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AT WHAT POINT DO TRADE LINKAGES BECOME A CONCERN?

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Towards Demystifying Trade Dependencies: At What Point do Trade Linkages Become a Concern?

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Supply chain disruptions related to natural events or geopolitical tensions have in recent years prompted policy makers to identify potential vulnerabilities related to critical trade dependencies — commercial links that could potentially impose significant economic or societal harm, be a source of coercion, a risk to national security, or disrupt strategic activities. Using three complementary methodologies — detailed trade data analysis, input output data techniques, and computable general equilibrium (CGE) modelling — this paper examines the nature and evolution of trade dependencies between the OECD countries and major non-OECD economies (MNOE). It shows that global production has become increasingly concentrated at the product level, with China representing 15% of import dependencies in strategic products for OECD countries in 2020-21 compared to 4% in 1997-99. The methodologies used in this paper unanimously demonstrate a high degree of trade interdependency between OECD and MNOE countries. The current debate on "de-risking" international trade, therefore, needs to carefully consider the possible costs and benefits of different policy choices.

Key words: Global supply chains, global value chains, international trade, input-output analysis, computable equilibrium analysis, supply concentration, market concentration

JEL codes: F6, F14, F15, C67, C68

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Glossary

APAC	Asia-Pacific
BACI	CEPII's International Trade Database at the Product-level
BEC	United Nations' Broad Economic Categories
CEPII	Centre d'études prospectives et d'informations internationales
CGE	Computable General Equilibrium
CPB	Netherlands Bureau for Economic Policy Analysis
CRMs	Critical Raw Materials
EU	European Union
FIR	Foreign Input Reliance
FMR	Foreign Market Reliance Index
G7	The Group of Seven (Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States)
GTAP	Global Trade Analysis Project
GVCs	Global Value Chains
HHI	Herfindahl-Hirschman Index
HS	United Nations' Harmonised System
ICIO	Inter-Country Input-Output
IDP	Ideal Point Estimate
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification of economic activities
METRO	OECD's global computable general equilibrium trade model
MNOEs	Major non-OECD economies (Brazil, China, India, Indonesia, Russia and South Africa)
OECD	Organisation for Economic Co-operation and Development
PIF	Potential Impact Factor
PTF	Pass Through Frequency
RCA	Revealed Comparative Advantage Index
SMEs	Small- and Medium-Sized Enterprises
TiVA	OECD Trade in Value Added Database
UN	United Nations
USMCA	United States-Mexico-Canada Agreement
WTO	World Trade Organisation

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Key findings and messages

This report examines the nature and evolution of trade dependencies in OECD and major-non-OECD economies (MNOEs)[1] combining detailed trade data analysis, input-output data techniques and computable general equilibrium (CGE) modelling.

Concentration of global and national trade and bilateral import dependencies

- Since the late 1990s, **both global exports and imports of products[2] have become gradually more concentrated,** featuring fewer exporters and importers, and global exports of products are currently, on average, two times more concentrated than imports.
- There is a considerable variation in levels of export concentration across different products: **exports of close to 30% of products are relatively highly concentrated,** but the remainder are relatively well diversified. This suggests that **large portions of international product markets are characterised by a reasonable degree of competition**, and that specific exporters and importers have a limited control over supply or price formation.
- **Countries typically source their imports from — and ship their exports to — fewer partners than is in principle globally possible**. Concentrations of national imports have also grown more quickly than concentrations of national exports and this might explain the current focus in public debate on import dependencies.
- The relatively **higher country-level concentration of imports likely reflects a combination of natural factors**, such as the role of geography and trade costs in global value chains (GVCs), **as well as countries' preferences and policies** (e.g. preferential trade agreements, strategic economic policies of importers and exporters). In particular, the rise in national import concentration has coincided with raising shares of The People's Republic of China (hereafter "China") as a source of imports while shares of the other major trading partners fell.
- 'Excessive concentration' of national imports, where countries rely on significantly fewer suppliers than is offered by international markets, has increased globally but this increase is accounted for by mainly MNOEs and other non-OECD countries, while **excessive import concentration has decreased on average for OECD countries.**
- This suggests that a significant portion of **firms and consumers in at least some OECD countries have been able to take advantage of diversification possibilities offered by international markets.**
- **Relatively high import value shares can be attributed to relatively few highly concentrated bilateral import links.** This means that, beyond being of interest to specific countries, sectors, firms and consumers, such dependencies may also matter for the economy as a whole.

[1] Brazil, China, India, Indonesia, Russia, and South Africa. This focus is purely analytical and is without prejudice to the relationships between the OECD or any of its members and any of the individual countries of the MNOE grouping.

[2] As classified at the 6-digit level of the UN's Harmonised System of product classification.

- The average per country incidence **of bilateral import dependencies**[3] **has declined both across the OECD and MNOEs** since the late 1990s, and the decline was more rapid for OECD countries which are now on average less dependent than MNOEs.
- **Among the G7 countries, Canada and Japan recorded the highest incidence of bilateral import dependencies** overall and for a list of 'strategic' products and their dependency levels were some 50% higher than that of **Germany which had the lowest level of dependency in the OECD grouping**.[4] Among the selected smaller OECD countries covered in this analysis, **Korea recorded a level of dependencies which approached that of Canada and Japan** and was about 20% higher than those of Australia, the Netherlands, Spain, Poland and Sweden.
- **In the MNOE grouping, Indonesia recorded the highest levels of import dependencies** which were about 20% higher than those for the **Russian Federation (hereafter "Russia") and China which had the lowest dependency levels in this country group.**
- **Bilateral import dependencies tend to be concentrated regionally** which is consistent with patterns of regional trade integration and with the regional nature of GVCs which tend to be centred around the three large manufacturing hubs and consumer markets of the United States, the EU and China**. The EU appears as the region with some of the lowest levels of import dependencies in the OECD** especially since most of the concentrated import linkages of EU countries are with participants of the European single market. The high degree of trade integration in this market along with regulatory provisions and institutions lower the risk of shocks and facilitate adjustments when such shocks occur.

Interdependencies between the OECD countries and China

- Asian countries[5] — and **China in particular — are the most prominent trans-regional counterparts in import dependencies across the globe** and the level of dependency on Asia has **increased significantly across all OECD regions** since the late 1990s.
- For the OECD region as a whole, **the number of bilateral dependencies on China has gone up, notwithstanding the decline in the total number of such dependencies on any country**. Most recently, China accounted for some 14% of all OECD countries' import dependencies of 'strategic' products[6], more than three times as much as in the late 1990s.
- A yet **more pronounced expansion of trade dependency on China can be observed for its MNOE partners** for which the share of dependencies on China in 'strategic' products increased from approximately 6 to 23% in the same period.
- Overall, **China is an important and growing counterpart in OECD import dependencies** but dependencies on China vary considerably across the different OECD regions, countries and sectors.

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[3] A country's import of a product is considered dependent on a particular trade partner if a high share of its import is sourced from that partner and if country sources the product from only a few partners making it hard to find alternative sources should a supply disruption occur. This is considered one bilateral trade dependency in this study.

[4] Import dependencies of EU countries referred to here, include bilateral trade links with other EU Members if they meet the adopted dependency criteria. If intra-EU links were excluded, the incidence of dependencies in EU countries would be even lower.

[5] This categorisation includes both OECD and non-OECD Asian countries.

[6] Identified based on recent literature.

