives to sufficiently diversify their supply chains? That depends on the nature of market imperfections and externalities.

This situation can be illustrated by the procurement of an intermediate product, for example microelectronics. Let us assume that there are several suppliers in Germany and abroad who can supply suitable chips, but who charge different prices for long-term supply contracts. However, their ability to supply is not always guaranteed because suppliers can be hit by "shocks" that, for example, affect their production, block the supply route, or change the political environment. If the shocks are not perfectly correlated, the buyer can hedge against supply risks by sourcing chips from more than one supplier, i. e., by diversifying the supplier portfolio. How much he should diversify depends on many influencing factors: (i) the nature and strength of the correlation of the shocks, (ii) the loss of profit due to non-delivery, (iii) the possibility of varying sourcing quantities at short notice, (iv) the costs of different suppliers for different quantities of chips, (v) the fixed costs that arise for each active buyer-seller relationship,[24] (vi) the costs of alternative hedging options, such as warehousing or traditional insurance. Typically, a buyer will not diversify his supplier portfolio to the maximum because the costs would be prohibitively high. Of course, diversification can only work if there is more than one source of supply for a product.

In general, one cannot expect the decentrally chosen degree of diversification to correspond to the social optimum. This would be the case if (i) the buyer's behaviour does not exert any relevant externalities on other market participants or the general government, (ii) full information and (iii) perfect competition prevail, and (iv) there are no further distortions, for instance due to (poorly chosen) economic policies or the lack of risk markets.

In practice, these conditions are usually not met. However, this does not necessarily mean that the government intervenes in a regulatory way; after all, deviations from the optimum can create incentives for corrections within the framework of the market economy, for example through competition between companies with other strategies. The question is ultimately how serious deviations from the optimum are and whether an automatic correction can be expected.

Important externalities concern the customers and competitors of a company. For customers, a company's offer creates a surplus ("consumer surplus externality"). This ceases to exist if the company's offer fails. A complete failure can be very serious for the customer, whereby it must be considered that there is often a lack of markets in which the customer could insure himself in advance against the risk of such a failure. In extreme cases, it must be considered that the government could be forced to compensate for the consumer's loss through costly measures of its own; an example of this is the construction of LNG terminals to purchase gas from sources outside Russia.

24 See for example the overview article by Antras and Chor (2022) and the numerous references contained therein.

In the absence of risk markets and strong risk aversion (high damage potential of risks), it can be assumed that the purely private-sector determined choice of supply sources will result in too low a degree of diversification. If the welfare losses are very high, this would justify state intervention.

A counter-argument concerns competition between companies. A company that does not diversify its sources of supply much creates room for other companies that bet on being able to earn well in an emergency by replacing the first company ("business stealing effect").[25] However, this effect is likely to be small if the alternative strategies require upfront investment and the probability of distress is low, especially since the consumer surplus remains with the consumers in any case. Moreover, companies must expect that in an emergency the return from their provision will be reduced by political measures such as a price brake or the skimming off of "windfall profits".

The situation is exacerbated when distortions interact at individual stages of a supply chain, for example when incomplete information hinders the operation of price signals along the supply chain beyond the buyer. Then, the buyer's behaviour generates a potentially negative externality on further (downstream) firms that cannot be (fully) internalised by contracts (Liu, 2019). In other words, in complex supply networks, systemic risks can arise that are not addressed by market activity alone. Firms do not sufficiently diversify their supplier base (and keep their inventories too small) because the impact of failures must equally be borne by other firms in the production network and these risks are not properly priced. In supply networks, systemic problems occur, as they also arise in the financial sector.

4. Security Externality

The most obvious case of an externality arises when the procurement decisions of domestic companies have an impact on the government's foreign and security policy leeway. Thus, it is conceivable that a strong concentration of the procurement of chips on only one supplier country makes the government vulnerable to blackmail, because an interruption of supplies would be associated with large economic and political costs. However, domestic "strategic autonomy" does not enter the decision-making calculus of companies because it has characteristics of a public good: Companies are not willing to incur higher costs to improve their governments' strategic autonomy through better diversification of their supplier portfolios, because the respective contribution of each company in itself has only a very small effect on its own corporate success. Therefore, under-diversification occurs, just as under-supply occurs in the private provision of public goods.

Ignoring the consequences of power-politics is rational at the individual economic level, but irrational at the collective level. One can speak here of a security policy externality, whereby "security" can refer both to military security and to security of supply. State intervention can be justified by the divergence of individual economic and total economy rationality.

The comments made above apply not only to procurement processes (imports), but analogously to the sale of goods or services (exports). Here, there can be an excessive concentration on individual countries or buyers. However, the elimination of export opportunities at home does not lead to supply

25 For the logic of the "consumer surplus effect" and the "business stealing effect", see Grossman et al. (2023).

bottlenecks and price pressure but creates the opposite. In this respect, dependencies on individual export markets are less problematic from a welfare economics perspective than on individual import markets.

5. Moral Hazard through State Rescue Policy

These problems are exacerbated if companies can count on being supported by government measures such as short-time allowances, liquidity assistance or subsidies in the event of a supply disruption, without incurring any ex-ante costs for the insurance benefit. This reduces the incentives to invest in their own supply security measures. To eliminate the problem, governments would have to be able to commit ex-ante – i.e., before shocks occur – that there will be no support measures, even if this causes major economic distortions. However, such "no-bail-out" commitments are rarely credible. The resulting "moral hazard" reinforces the problems mentioned above and leads to the socially optimal degree of diversification deviating even more from that resulting from the sum of decentralised decisions.