- **The shares of China in dependencies exceeded 10% in several 'strategic' industries** for the OECD and, within that, EU, as groups of countries and notably for the Netherlands individually (e.g. *manufacture of refractory products*, *cutting, shaping and finishing of stone, manufacture of pharmaceuticals, medicinal chemical and botanical products, manufacture of lifting and handling equipment*, *manufacture of consumer electronics*, and *manufacture of electronic components and boards*).
- **That said, China is more dependent on OECD countries than vice versa.** Most recently, OECD countries as a group accounted for approximately 70% of China's import dependencies in 'strategic' products. Japan and the United States were the two individual OECD countries which accounted for the highest—albeit declining—portions of import dependencies (respectively at 15 and 12% in 2020-21), while the EU as group has become progressively more important, most recently accounting for 29% of import dependencies.
- Together with Germany, Italy, France and Sweden, **the Netherlands was among the top 5 EU countries that accounted for the highest shares of China's import dependencies in 'strategic' products.** The Netherlands alone accounted for 2% of China's dependencies in 2020-21.
- The **high levels of import dependency of China on OECD countries can be seen across most of 'strategic' products it imports**.
- The **EU alone, for example, accounts for more than 40% of import dependencies** in a long list of China's 'strategic' industries (e.g. *manufacture of motor vehicles*, *manufacture of pharmaceuticals, medicinal chemical and botanical products, manufacture of bearings, gears, gearing and driving elements, manufacture of lifting and handling equipment, manufacture of ovens, furnaces and furnace burners).*
- China's sectoral import dependencies involving OECD countries include several industries in which several OECD countries also depend on China for imports, which underscores the **mutual nature of these dependencies**.

Possible implications of reduced trade between the OECD and major non-OECD countries

- The hypothetical trade reduction scenarios used in the input-output and CGE modelling parts of this analysis considered a **10% reduction of all bilateral goods and services trade flows between each of the OECD countries and each of the MNOEs**, while all the other flows were assumed to be not directly affected (hereafter 'trade shock').[7]This is a fairly stylised trade reduction scenario and the estimated impacts should be interpreted as such.
- Overall, the results confirm the **relatively high degree of trade interdependence between the two groups of countries (and especially between OECD countries and China)** and illustrate some of the economic costs that may be involved in some of the currently debated strategies for 'de-risking' international trade, especially if the latter would lead to significant trade reductions.
- Most **OECD and MNOE countries lose in the trade reduction scenario**, notwithstanding significant variation between countries, including relatively small impacts.

[7] They can be nevertheless affected indirectly, for example through interruption of indirect links involving OECD-MNOE trade, if such links exist, or through redirection of trade and other economic adjustments.

Impacts on OECD countries

- In the OECD countries, GDP declines range from nil to about 1.4% depending on the country and the modelling approach used. As expected, **OECD countries and sectors with stronger trade linkages with MNOEs rather than the OECD fare worse** while stronger linkages within the OECD help mitigate the impacts of the trade shock.
- **OECD countries in the Asia Pacific, in particular Korea and Australia, are affected the most** (GDP declines ranging from about 0.1% to 1.4%). This is due to their relatively strong intermediate and final product linkages with MNOEs, particularly China, but also Indonesia and India.
- The **OECD countries of North America (Canada, Mexico and the United States) come across as largely unaffected.** This is explained by their lower direct trade exposure to MNOEs as well as the fact that the negative effects of reducing inputs from MNOEs are outweighed by market gains domestically and abroad, especially in markets of OECD partners who also cut supplies from MNOEs and where they are in a strong position to compete, including within the USMCA market.
- **EU countries are somewhere in between, with Germany and the Netherlands appearing relatively more exposed** than other EU Members (GDP declines ranging from about 0.03 to 0.6%) due to compound effects across manufacturing and services.
- Across the EU, **exposure to trade with MNOEs appears relatively high in important manufacturing sectors**, such as *machinery*, *chemicals* and *electronics*, which experience the largest declines in value added resulting from a decline in export demand. At the same time, **some services industries** with **a close connection to trade (e.g. transport and wholesaling) also tend to experience above-average declines** in value added and this is important for economies such as that of the Netherlands where transport and logistical services are important contributors to GDP and household incomes.
- Indeed, **the Netherlands' economy is exposed not only across the manufacturing industries but also for several types of services** which are affected by the trade shock and which account also for significant shares of GDP (e.g. legal services, IT services, wholesale trade and shipping and transport services).
- Across all OECD regions, **the main driver of these GDP reductions is the decrease in trade with China**, although some OECD countries have also noticeable exposures to other MNOEs.

Impacts on MNOEs

- The trade shock modelled is found to **hurt the GDPs of some MNOEs even more than those of OECD countries**. This is because the export and import links which are being disrupted in this scenario represent a larger share of the economy in MNOEs.
- **Russia loses the most** (GDP declines ranging from about 0.1% to 1.7%), **followed by China** (0.1 to 1%), while India, South Africa, Indonesia, and Brazil experience somewhat smaller losses (0.02 to 0.9%).
- Different **countries in the MNOE grouping have tighter trade linkages with different OECD regions** and this determines the nature of their exposure to the trade shock with some being more exposed to reduced trade with Europe (e.g. South Africa, Russia) and some with North America (e.g. China, India and Brazil).

Impacts across industries

- The list of industries which are most impacted in terms of output, as well as through direct and indirect channels, varies from one country to another, but it is fairly common to find **high levels of exposure in industries belonging to the *mining and quarrying cluster* and other *primary industries***.
- The list of relatively **highly impacted industries also includes a number of advanced manufacturing industries, such as *electronics***.

Conclusions and implications

- The results of this analysis **illustrate some of the concerns that lie behind the debate on trade dependencies** in the context of increasingly uncertain global economic and geopolitical environments. Some findings support a cautious approach to concentrated trade relations while others are more reassuring.
- The growth in concentration of supply and demand, and its clustering around some countries and regions, suggest an **increased potential for disruption of commercial links, causing economic or societal damage,** as well as the potential for trade to be used as a tool of economic coercion.
- Having said that, the evidence presented shows also that **large, if not dominant, portions of global and national trade are relatively well diversified,** that several countries—most notably within the OECD group—have used international markets to diversify and reduce dependency, and that there is also untapped potential to diversify further.
- **It is difficult to distinguish concentrated trade links that could cause problems from advantageous trade linkages**. Concerns that policy responses which aim to minimise trade risks and improve supply chain resilience may not be well designed and may in fact unnecessarily undermine the benefits of international trade are therefore also legitimate.
- The **rise of China as the main counterpart in trade dependencies of OECD countries calls for a better understanding of underlying natural and policy-related factors**, including policies which may have involved market distortions or targeted non-economic objectives. Trade dependencies of OECD economies on China also need to be put in the context of China's dependencies on OECD economies, which appear even larger.
- The current debate on 'de-risking' international trade needs to consider carefully the possible costs and benefits of different policy choices. The different methodologies used to produce evidence unanimously demonstrate a relatively high degree of trade interdependence between the OECD and MNOE countries (and especially between OECD countries and China) as well as potentially **high economic costs of significant trade fragmentation**.
- **OECD countries in Asia and Pacific appear to bear the highest costs from fragmentation, followed by Europe** (where Germany and the Netherlands are affected more than the average), while OECD countries in North America record lower impacts. **MNOEs, including China, tend to be affected relatively more than the OECD.**

Summary

Purpose and approach

There is a growing interest in identifying 'critical trade dependencies' which can be broadly defined as commercial links that could cause high economic or societal damage in case of unexpected disruptions, or those that could be used as a tool of coercion or that might create national security risks, weigh on countries' sovereignty or undermine economic or non-economic activities deemed as 'strategic' (hereafter 'trade dependencies'). At the same time, what is considered 'strategic' is often country-specific and it is difficult to distinguish such trade dependencies from otherwise advantageous trade linkages. There is thus concern that policy responses which aim to minimise trade risks and improve supply chain resilience may not be well designed and may in fact unnecessarily undermine the benefits of international trade or have unwanted or unintended effects.

This report has been commissioned by the Ministry of Foreign Affairs of the Netherlands with a view of harnessing analytical work undertaken in this area at the OECD and shedding more empirical light on the question of trade dependencies, not only in the Netherlands but also across the wider OECD membership as well as in Brazil, China, India, Indonesia, Russia and South Africa (which are thereafter referred to in this report as 'major non-OECD economies', or 'MNOEs').[8]

There is currently no commonly agreed definition of trade dependencies nor an established approach to measuring them. Concerns that lie behind the debate on trade dependencies are also often non-economic. Economic analysis can nevertheless help draw a more comprehensive picture of some of the economic characteristics of global and national trade linkages which have been put forward as exemplifying trade dependencies. As such, it can help assess the economic costs and benefits associated with different policy options.

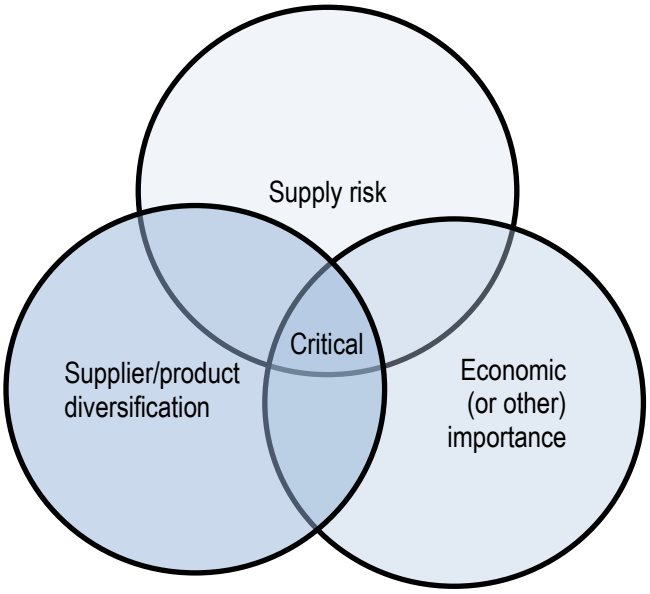
The emerging economic literature in this field suggests that trade dependencies can be defined as trade flows combining the following three characteristics: high risk of disruption; high economic (or other) importance; and constrained possibility of substitution (Figure 1). Analysis undertaken in this report combines different methods to measure some of these characteristics. Potential dependencies identified in this way can be further scrutinised in detail from multidisciplinary angles, and can integrate geopolitical, or other, perspectives on risk.

The report starts with a review of the emerging economic literature, focusing on definitions and methodologies used to define and measure trade dependencies (Chapter 2). This is followed by a descriptive statistical analysis of global trade data at a detailed product level through the lens of trade shares and trade concentrations in order to provide an overview of the possible extent, character and evolution of dependencies over the last thirty years (Chapter 3). In order to better capture some of the economy-wide dimensions of trade dependencies, and to take into account trade diversification and other economic adjustments in the event of shocks, the analysis further considers possible economic implications of a hypothetical scenario that partially reduces trade between the OECD and MNOE countries. This scenario is analysed using the OECD Trade in Value Added (TiVA) data and Inter-Country Input-Output techniques (Chapter 4) and the OECD's computable general equilibrium (CGE) trade model METRO (Chapter 5). Chapter 6 concludes and outlines some preliminary implications.

[8] This country focus is purely analytical and is without prejudice to the relationships between the OECD or any of its members and any of the individual countries of the MNOE grouping. Brazil, China, India, Indonesia and South Africa have all been designated by the OECD as its Key Partners with a view to enhancing their involvement in the daily work of the OECD, promoting the sharing of perspectives and policy approaches through their partnerships with OECD bodies, promoting adherence to OECD legal instruments and integration in the Organisation's statistical databases and policy indicators (see https://www.oecd.org/global-relations/keypartners/). In addition, in 2022 the OECD Council opened accession discussions with Brazil and in February 2024 with Indonesia.

The time period covered by the analysis varies due to data requirements of the methodologies used. The descriptive analysis of trade data in Chapter 3 covers the period 1997-2021, although, due to large and often temporary changes in the structure of trade during the COVID-19 pandemic, 2019 is often used as the most recent data point relevant for long-term comparisons. The Inter-Country Input-Output (ICIO) analyses presented in Chapter 4 are carried out on the basis of data for 2019, the most recent non-pandemic year for which data are available. Finally, the base data used in the CGE modelling in Chapter 5 are for 2017. The analysis presented in this report therefore does not cover some of the most recent disruptive events which deepened concerns about trade dependencies such as the economic and geopolitical ramifications of Russia's full-scale invasion of Ukraine in 2022.

Figure 1. Critical dependency criteria



Source: Authors' compilation.

The extent and evolution of concentration of global trade

One measure of trade dependency is reliance on only a few suppliers (exporters) or markets (importers). If total trade of a product is accounted for by only a few partners, in other words is highly concentrated, countries may find it hard to find alternatives in the face of disruptions in foreign supply or demand.

Since the late 1990s, both global exports and imports of products (defined at the Harmonized System 6-digit (HS6) level of product aggregation) have become gradually more concentrated across, respectively, exporting and importing countries. This likely reflects finer levels of specialisation in global value chains (GVCs) which proliferated during this period. It is also consistent with the perception of an increase in vulnerabilities to unexpected shocks transmitted through international trade and supply chains.

Global exports of products are currently on average two times more concentrated across exporting countries than imports are across importing countries. But there is also a considerable variation in levels of export concentration across different products: exports of close to 30% of products are relatively highly concentrated but exports of the rest of internationally traded products are relatively well diversified. This suggests that large portions of international product markets are characterised by a reasonable amount of competition, and that specific exporters and importers have a limited control over supply or price formation.

Perhaps surprisingly, the lists of products with the highest average export concentrations, do not seem to be dominated by products that are typically referred to in public debates as 'strategic' and which often feature critical raw materials (hereafter CRMs), which are used intensely as upstream

inputs in green and digital technologies, and products of advanced manufacturing industries such as electronics, machinery or motor vehicles. Instead, products with some of the highest levels of export concentration feature, for example, a range of products of light manufacturing industries (e.g. textiles and footwear or headgear). Zooming in on a list of products of some of the strategic industries identified in the recent literature[9] (hereafter 'strategic products' or 'strategic industries'), the analysis presented in Chapter 3 found that such products are in fact on average somewhat less export- and import-concentrated than all traded merchandise products.

This is not to say that the levels of concentration seen for CRMs or advanced manufacturing products are not of concern but rather that, for many products which are emphasised as 'strategic' in recent public debates, international markets in fact offer good options for diversification in line with those available for other traded products. This also highlights multiple factors which likely drive production and trade concentration, such as natural endowments, comparative advantage, low costs of production and processing, and economies of scale.

Concentration of national imports and exports

Having said that, concentrations of national imports and exports tend to be higher than their global equivalents and they have increased since the late 1990s, including for our list of strategic products (Figure 2).[10] This means that countries typically source their imports from — and ship their exports to — fewer partners than is in principle globally possible. Countries are importing from fewer partners (their imports have become more concentrated) throughout the investigated period. At the same time, countries are exporting to fewer markets although export concentration has grown less quickly which might explain the focus in public debate on import dependencies.

The relatively higher country-level concentrations of trade likely reflect a combination of natural factors, such as the role of geography and trade costs, particularly in the context of GVCs which remain concentrated regionally, as well as countries' preferences and policies which have been revealed for example in the expansion of regional and preferential trade agreements which by design tend to lower trade costs and give other advantages to selected trade partners, contributing thereby to trade concentration.