6. Market Structure and Free Competition

The number of suppliers in a sector and thus the possibility of diversification is the result of economic processes. It changes through market entries and exits or through takeovers and mergers. Such processes can take place relatively quickly. Where narrow oligopolies or even monopolies dominate a market, the systemic risks arising from the failure of one or more of these companies are particularly high.

In various ways, the market structure can influence the security of supply as well as the market outcome in the event of supply shortages. If one initially only looks at the price level, a high market concentration can lead to increased market power that leads to even more significant price increases, especially in the case of supply bottlenecks. Companies can counter dependencies, which then lead to high procurement prices, through a diversified procurement strategy, provided there are corresponding options on the supplier side. Ensuring competition between different suppliers as well as guaranteeing alternative diversification options is the task of a consistent competition policy, especially merger control.

IV. General Principles and Objectives of a Sound Supply Chain Policy

1. Basic Remarks

Because future needs of European industry and the nature of disruptions affecting supply chains are not yet known today, but can at best be guessed at, politicians and companies are advised to create general structures that increase security of supply and improve resilience to shocks. Interventionism driven by special situations typically comes too late – namely only after the disruption has occurred. In any case, this is costly and, if many countries and companies act simultaneously and in the same way, can lead to an amplification of fluctuations.

The question now is which efficient and effective instruments are available and should be used and how they can be protected against the danger of protectionist abuse or against unwarranted influence by lobbyists. Not every distortion can serve as a reason for intervention, because every state action is subject to the danger of misdirection. Therefore, procedures are needed to justify why certain interventions are chosen and others not. These procedures should be as transparent as possible and follow clear principles. This is currently the subject of a lively debate.

In general, what is required is a regulatory framework that can directly address the security externality and the moral hazard. Such a framework should provide incentives to diversify procurement and sales markets, for example by concluding free trade agreements. Where there are very few sources of supply, it makes sense to promote research into substitute products and, if necessary, to build up strategic reserves.

2. Regionalisation (Decoupling) Does Not Enhance Supply Security

Eppinger et al. (2022) show that cutting off Germany or Europe from individual supplier countries would not contribute to supply security. Although production losses abroad would have a smaller impact on the German economy if it were less dependent on supplies from abroad, but the costs of decoupling are orders of magnitude higher than the benefits of reduced dependence. Even if one were to allow security policy arguments to apply alongside economic considerations, these would have to be given a very high monetary valuation for the calculation to turn around. And if production problems occur in a situation of restricted foreign supply relations at home, the damage would be maximum.

Starting from a situation of well-diversified supply networks, it obviously does not make sense to concentrate procurement on friendly countries ("friendshoring") because this reduces the diversity of domestic supply relationships. Conversely, expanding supply networks to countries with which friendly relations exist makes sense if (but only if) diversification is improved in this way.

3. More Diversification for More Security of Supply

The premise of government and corporate policy should be to diversify German and European supply chains sufficiently so that the failure of one supplier or one supplier country does not jeopardise the entire supply. Diversification has the great advantage that it can hedge risks of various kinds, whether supply chains are interrupted by political events, natural disasters, pandemics, or technological breakdowns.

The prerequisite for diversification is that there are different sources of supply and that the risks of supply disruption are not perfectly correlated. If the risks are too highly correlated or there are too few supply sources, there are narrow limits to diversification. Moreover, determining an optimal degree of diversification is not easy. One would need to know their expected strengths in addition to the correlation of shocks as mentioned above. Moreover, one would need information on technical substitution possibilities, on the variable costs of procuring alternative sources of supply and on the fixed costs of maintaining supply relationships. This information is rarely available to government agencies. The management of supply chains and the responsibility for their resilience in crises is therefore fundamentally a private sector task due to the information deficit of the public sector.

Government subsidies for such diversification make sense if companies themselves do not have sufficient incentives to ensure a diversified portfolio of suppliers. This could be the case in view of systemic and geopolitical risks, as shown in Chapter III.

4. Expand Reciprocity of Bilateral Dependencies

Mattoo and Staiger (2020) show that unilateral bilateral dependencies can be abused for opportunistic deployment. The attractiveness of such behaviour can be reduced by the (tacit) threat of countermeasures. However, this requires the existence of a threat potential. In short, for there to be sufficiently strong incentives for cooperative behaviour, reciprocal dependencies are needed. It is therefore important not only to have a good grasp and understanding of one's own dependencies, but also to be clear about how trading partners depend on German and European goods and services. Reciprocity in this sense, however, cannot be measured by the balance of bilateral trade, because even if exports are equal in value to imports, it is not certain that an interruption of supply would be associated with similar or even equal economic losses. In addition, the political costs for a foreign government should not be equated with economic costs alone.

Gehrke and Ringhof (2023) recommend expanding technological leadership positions in a targeted manner to maintain sustainable pressure points vis-à-vis trading partners. The best instrument for this is a smart innovation and technology promotion policy that specifically seeks to strengthen comparative advantages instead of compensating for comparative disadvantages.

5. Security Policy Aspects in Foreign Trade Law

As is well known, there is a multi-faceted set of foreign trade policy instruments in world trade law. Often, however, these are not very targeted, for example when the most-favoured-nation clause of trade law forces the application of a measure to all trading partners. Anti-dumping duties under Art. VI GATT are more targeted because they are aimed at specific trading partners and products. But they are also more specific in their justification. For example, they can be implemented to prevent a foreign supplier from using predatory pricing to achieve a monopoly position with the objective to exploit it politically or economically. In addition, there is the possibility of temporary safeguard duties under Art. XIX GATT if there is a rapid and massive increase in imports. Finally, subsidies are subject to Art. XVI GATT and the rules of the "Agreement on Subsidies and Countervailing Measures"; in the event of a breach of the rules, countries can introduce compensatory tariffs.

GATT and WTO also provide legitimacy for security restrictions on trade. Article XXI allows exceptions for national security. In recent years, use has been made of this provision after it had been rather taboo for many years – for good reason, since it is the right of every sovereign nation to define for itself what threatens national security and what not. Thus, Article XXI is difficult to litigate in the WTO courts (although it does happen). The most famous case is that of the USA under President Trump, which began imposing additional tariffs on steel and aluminium imports in 2018, citing national security concerns.

The world trade order has inherent difficulties with national security issues, as it was created to achieve reciprocal welfare gains in a context of positive-sum games. It cannot deal with the zero-sum game logic of international rivalries; it lacks the instruments to do so. Article XXI also has tough preconditions that go beyond mere endangerment. Moreover, the permitted reactions to breaches of the rules by trading partners are only aimed at compensating for the economic damage caused and not at punishment – the talk of "punitive tariffs" is therefore often out of place.

Nevertheless, it is welcome that the EU and the German government want to make aggressive use of the possibilities offered by WTO law. In the same way, relevant provisions in the EU's bilateral trade agreements should be actively used. The establishment and appointment of a Chief Enforcement Officer in the EU Commission's Directorate-General for Trade to monitor compliance and drive enforcement is therefore a welcome development.

While there are trade law instruments at the EU level, the German Foreign Trade and Payments Act offers the possibility of export and investment control. In the latter area, it is increasingly not only a matter of checking investments at home, but also German investments abroad, especially if these lead to a dissemination of technological know-how. This is the focus of the German government's new China strategy, for example. In practice, however, there are increasing problems of demarcation: Almost all new technologies have uses in both the military and civilian sectors. The policy of "civil-military fusion" promoted by the Chinese leadership poses a challenge here. Thus, the narrow definition of the sectors and goods relevant for export and investment controls proposed by Steinberg and Wolff (2023), which the Scientific Advisory Board agrees with in principle, is hardly feasible. In practice, the demarcation problems, especially in the high-tech sectors, are likely to turn the intended de-risking into a far-reaching de-coupling.

It is obvious that a Europeanisation of the latter instruments would be highly useful for preserving the integrity of the internal market and for increasing the effectiveness of the measures.

6. Market Structure and Free Competition

Competition law has the task, in accordance with the objectives of German and European competition law, of ensuring functioning competition between different suppliers as well as guaranteeing opportunities for substitution and diversification. This is particularly in line with the interests of consumers. The situation is somewhat more complex when considering market power on the (domestic) demand side. This is because, especially in the face of a supply side that offers only few alternatives, this can counteract the resulting supply-side market power and thus excessive price increases in the event of bottlenecks. However, increasing buyer power is often accompanied by an increase in supply-side market power. Here, German and European competition law already allow for a balancing in the sense of consumer welfare.

In the case of a dominant position, German and European competition law also allow action to be taken against excessive prices by means of the concept of exploitative abuse. However, it must be considered that an abuse of price levels is always measured against the counterfactual scenario without the existence of a dominant position. In the case of general supply bottlenecks, it may therefore be difficult in practice to causally attribute significant price increases to the exploitation of a dominant position. On the other hand, the necessity of such proof of causality prevents the imposition of purely politically opportune "market outcomes", possibly at the cost of considerable long-term efficiency losses.

The achievement of higher security of supply can in principle also be subsumed as efficiency under consumer welfare and thus be considered, for example, in merger decisions. Hypothetically, this could also be the case, for example, in vertical mergers in which a strong buyer secures a source of supply for an essential input, provided that domestic consumers demonstrably benefit. In the Coronavirus epidemic, antitrust practice has also proven flexible in granting temporary exemptions in cooperations to cope with acute supply bottlenecks and, for example, through so-called "comfort letters" (so-called "chairman's letters" of the Federal Cartel Office).

If we initially consider only the purely economic aspects of excessive prices in the event of bottlenecks and of security of supply in general as well as in emergency situations, the existing competition law already offers sufficient possibilities to take these into account in the interest of consumers.

As before, however, the focus of our consideration is on achieving goals that go beyond economic efficiency. In particular, this relates to security policy concerns in avoiding dependency on individual countries for critical resources. In individual cases and with corresponding outstanding importance, this may concern the achievability of other political goals, if it must be assumed that companies lack corresponding incentives. This raises the question of the extent to which European and German competition law take such non-competitive aspects into account. In merger control, this is explicitly the case in Germany through the instrument of ministerial approval. European merger control only provides for the consideration of non-competitive aspects as a recital and only to the extent that they explicitly fall within the framework of the activities and objectives of the Communities.[26] It is open to what extent aspects of security of supply are covered here, for example, by the industrial policy newly included in the catalogue of the Communities' activities.

From the Scientific Advisory Board's point of view, however, this does not result in a deficit, precisely because the consideration of non-competitive aspects, insofar as they are covered by the catalogue of activities and objectives of the communities, is not excluded per se and, as the example of state aid control, which is not taken up further here, shows, practice has already proven to be sufficiently flexible. There is therefore no justification or even necessity for an explicit softening of competition law to also achieve other objectives that go beyond consumer welfare, also from the aspect of security of supply.