Strategic economic policies of importers and exporters could also have played a role. On the export side, China may be a case in point as the overall rise in national import concentrations of other nations has coincided with raising shares of China as a source of imports (Figure 2, Panel B).

Evaluating the extent to which countries rely on significantly fewer suppliers (national import concentration) than is offered by the global economy (global export concentration) reveals that the overall incidence of such 'excessive import concentration' of national imports has been on the rise in the investigated period. Nevertheless, this has been accounted for mainly by MNOEs and other countries, while excessive import concentration has decreased somewhat on average for OECD countries (Figure 3). This suggests that to some extent firms and consumers in OECD countries have been able to take advantage of diversification possibilities offered by international markets.

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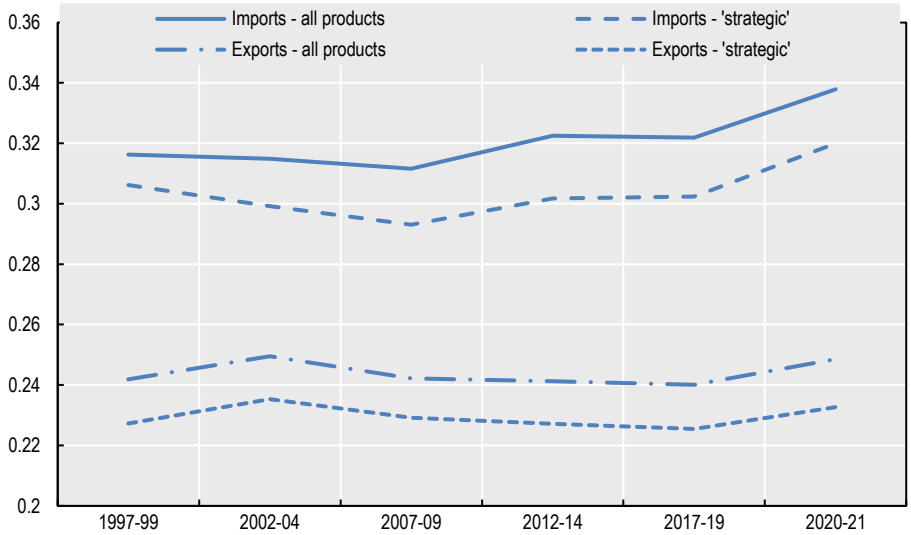
[9] A list of strategic products and industries studied in this work follows the study of fragmentation of FDI by IMF (2023[18]) which had built on a list of sectors designated as strategic in study by the Atlantic Council (Tran, 2022[40]).

[10] The increases and other changes observed in the most recent period are related to more geographically concentrated sourcing of imports, and, generally, other large, but not necessarily permanent, changes in the product and country compositions of trade which occurred during the COVID-19 pandemic. This means that the trends observed for the period 1999_98_97 – 2019_18_17 are deemed more telling of medium to long term trends than what may be observed for 1999_98_97 to 2021_20. '1999_98_97', '2004_03_02', etc., denote the averages for the three-year periods 1999, 1998 and 1997; 2002, 2003 and 2004; and so on. These averages are used to reduce the influence on calculations of unusually high or low data records in specific years.

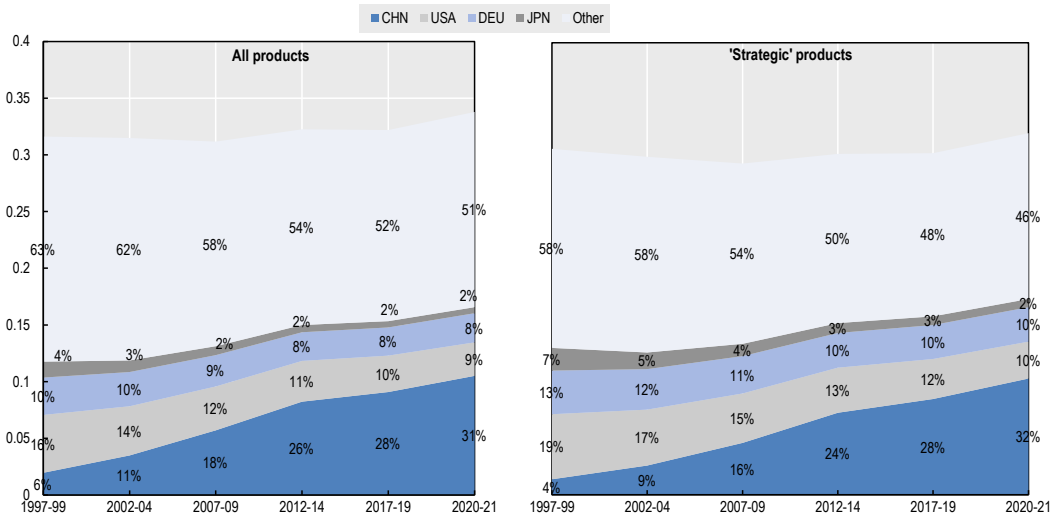
Figure 2. Country-level concentrations of exports and imports of strategic sector and all merchandise products

Panel A. Average country-level concentration* of exports and imports across 'strategic'** and all HS6 products



Note: * This measure is obtained by calculating, first, for each HS6 product and, for exports (imports), each exporting (importing) country an index of concentration (HHI) across all importers (exporters) from (to) that country, and second by averaging across all relevant 'strategic' and 'all' product lists. '1999_98_97', '2004_03_02', etc., denote the averages for the three-year periods 1999, 1998 and 1997; 2002, 2003 and 2004; and so on.
** 'Strategic' products are those identified on the Atlantic Council/IMF lists and concorded to HS classification, see also Annex 8.1.

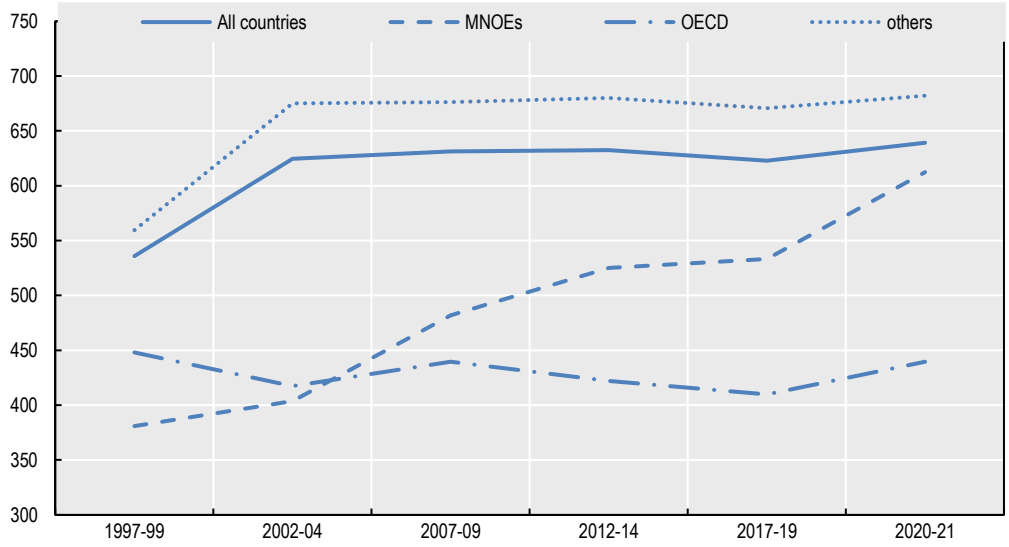
Panel B. Contributions of China to average country-level import concentrations



Note: Panel B. shows the decomposition by selected exporters of the above values of the HII index for imports of all and 'strategic' products.
Source: OECD calculations using the BACI data.

Figure 3. Average incidence of 'excessive import concentration' by country grouping

Average number of imported HS6 products with 'excessive'* import concentration per country in each of the country grouping



Note: "excessive import concentration is defined in cases of bilateral import links at the product level where the value of country-level HHI for imports is more than double the value of the corresponding HHI for global exports. To further constrain the spectrum of cases of excessive concentration, an additional minimum cut-off value of HHI calculated for global product-level exports was set at 0.2. This means that only products with a global exports HHI of at least 0.2 and products with country-level imports HHI of at least 0.4 were considered. The category 'others' comprises all non-OECD, non MNOE countries for which data is available in the BACI database.
Source: OECD calculations using the BACI data.

Bilateral trade dependencies

Identifying which trading partners countries rely on the most among highly concentrated trade linkages has been raised as one of the key issues in the trade dependency debate. This is because geographic, economic and geopolitical risks are often related to the country affiliation or geographical location of trading partners.

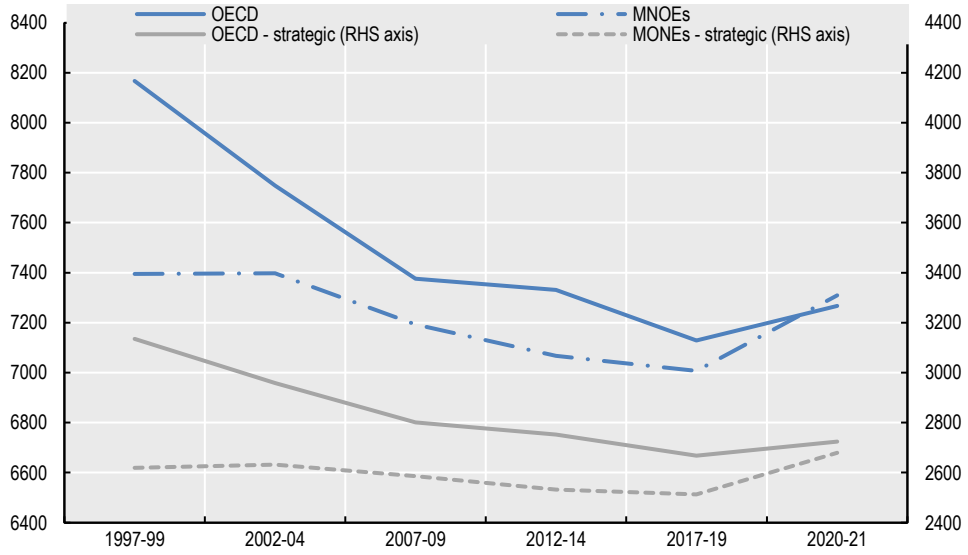
In this report, a country's trade of a product with a specific partner is considered dependent in a given period if: 1) a relatively high share of the country's imports (exports) comes from (is exported to) the specific partner; and at the same time; and 2) the country cannot easily replace these specific bilateral imports (exports) with alternative sources (markets) because the country imports from (exports to) relatively few suppliers (markets) or, in other words, the overall concentration of their national imports (exports) of these products is high.

As far as imports are concerned, such dependencies account for 4.9% of all active bilateral import links across the OECD and for 4.6% across the MNOEs. In value terms, they account for respectively 42 and 45% of the total values of imports of these country groups. This suggests that in both these groups high portions of imports can be attributed to relatively few highly concentrated bilateral import links[11] and reminds that, beyond being of interest to specific countries, sectors, firms and consumers, dependencies may also matter for the economy as a whole.

[11] In the Netherlands, for example, bilateral import dependencies in the electrical and electronic products (Chapter HS85 in the 2-digit version UN's Harmonised System) accounted for only 0.1% of the country's all bilateral import linkages in the period 2017-19 (altogether 235,086 bilateral linkages at the 6-digit level of product

Figure 4. Bilateral import dependencies have been falling faster in the OECD than in the MNOE grouping

Average number of bilateral import dependencies per country in each of the country grouping



Source: OECD calculations using the BACI data.

Having said that, the average per country incidence of bilateral import dependencies declined both across the OECD and MNOEs in the analysed period and the decline was more rapid for OECD countries (Figure 4). These findings are confirmed when only 'strategic' products are considered and when trade shares are studied instead of counts.

There is also important heterogeneity within these country groups. Among the selected OECD countries that were studied in more detail in this report, within the G7 grouping, Canada overtook Japan in the mid-2010s and was the G7 country with the highest level of bilateral import dependencies in the most recent periods. Both these countries had markedly higher levels of all and 'strategic' dependencies than the other G7 countries, where dependencies generally decreased, although the dependencies of United States increased temporarily in the aftermath of the Global Financial Crisis of 2008-09. Germany[12] saw one of the most impressive decreases in dependencies and had the lowest level of import dependencies among G7 countries throughout the period.

Among the selected smaller OECD countries, Korea has maintained a level of dependencies which was similar to that of Canada and was markedly higher than that of Australia, the Netherlands, Spain, Poland and Sweden, all of which recorded similar moderate and generally decreasing levels of dependencies.

The MNOE grouping presents a more diverse picture as the levels of dependency across all products were more stable than across 'strategic' products, for which dependencies increased gradually in some countries. The growth of dependencies in 'strategic' products has been the most pronounced in India and Indonesia and to a lesser extent in South Africa. Brazil, China and Russia recorded decreases in 'strategic' dependencies in the period 2007-19 which were nevertheless reversed

classification), while they accounted for 3.7% of the overall value of imports in the same period. Similarly, dependencies in machinery and equipment (HS84) accounted for 0.2% of all bilateral links, but they accounted for 3% of the overall value of imports.

[12] Import dependencies of EU countries referred to here, include bilateral trade links with other EU Members if they meet the adopted dependency criteria. If intra-EU links were excluded, the incidence of dependencies in EU countries would be even lower.

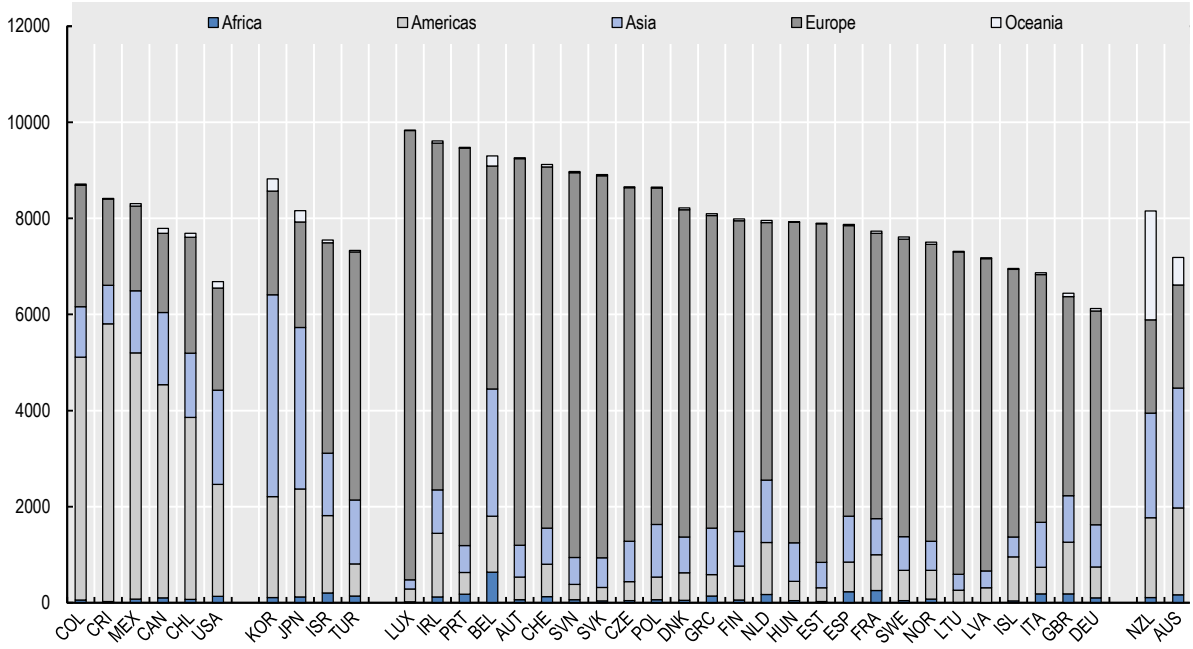
somewhat during the COVID-19 pandemic. Indonesia has maintained the highest level of dependencies in the MNOE grouping across both 'strategic' and all product categories. From the mid-2010s, Russia and China recorded the lowest levels of import dependencies in the MNOE grouping across both product categories.