26 This is decidedly different in various member states, as they explicitly apply an extended standard of review, for example in merger control, which in Sweden, for example, explicitly takes national security and supply interests into account.

V. Measures to Promote Procurement Diversification

1. Customs Policy Measures and Free Trade Agreements

The excessive concentration of supply chains in a few countries could be addressed in a targeted manner with the help of special quota duties. This refers to tariffs on imports of raw materials or intermediate products from countries whose supply shares exceed a certain percentage. If imports from such countries become more expensive, companies have an incentive to turn to sources of supply from other countries or to substitute the respective product with other products. For example, it could be envisaged in future that liquid or pipeline gas can be imported duty-free into the EU from those countries whose shares of total imports into the EU do not exceed 25 percent. To avoid the need for additional quota duties for specific member states, which would hardly be compatible with the principles of the European Customs Union, such a policy would have to be accompanied by an expansion of the intra-European distribution infrastructures. The goal would be for EU imports to be both duty-free and sufficiently diversified. Such a quota tariff is currently incompatible with WTO law, even if it were a proportionate instrument to pursue legitimate national security objectives under Art. XXI GATT (National Security Exception). A quota tariff can also not be implemented with the help of Art. VII GATT (Safeguards), because this would require proof of a threat to the economic situation of the industry directly affected by import competition through surprisingly increasing imports. In a reform of WTO law, the concern for security of supply should be considered.

Where the EU still has external tariffs on inputs or raw materials, it can vary them within the framework agreed under WTO law, i.e., without discriminating against trading partners. For example, there are tariffs on lithium and gallium, on many steel products or other metals. Tariff barriers are still particularly pronounced in the agricultural sector. These tariffs could be adjusted according to the situation: When world market prices are high, they could be lowered; when world market prices are low, import tariffs could be raised to the maximum WTO-compliant rate. Switzerland maintains such a system of "breathing tariffs". This cannot directly promote diversification, because the system would have to be applied equally to all trading partners. However, the price effects of shortages could be mitigated in this way. It could also provide incentives to develop alternatives to the respective imported goods.

For companies to diversify, they need the best possible and least bureaucratic access to as many international procurement markets as possible. This means that Germany should push for free trade agreements in the EU that minimise import tariffs or non-tariff restrictions on trade. However, this requires a strategic shift: instead of focusing primarily on opening new sales markets for European goods and services, the security of supply for its own economy must gain in importance as a strategic goal for the entire EU trade policy. This means, among other things, that the EU must conclude agreements with countries that are particularly important as procurement markets for raw materials. Such countries have so far been granted unilateral trade advantages by the EU in the context of the Generalised System of Preferences, making access to the European market conditional on compliance with human or environmental rights. In times of greater scarcity of raw materials and high prices, the conditions for granting preferences should be reviewed and adjusted if necessary. The negotiation and adoption of agreements on critical minerals – a process the EU has started with the USA or Chile, for example – is to be welcomed and a good step away from comprehensive free trade agreements under Art. XXIV GATT.

The Federal Republic of Germany maintains a well-functioning system of export credit insurance (Hermes guarantees). This can be adapted to give companies incentives to better diversify their sales markets, for example by making the conditions dependent on how high the share of German companies in the target markets already is. While the Hermes guarantees are intended to support the financing and settlement of export transactions, the instrument of guarantees for untied financial credits (UFK guarantees) provides support for the settlement of commodity imports. Compared to Hermes guarantees, UFK guarantees are much less in demand. In times of rising interest rates, however, this could change. In any case, UFK guarantees should be granted with the aim of diversifying Germany's sources of raw materials. The export and import guarantees are coordinated internationally via an OECD body to avoid distortions of competition. It should also be considered whether the instruments, which exist in different forms in all EU member states, should not be replaced by a uniform European procedure to adequately consider the integrity of the internal market and the close interconnectedness of intra-European production networks.

2. Investments to improve security of supply

In many cases, it is not possible to diversify the procurement base because there are only a few countries where certain raw materials are produced or because the production capacities are limited. It can therefore make sense for German and European companies to invest in countries rich in raw materials to find alternative sources of supply. Because legal certainty is often not sufficiently well guaranteed in these countries, investment promotion and protection agreements (International Investment Agreements, IIAs) have been concluded in the past. These have fallen into disrepute since the discussion about the transatlantic free trade agreement TTIP. The fundamental criticism is not objectively justified, because the agreements address the very real problem that German or European investments in third countries are exposed to a political risk against which investors cannot defend themselves in normal courts. If foreign investments are too risky, they are not made. The result can be that the procurement base of domestic companies is not sufficiently diversified.

The Scientific Advisory Board commented on this in 2018 and proposed a reform of IIAs to reduce the risk for European investors.[27] IIAs should be focused on Foreign Direct Investment, elevated to EU level and offered to third countries with new engagement. Germany's withdrawal without replacement from the Energy Charter, a multilateral IIA for investments in electricity, gas, steam and air conditioning supply, seems problematic, especially against the background of supply difficulties with gas and new renewable energy sources to be developed in sun- and wind-rich areas of the world.

Germany grants guarantees for foreign investments, but only under certain conditions and if an IIA is available. So far, like the Hermes loans, it is mainly economic indicators that are relevant. It would make sense to take the total economy criterion of securing the supply of raw materials into account when granting guarantees. Germany has some catching up to do here: In contrast to other EU states, the country has virtually no foreign investments in raw material supply; see Felbermayr and Yalcin (2016). Especially in countries where the human rights situation is problematic, investments from Europe and Germany can trigger changes for

27 Scientific Advisory Board at the Federal Ministry for Economic Affairs and Energy (2018).

the better. If they fail to do so, investments from countries like China are likely, where human rights violations play no role in the assessment of an investment location. In any case, the granting of investment guarantees should take geostrategic and security of supply policy arguments into account.

For raw materials and industrial primary products to reach Germany safely and at good prices, a good infrastructure is needed. The Chinese government initiated this many years ago; the Belt and Road Initiative is aimed precisely at opening procurement and sales markets for its own benefit; development policy goals take a back seat. Infrastructure such as ports, road or rail connections are in principle available to all trading partners of the countries in which they are developed. In practice, however, it often turns out that access is not equal and Chinese companies are favoured (Bluhm et al., 2018). It is important that Europe and Germany make attractive offers to countries in the global South. In addition to the human rights situation, arguments such as the country's own security of supply or geostrategic influence should find their way into investment decisions made by publicly financed development banks in Germany and Europe. Furthermore, the protection of transport routes must be given higher priority. For example, Sandkamp et al. (2022) empirically show that pirate activities on European sea routes to and from China have negative consequences for maritime trade. The recent announcements by the EU and the USA to push ahead with the development of an India - Middle East - Europe Economic Corridor and a Trans-African Corridor within the framework of the Partnership for Global Infrastructure and Investment are therefore to be welcomed.[28]

3. Measures if diversification of supplier countries is not possible

As described above, it is not possible or efficient to fully control all supply risks through diversification. In the case of products whose manufacture is associated with strong economies of scale, an increase in the global number of production sites is associated with substantial cost increases. This is the case in battery cell production or in the manufacture of computer chips. In such markets, purely market-based processes lead to a sub-optimally small number of producers in the presence of a security externality (see Chapter III). Therefore, it may be justified to promote the location, establishment or scaling of production facilities in the EU (or even abroad) with subsidies.[29] However, the correct calibration of subsidy policy is difficult. The risk of subsidy races is high and there is a threat of global overcapacity.

For products where there are only a few sources of supply or where the risks over the possible suppliers are highly correlated, the establishment of strategic stocks may be necessary, as for example in the case of petroleum stockpiling, which is regulated by the "Act on Stockpiling of Petroleum and Petroleum Products". But because stockpiling is expensive when interest rates are positive, there are limits to this strategy and unconditional security of supply cannot be established. The government should consider providing additional fiscal incentives to build sufficient stocks of critical inputs. It should ensure that companies can create storage capacities – this requires appropriate zoning and the approval of storage buildings. And it should consider state-organised strategic storage for inputs that play a key role

28 https://ec.europa.eu/commission/presscorner/detail/en/ip_23_4421

29 Modern research on the meaningfulness of industrial policy is less sceptical than older research, both in terms of its theoretical foundation and empirical evidence. Liu (2019), for example, shows in a model in which economic sectors form a production network via input-output linkages that market imperfections lead to distorting effects that are amplified by feedback loops. Therefore, upstream sectors become a reservoir of imperfections and exhibit the greatest distortions. As a result, there is an incentive for a well-meaning government to subsidise upstream sectors.

in many industries. The establishment of a strategic gas reserve, for instance along the lines of the strategic oil reserve, is a good example of this. It would be important here that such reserves are pooled EU-wide and used to manage prices – in the oil market this has been done for decades in close coordination with the USA.

A second means of improving the security of supply of poorly diversifiable raw materials or intermediate products is through fiscal and regulatory subsidies for recycling. "Urban mining" is the extraction of valuable raw materials, such as copper, silver, and gold from waste, such as that produced by shredding old cars. But this requires suitable facilities in Germany or the EU. Above all, it needs a minimum of planning certainty, because if commodity prices fall again on the world markets, the processing plants will no longer be profitable. Because recycling produces far fewer CO_2 emissions than production from raw materials, a high domestic CO_2 price combined with effective CO_2 border adjustment makes domestic processing more profitable than imports, even if world market prices fall. Finally, standards are needed for the efficient recycling of complex products, for example regarding the ease with which batteries from household appliances can be dismantled.

A third sensible approach is to direct research policy towards exploring technological substitutes for raw materials or intermediate products that are difficult to diversify.

4. The state as a buyer

In many areas, the state is itself active as a buyer, albeit often indirectly. The market for medical products, for example, is dominated by demand from public health insurance companies. In the last few decades, they have mainly worked to reduce the pecuniary costs for the health system, for example with regularly recurring mandatory discounts for the pharmaceutical industry, which has reacted by outsourcing and concentrating on the cheapest suppliers. At the same time, the health insurance companies do not seem to have prioritised security of supply sufficiently, also because this would have entailed additional costs. As a result, bottlenecks arose when shocks occurred. In such highly regulated markets, the lack of diversification is not always a result of market or management failure, but occasionally of government or regulatory failure.

In any case, in these markets, which are shaped by nation states, it is necessary to consider the effects of one's own measures on the integrity of the EU internal market. In other EU states, it is being observed with concern that Germany is offering up to 50 percent higher prices to the pharmaceutical industry in order to secure its own supply of medicines, which can endanger the security of supply in other countries. As already emphasised several times: in a single market, close coordination of the EU member states is needed to manage supply crises.

5. New markets for supply security

Finally, newly created markets can counteract the tendencies towards suboptimal low diversification or stockpiling described in Section III.[30]

Forward transactions for crisis situations – pull incentives

A commitment by the public sector to spend funds on certain products in the future is known as an Advance Market Commitment (AMC). AMCs go back to Nobel laureate Michael Kremer, who proposed this instrument at the beginning of the millennium for the development of drugs and vaccines against diseases in developing countries. The government commits in advance to buy a predetermined quantity of the respective product at a certain price.