Regional dimensions of bilateral dependencies

Import dependencies tend to be concentrated regionally. Among the OECD countries, for example, Canada, Mexico, and the United States tend to have a relatively high proportion (44% on average, Figure 5) of their dependencies with each other and with other countries in the Americas. For the Asian OECD countries approximately 51% of dependencies on average originate within Asia and an even higher share of import dependencies for EU countries is with EU partners (77%). Such regional concentration of dependencies is consistent with the regional nature of integration in GVCs, which is centred around the three large manufacturing hubs and consumer markets of the United States, the EU and China.

Figure 5. Regional dimension of import dependencies across OECD countries

Number of import dependencies across all products by region of exporter 2017-19



Source: OECD calculations using the BACI data.

For the participants of the European single market, these findings reflect the high level of international trade integration within this market achieved through advanced provisions establishing free movement of goods, services, people and capital among participating countries. Due to the high depth of economic integration in the European single market, some types of idiosyncratic shocks are less likely within this area and, when shocks occur, regulatory provisions and institutions in place facilitate adjustment. Taking this into account, the EU comes across as the region with some of the lowest levels of trade dependencies in the OECD.

Bilateral import dependencies feature also remarkable trans-regional patterns and developments. First, OECD countries in the Americas are more dependent on OECD countries located in Europe (20% of these countries' dependencies originate in Europe) than European countries are on countries located in the Americas (5%).

Second, Asian countries — and China in particular — are the most prominent trans-regional counterparts in import dependencies globally. The level of dependency on Asia has increased significantly across all OECD regions since the late 1990s. For example, while in the period 1997-99 Asia accounted for on average 17 and 10% of dependencies in, respectively, the OECD countries located in Americas and Europe, in the 2017-19 these shares increased to 34 and 16%. The expansion of import dependencies on China and other Asian countries was the most prominent for the two OECD countries located in Oceania (Australia and New Zealand) where it increased from 30% in 1997-99 to 49% in 2017-2019. This region is also the only one in which the share of dependencies originating in Asia exceeds the share of intra-regional ones (12%).

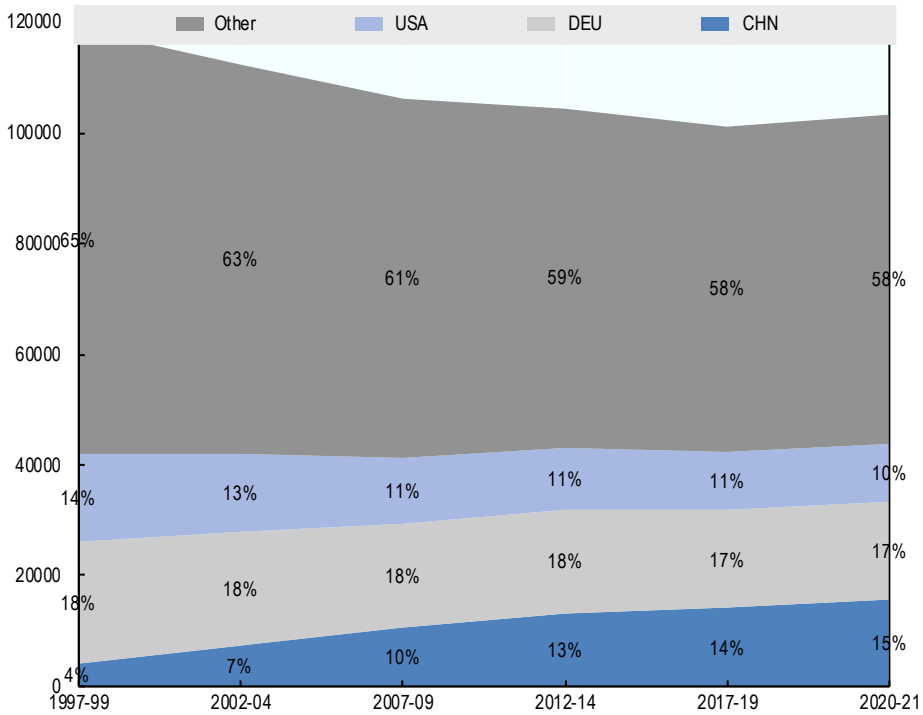
Interdependencies between the OECD countries and China

Throughout the different OECD regions, the bulk of the increase in dependency on Asia has been accounted for by China. For the OECD region as a whole, the number of bilateral dependencies on China has gone up in contrast to the total number of such dependencies on any country which actually decreased.

Most recently, China accounted for some 14% of all OECD countries' import dependencies in strategic products, more than three times as much as in 1997-99 (4%) while the corresponding shares of the most prominent counterparts within the OECD membership — Germany and the United States — declined (Figure 6). The average shares of China in import dependencies of OECD countries located in Europe and the Americas increased from, respectively, 2 and 5% in 1997-99 to 8 and 21% in 2017-19. OECD countries of Asia and Oceania are even more exposed (respectively, 24 and 25% of dependencies on China in 2017-19).

Figure 6. Evolution of OECD countries' import dependencies, by major exporting country

Total number of OECD countries' import dependencies in 'strategic' products on the United States, China, Germany, and other countries (shares in labels)



Note: DEU - Germany; USA - the United States; CHN – China; and Other – all the other OECD and non-OECD countries covered in the BACI database.
Source: OECD calculations using the BACI data.

A yet more pronounced expansion of trade dependency on China can be observed for the MNOE countries for which the share of dependencies on China increased from approximately 6% in 1997-99 to 23% in 2017-19.

Overall, the extent of import dependency on China across OECD countries has grown although it still seems relatively moderate and varies considerably across the different OECD sectors and countries. For the OECD and EU groupings, as well as for the Netherlands individually, China does not manifestly account for unusually high shares of dependencies in 'strategic' product categories where these regions record the highest overall levels of dependency (e.g. *manufacture of cement, lime and plaster, manufacture of fertilizers and nitrogen compounds, manufacture of plastics and synthetic rubber in primary forms, manufacture of watches and clocks and mining of other non-ferrous metal ores*). Nevertheless, China's share of dependencies exceeds 10% in several 'strategic' industries such as *manufacture of refractory products*, *cutting, shaping and finishing of stone, manufacture of pharmaceuticals, medicinal chemical and botanical products, manufacture of lifting and handling equipment*, *manufacture of consumer electronics*, and *manufacture of electronic components and boards*).

These figures illustrate that China is an important and growing counterpart in OECD import dependencies. But equivalent calculations for China suggest that OECD countries are an even more important counterpart for China.