If one wants to use this instrument to prepare for crisis situations, it must additionally be defined when exactly the obligation to purchase by the public sector takes effect. The trigger could be, for example, that the market price of the commodity or intermediate/finished product exceeds a certain level.

When such AMCs are in place, companies can better plan for crisis situations. This reduces the concern that the government will intervene in market prices or tax (windfall) profits in these situations, as they have previously contractually committed to these AMCs. This makes investments in alternative supply channels and stockpiling more attractive.

Such contracts are discussed under the term "pull incentives", as the expectation of future business provides incentives for present investments; the investments are "pulled". These are to be distinguished from "push incentives" where companies get funds to make the respective investments; here the investments are "pushed".

Capacity markets – push and pull incentives

It will often be insufficient or poorly targeted to encourage companies to invest today with the expectation of assured profits in times of crisis in order to be prepared for these usually very rare times of crisis. Then it may be additionally necessary to provide financial support for this preparation.

Capacity markets, which are known from the electricity market and are used in the USA or France, for example, do exactly this (Cramton, Ockenfels and Stoft 2013). Electricity producers apply for contracts on the capacity market, with which they enter into the obligation to supply electricity at a predetermined price at certain times – e.g. when the electricity price exceeds a certain level. In return, they now receive funds, payment on the capacity market.

30 Innovative market design can also contribute to easing the situation after a crisis has occurred, as e.g. Cramton et al. (2020) show.

Pandemic preparedness contracts

The Federal Government has used an adaptation of a capacity market 2022 in connection with the Corona pandemic and possible future pandemics (Ockenfels 2021). Five pharmaceutical companies based in Germany have entered into so-called pandemic readiness contracts. These contracts ensure the availability of manufacturing capacities for vaccines; they include agreements for the production and delivery of vaccines to the federal government in the event of a pandemic. The Federal Government expects costs of up to 2.861 billion euros for the years 2022 to 2029.

The contracts are managed by the Centre for Pandemic Vaccines and Therapeutics (ZEPAI), which is located at the Paul Ehrlich Institute. The companies that have been awarded contracts for various technology platforms (mRNA vaccines, vector vaccines, protein vaccines) are currently in a two-year qualification phase, which is being carried out in close coordination with ZEPAI. After that, ZEPAI will assess whether they are pandemic-ready and can enter the pandemic readiness phase.

The contract not only includes the provision of vaccine production capacities, but also further requirements to secure raw materials and supplier products, whose production in Germany will be expanded as a result.

In the event of a crisis, which takes place after being called off by the federal government, the companies are obliged to produce up to 80 million vaccine doses per contract and make them available to the federal government. Payment is made at “market prices”, which are further determined by the contracts. The total quantity of vaccine doses is calculated very generously at up to 400 million in total, so that a contribution is made to the European supply if the entire production is used.

The European Union has also set up its own contracts (EU FAB), which are managed by the Health Emergency preparedness and Response Authority (HERA). These contracts provide funding to companies that have production capacity for one or more of the three vaccine technologies in the EU or in countries of the European Economic Area. At € 160 million, however, this programme is much smaller than the German one.

6. Transparency about supply chain risks

The analysis by Grossman et al. (2023) discussed in Chapter III shows that private incentives may be sufficient to optimally diversify supply chains, at least in the absence of security externalities and systemic risks. However, a prerequisite for this is that market participants and regulators are properly informed about the risks. The study does not address the fact that information asymmetries may exist between management and owners of companies on the one hand and the authorities on the other. In the literature on financial market risks, however, this is a problem that is often addressed with empirical evidence. Despite years of efforts, transparency about risks and their hedging in this sector is still insufficient. Therefore, it can be assumed that making risks in supply chains transparent is not a trivial undertaking.

Nevertheless, transparency obligations on supply chain risks are among the measures that the Scientific Advisory Board considers necessary to improve security of supply. Regular reporting on supply chain risks should enable the capital market to make correct risk-adjusted estimates of company values. It should help government authorities to identify and address systemic risks at an early stage. In addition to the reliability of supply relationships, there is other information about supply chains that is of concern, such as CO_2 emissions, cumulative and in the individual processing steps for purposes of carbon offsetting, or the risks arising from the requirements of the Supply Chain Sourcing Obligations Act. The Advisory Board is concerned that additional reporting obligations will burden companies with costs. It is therefore important to create structures that are as efficient as possible. For example, it is typically cheaper not to check all possible occurring (Foreign) supply relationships of the national economy, but to monitor the suppliers and to share the information about them in an appropriate way and to link them along the supply chains. Private sector solutions should be found for this as far as possible, but they require state supervision. The establishment of a European supply chain certificate could therefore be a worthwhile option.

7. Accompanying measures

German and European policy should ensure that other foreign trade policy initiatives do not have counterproductive effects on security of supply. All measures relevant to foreign trade should be examined regarding their intended and unintended as well as direct and indirect effects on the security of supply, especially with regard to the question of whether they promote or impede diversification. All measures should be coordinated as far as possible with partner countries such as the USA or Japan.

VI. For a European Security of Supply Office – ESSO

Information from public authorities that is adequate and as comprehensive as possible is needed to ensure security of supply. In addition, competences are needed for the development and implementation of preventive and downstream measures, which must be synchronised and harmonised across the EU in order not to jeopardise the integrity of the internal market. The Scientific Advisory Board therefore proposes the establishment of a European Supply Security Office (ESSO).

If companies can expect to receive state support in the event of supply chain disruptions, they are not diversifying their supply chains sufficiently because this can save costs in the short term. On the part of the state, it should therefore be made as clear as possible from the outset that there will be no bailouts without substantial deductibles if risks materialise. For such announcements to be credible, the government must create clear structures and rules for the insurance of supply chain risks. Because – like bank bailouts – it is hardly possible to deny state support in the event of a risk materialising and thus to socialise private losses that occur, it is appropriate for the government to be aware of the risks and, under certain circumstances, to intervene in a forward-looking regulatory manner if high vulnerabilities build up in companies or sectors.

Companies that want to secure their own supply chains rely on information that they currently do not have or only have to a limited extent (e. g. on the supply chains of their own suppliers, on the prevalence of political or other risks). To evaluate existing or proposed measures to improve supply security, an impact analysis is needed, for which competences on supply chains are necessary. As outlined above, such analyses need to be systemic in nature and take place at the European level.

The above-mentioned European Office for Security of Supply should collect, systematise, and provide quality-assured relevant information and carry out corresponding analyses. Experience with the European Systemic Risk Board (ESRB) can be used here.[31] In addition to internalising cross-border effects within the EU, a European institution can use economies of scale that are not available at national level.

The ESSO should (i) monitor and assess systemic risks in European supply networks, (ii) support companies in risk management about operational supply chains, (iii) develop measures to limit systemic risk and introduce them into the political process, and (iv) assess measures taken by member states or third countries with regard to their impact on European security of supply. As shown above, the existence of such a new institution can be justified in terms of welfare economics.

The ESSO could support the implementation of stress tests, together with the largest importers of critical raw materials, inputs or services (as recommended in the EU's draft Raw Materials Act (RMA)). Scenarios for adverse economic and policy developments need to be developed and coordinated with national agencies. The ESSO could issue warnings on vulnerabilities in the European Union when significant systemic risks to security of supply are identified. The ESSO could comment on the appropriateness of certain proposed measures before they are adopted at national or European level.

The ESSO's tasks would also include (i) identifying and quantifying potential systemic risks, (ii) designing crisis resilience audits (as recommended in the RMA) and accrediting private auditors, (iii) coordinating joint strategic reserves and their management, and (iv) developing and evaluating national or joint

31 The ESRB is responsible for macro-prudential oversight of the EU financial system and for the prevention and mitigation of systemic risk. As part of its mandate, the ESRB monitors and assesses systemic risks and issues warnings and recommendations as appropriate.

supply chain crisis mitigation tools. In addition, the ESSO could conduct and/or provide information for the screening of suppliers in problem countries.

The ESSO could produce or commission reports on potential systemic risks in supply networks and give specific mandates to expert groups to assess supply chain risks. It could publish, by analogy with the ESRB Risk Dashboard, a set of quantitative and qualitative indicators of systemic risk in European supply networks.

The ESSO should be integrated into the interaction of national and European institutions in such a way that redundancies, unclear responsibilities, and additional bureaucracy are avoided. For example, a "European Critical Raw Materials Board" is proposed in the planned RMA, and an advisory board is envisaged in the "Single Market Emergency Instrument". The Authority for Emergency Preparedness and Response (HERA) also has overlapping competences.[32] By bundling activities, the greatest possible synergies should be created.

Because questions of international security of supply are inherently connected with political, especially foreign policy aspects, for which the responsibilities are shared between the EU and the member states, the ESSO should not be constructed as an independent agency with its own decision-making powers but should work with the European and national institutions. Subsequently, the ESSO could be further developed in the course of treaty adjustments.

For its activities, the ESSO will be dependent on information from the companies. For this purpose, appropriate legal foundations must be created that regulate the rights and obligations of those concerned. These should not only specify the contents that the companies are obliged to provide, but also legally viable procedures for adapting these contents, e.g. the critical goods and risks, to changes in circumstances.

32 Steinberg and Wolff (2023) have recently proposed the establishment of a "European Economic Security Committee", which would take on tasks similar to those of the ESSO recommended in this report.

VII. Concluding remarks

Germany and many other countries in the EU owe their prosperity, among other things, to specialisation in high-value niche products whose production requires the availability of intermediate products and raw materials from many countries and which are sold worldwide. This economic model depends on secure and largely unhindered access to world markets. In recent years, this system has come under threat as various trading partners have sought to exploit Europe's dependence on certain supplies from abroad and on certain export markets to gain foreign policy concessions. At the same time, the COVID-19 pandemic has highlighted how vulnerable domestic supply chains and security of supply can be. The current inflation crisis is partly due to supply-side disruptions.

The German government and the EU therefore advocate de-risking, which should lead to a reduction in unilateral dependencies and thus to greater resilience and less susceptibility to blackmail, without leading to isolation vis-à-vis individual or several trading partners (de-coupling). The Scientific Advisory Board welcomes this strategy. However, the transition between de-risking and de-coupling is a fluid one, for example because all important future technologies have both civilian and military fields of application.

In this report, the Scientific Advisory Board shows how a policy to reduce such risks can be justified in terms of welfare economics and which measures appear sensible. The Advisory Board opposes protectionist policy approaches and calls for a clear justification of all measures. Where measures appear necessary to maintain security of supply, a coherent derivation is needed.