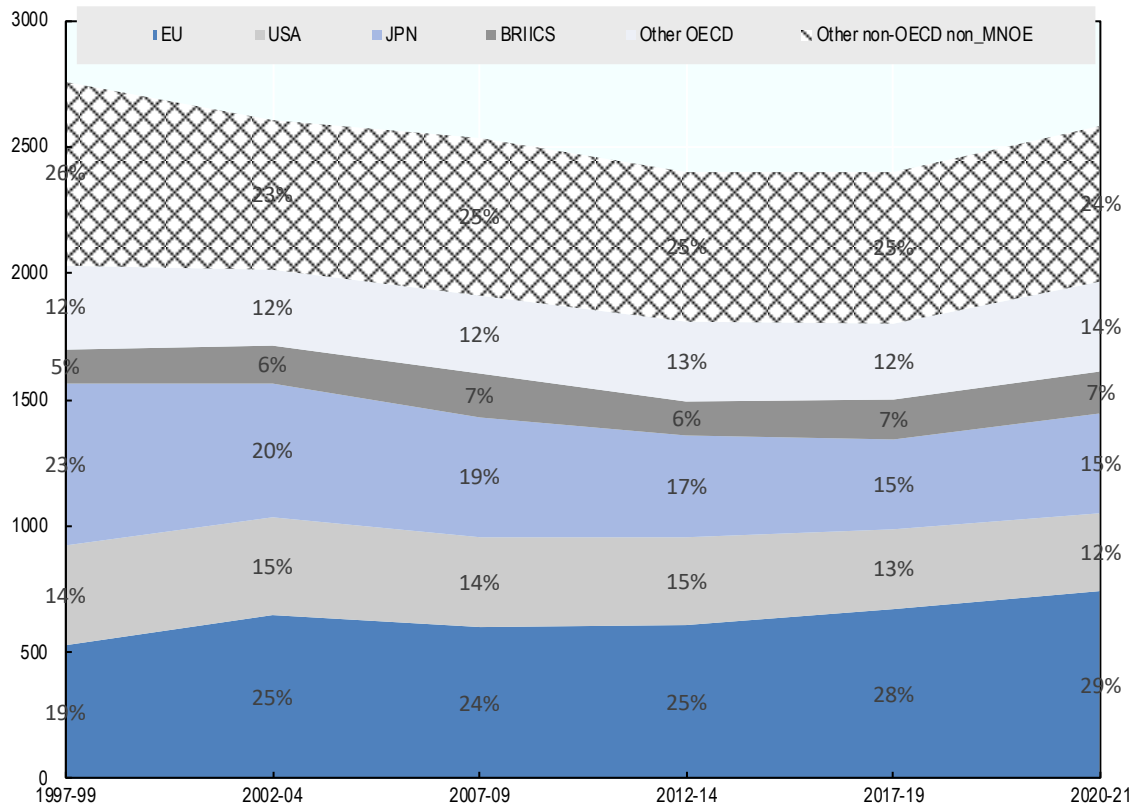
In the most recent periods, OECD countries as a whole accounted for approximately 70% of China's import dependencies in 'strategic' products. Japan and the United States are the two individual OECD countries which continue to account for the highest shares of China's dependencies (respectively 15 and 12%). Nevertheless, the EU as group has become progressively more important and most recently accounted for 29%.

Together with Germany, Italy, France and Sweden, the Netherlands is in the top-5 EU countries with highest shares of China's import dependencies in strategic products, accounting itself for 2% of them in 2020-21. Other OECD countries accounted for an additional 14% of China's dependencies in 'strategic' products in that period.

These high levels of China's import dependency on OECD can be seen across most 'strategic' industries. The EU on its own accounts for more than 40% of China's import dependencies in industries such as *manufacture of motor vehicles*, *manufacture of pharmaceuticals, medicinal chemical and botanical products, manufacture of bearings, gears, gearing and driving elements, manufacture of lifting and handling equipment, manufacture of ovens, furnaces and furnace burners*. This list clearly includes several industries in which many OECD countries are also significantly dependent on China, which underscores the mutual character of these dependencies.

Figure 7. Evolution of China's import dependencies, by major exporting country or region

Total number of China's import dependencies in 'strategic' import dependencies by exporting country/region (shares in labels)



Note: **Other OECD* are all the OECD countries except the United States, Japan and OECD countries of the EU.
Source: OECD calculations using the BACI data.

Possible implications of a reduced trade between the OECD and major non-OECD countries

Assessing trade dependencies through scenario analysis

Chapters 4 and 5 complement the picture of trade dependencies derived from the detailed trade data with two types of scenario analyses which use, respectively, the OECD ICIO tables combined with the so-called 'hypothetical extraction' methodology (hereafter 'ICIO approach') and the OECD global CGE trade model METRO (hereafter 'CGE approach').

The principal trade reduction scenario considered in both approaches reduces all goods and services trade flows between each of the OECD countries and each of the MNOEs by 10% (hereafter 'trade reduction shock' or 'trade shock'). All the other trade flows remain directly unaffected, but they can be affected indirectly, for example through interruption of indirect links involving OECD-MNOE trade if such links exist, or through redirection of trade and other economic adjustments. Wherever relevant, the results of the principal scenario are also decomposed further to tease out the possible contributions to the principal trade shock scenarios of specific sectors and economies where trade is being reduced (e.g. a reduction of trade between OECD countries and just China or Russia or just electronic products). Note that this is a fairly stylised trade reduction scenario and the estimated impacts should be interpreted as such.

Albeit allowing for different levels of country and industry detail and putting different emphases on various economic adjustment mechanisms, both the ICIO and the CGE approaches allow assessment of economy-wide implications of trade dependencies. They also take a broader supply

chain perspective and capture not only those trade dependencies that are due to direct import-export relationships but also those that may result from indirect trade links (e.g. when a product exported from one country to another embeds a component produced in a third countries). Importantly, these methodologies allow analysis of direct and indirect dependencies in the services sectors, which was not the case with the analysis of merchandise trade data in Chapter 3.

The two approaches differ also in some important ways which helps shed light on different aspects of trade dependencies. The ICIO approach assumes that prices are fixed and does not allow for any substitution, through trade or in domestic product and factor markets, to cushion the impacts of trade disruptions. It can thus be thought of as portraying short-term impacts which derive purely from GVC linkages, and which would dominate impacts when other economic adjustments have not yet occurred. The CGE approach, while incorporating also the GVC linkages, accounts for typical adjustment mechanisms to gauge the impacts in the medium term (typically thought to be five to ten years). Modelling adjustments in the sourcing of inputs, the re-balancing of intermediate and final product markets as well markets for different kinds of labour and capital, gives a more comprehensive picture of possible economic impacts.

As expected, the magnitude and relative size of impacts differ somewhat between the two approaches due to their different assumptions, with the ICIO analysis producing generally larger impacts than the CGE approach. There are however also several common findings.

Overall, the results of these analyses confirm the high degree of trade interdependence of the two groups of countries (and especially between OECD countries and China) and illustrate some of the economic costs that may be involved in the currently debated strategies of 'de-risking' supply chains.

Most OECD and MNOE countries lose in the trade reduction scenario although there is a wide range in the extent of the economic impact.

The most significant specific findings of this analysis are summarised below.