The Scientific Advisory Board emphasises that a European perspective is central to both the assessment and the development of economic policy responses. Not only does competence for most foreign economic policy fields lie at the EU level; the integrity of the internal market and its dynamism are the best insurance against attempts from abroad to instrumentalise any dependencies. To ensure that national policies and initiatives are optimally dovetailed with the European level, the Advisory Board recommends the establishment of a European Supply Security Office to harmonise the collection of data on supply chains, develop uniform stress tests and monitor the impact of national policies on the internal market.

In this report, the Scientific Advisory Board develops a welfare economic framework that can be used to justify government supply chain policies. The core of the argument is that individual companies, even large ones, are too small for their sourcing strategies to have a noticeable impact on the strategic autonomy of the EU or Germany in each case. Therefore, such effects are rationally ignored. In sum, however, this results in strategic dependencies (an excessive concentration of imports on a few, low-cost supplier countries) that are problematic for companies and the entire economy. In this context, the report speaks of a security externality. If companies expect government aid measures such as short-time allowances to be used in the event of a supply chain disruption, this creates further incentives not to sufficiently diversify supply chains.

The Advisory Board is sceptical about drawing up lists of critical goods, technologies, or sectors according to objective standards for the purpose of financial support by the general government or deriving foreign trade policy measures. What is considered scarce or strategically critical is context-dependent and time-varying. Information on supply networks, especially abroad, is fragmented. Where a large number of suppliers exist at one point in time, mergers and market exits can create a monopoly in a short period of time, which can be opportunistically abused by host governments.

Therefore, the compilation of such lists remains an inherently political task. The Scientific Advisory Board recommends making the processes and criteria transparent to prevent excessive influence by special interests. However, it is clear that economically relevant dependencies exist not only in goods (primary products, raw materials), but also in a variety of services, from specialised financial services to software, and that dependencies do not only exist vis-à-vis China.

To avoid the emergence of dependencies, the Scientific Advisory Board advocates appropriate regulatory frameworks that can internalise the above-mentioned security externality. In doing so, conflicts with applicable WTO law can arise, for example if import tariffs are designed in such a way that they increase when a threshold value of the concentration of imports from a supplier country is exceeded. The Advisory Board recommends a number of measures that make it easier for companies to diversify their supply networks. Free trade agreements are among them, as is the promotion and facilitation of foreign investment to develop alternative sources of supply. Finally, the creation of special markets for supply security – analogous to capacity markets – could improve the security of supply of the Federal Republic and the EU.

The Scientific Advisory Board recommends the creation of a European Supply Security Office (ESSO). Such a body should ensure the coherence of national policies in the EU so that the integrity of the internal market is not jeopardised. It should set standards, for example for the conduct of stress tests or for company reporting and contribute to the best possible supply of adequate information on supply chain risks. When establishing it, care should be taken to reduce redundancies between national and European institutions and to avoid additional bureaucracy.

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Members

The report was prepared by the following members of the Scientific Advisory Board to the Federal Ministry for Economic Affairs and Climate Action

Professor Gabriel Felbermayr, Ph. D
(in charge)
Director of the Austrian Institute of Economic Research (WIFO)
Professor at the Vienna University of Economics and Business

Professor Dr. Felix Bierbrauer
Chair for Public Economics and Center of Macroeconomic Research
at the University of Cologne

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Director Emeritus Max Planck Institute for Research on Collective Goods
Professor Emeritus of Economics at the University of Bonn

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Professor of Finance and Economics
House of Finance
at Goethe University Frankfurt

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at the University of Mannheim

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Professor of International Economics
Düsseldorf Institute for Competition Economics (DICE)
at the Heinrich Heine University Düsseldorf

Professor Achim Wambach, Ph. D.
President of the ZEW – Leibniz Centre for European Economic Research in Mannheim
Professor of Economics at the University of Mannheim

List of the other members

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Professor of Economics,
Technische Universität Berlin
Director of the Research Unit "Market Behavior", WZB Berlin Social Science Center

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Department of Humanities, Social and Political Sciences
at ETH Zurich, Switzerland

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at the University of Basel

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Professor Emeritus of Economics
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Professor of Law
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Professor Emeritus of Economics
at the University of Mannheim

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Professor of Macroeconomics and Development
at Goethe University Frankfurt

Professor Christina Gathmann, Ph. D.
Head of the Labor Market Department, Institute for Socio-Economic Research (LISER), Luxemburg
Professor of Economics
at the University of Luxembourg

Professor Dr. Hans Gersbach
Professor of Macroeconomics: Innovation and Policy
Founding Member of CER-ETH – Center of Economic Research
at ETH Zürich, Schweiz

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Honorary Professor for Entrepreneurship and Innovation
at the University of Munich (LMU)

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Frankfurt am Main

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at the University of Tübingen

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Professor of Economics
at the University of Cologne

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Professor of Empirical Economics
at Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU)

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https://www.bmwk.de/Navigation/DE/Ministerium/Beiraete/Veroeffentlichungen-Wissenschaftlicher-Beirat/veroeffentlichungen-wissenschaftlicher-beirat.html

The roots of the Scientific Advisory Board to the Federal Ministry for Economic Affairs and Energy go back to the time of the Second World War. From 1943, some of the later members of the advisory board met under the chairmanship of Prof. Erwin von Beckerath to prepare Germany's economic future after the war. This so-called "Consortium Erwin von Beckerath" merged into the Advisory Board, which was founded at the beginning of 1948 and formally constituted on January 23, 1948 in Königstein/Taunus at the invitation of the Administrative Office of Economy, the predecessor of the Federal Ministry for Economic Affairs and Energy.

The Advisory Board had the following 17 founding members:

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