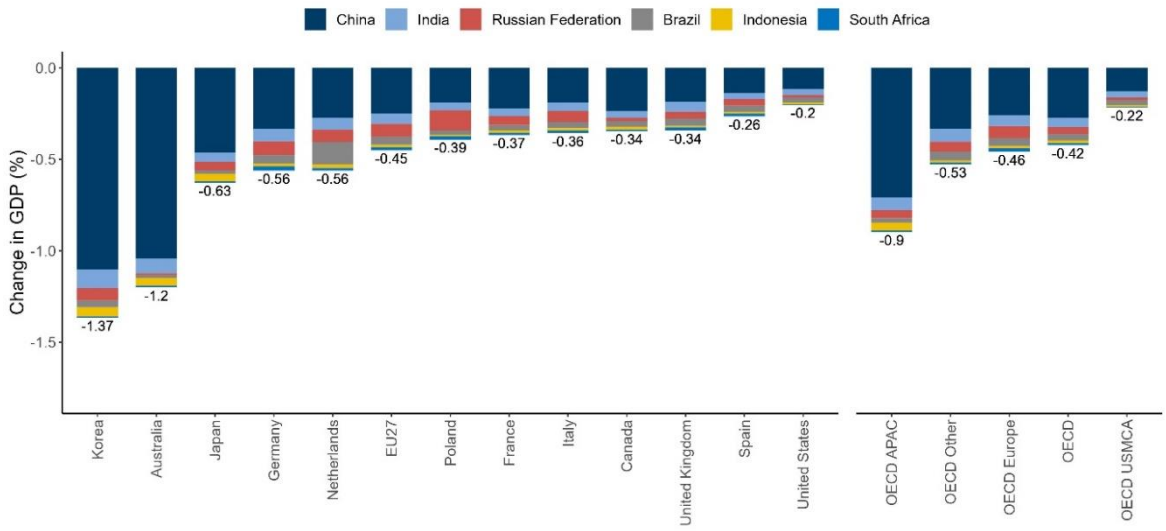
Impacts on OECD countries

Most OECD countries lose in the trade reduction scenario even if there is also a significant amount of inter-country variation and the estimated impacts depend on the modelling approach used.

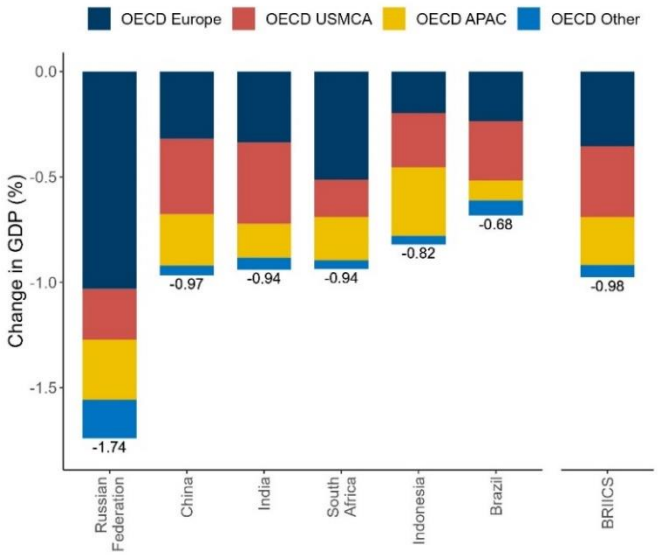
In the OECD countries, GDP declines range from 0.2 to 1.4% in the ICIO approach (Figure 8) and from nil to about 0.1% in the CGE approach.

Figure 8. Impact on GDP of selected OECD and MNOE economies: The ICIO approach

Panel A. Selected OECD countries



Panel B. MNOEs



Note: The aggregates OECD APAC, OECD Europe, OECD USMCA and OECD Other respectively refer to OECD countries that are part of the Asia-Pacific region, that are part of Europe, that are party to United States-Mexico-Canada Agreement, and to the remaining OECD countries.
Source: OECD calculations based on ICIO data.

As expected, OECD countries and sectors with stronger trade linkages with MNOEs rather than the OECD fare worse while stronger linkages within the OECD help mitigate the impacts of the trade shock.

In both approaches, OECD countries in the Asia Pacific, in particular Korea and Australia, are affected the most (GDP losses of, respectively, 1.4% and 1.2% in the ICIO approach and, 0.08 and 0.07% in the CGE approach). This is due to their relatively strong intermediate and final product linkages with MNOEs, particularly China, but also Indonesia and India. For example, Australia exports 77% of mining products and over a third of its metals to China. Similarly, half of Korean electronics and 45% of chemicals are exported to China. Both these countries also source relatively high portions of their intermediate inputs from China and other MNOEs.

At the other end of the spectrum are the OECD countries of North America, with the United States losing only about 0.2% of GDP in the ICIO approach and remaining largely unaffected in the CGE approach. This is explained by lower direct trade exposures to MNOEs as well as the fact that the negative effects of reducing inputs from MNOEs are outweighed by market gains domestically and abroad, especially in markets of OECD partners who also cut supplies from MNOEs and where they are in a strong position to compete, including within the USMCA market.

EU countries are somewhere in between. Among European countries, it is Germany and the Netherlands that appear relatively more exposed to the shock (both lose about 0.6% of GDP in the ICIO approach and they lose 0.03 and 0.07% respectively in the CGE approach).

Across the EU, exposure to trade with MNOEs appears relatively high in important manufacturing sectors, such as *machinery*, *chemicals* and *electronics*, which experience the largest declines in value added. At the same time, some services industries with a close connection to trade (e.g. transport and wholesaling) also tend to experience above-average declines in value added and this is important for economies such as that of the Netherlands where transport and logistical services are important contributors to GDP and incomes.

Indeed, it is noteworthy that the Netherland's economy is relatively exposed not only across the manufacturing industries but also for several types of services which are affected directly or indirectly by the considered trade shock and which also account for significant shares of GDP (e.g. legal services, IT services, wholesale trade and shipping and transport services). For example, transport

services are identified as one of the more affected sectors, which is explained by the fact that the decline in world trade reduces the demand for shipping and transport services and that the sector is a relatively important employer in the country.

Across all OECD regions, the main driver of these GDP reductions is the decrease in trade with China, even though some OECD countries have also noticeable exposures to other MNOEs. This is hardly surprising, given that China accounts for almost two-thirds of the MNOEs' overall trade with the OECD.

In the case of Europe, exposure to a disruption of trade with China is not as pronounced, but still significant. A 10% reduction in trade between the OECD countries and China is estimated to reduce GDP in the EU27 by about 0.3% in the ICIO approach and 0.04% in the CGE approach. However, the CGE approach shows that when trade links with MNOEs are reduced, adjustments result in intra-EU trade filling some of the gaps, and this cushions some of the negative effects. In addition, several European countries (most notably Poland) displayed non-negligible ties to the economy of Russia prior to its aggression on Ukraine.

In the Netherlands, close to 70% of the negative impact of the trade shock is accounted for by trade with China. Across many Dutch industries it is the linkages with China that represent the main source of exposure (e.g. postal and courier services, other utilities), but some Dutch industries also appear to have close links with Brazil (security services and rental services) and some with Indonesia (shipbuilding, wood).

Impacts on MNOEs

The considered trade shock is found to hurt the GDPs of some MNOE countries even more than those of OECD countries (Figure 8). This is because the export and import links which are being disrupted in this scenario represent a larger share of the economy in MNOEs.

Russia loses the most (1.7% in the ICIO approach and 0.1% in the CGE approach), followed by China (1% and 0.1%, respectively). India, South Africa, Indonesia and Brazil experience somewhat smaller losses (between 0.9 and 0.7% in the ICIO approach and between 0.07 and 0.02% in the CGE approach), although the loss rankings differ somewhat between the approaches.

Different countries in the MNOE grouping have tighter trade linkages with different OECD regions and this determines the nature of their exposure to the trade shock. South Africa is most dependent on OECD countries in Europe, whilst China, India and Brazil have comparatively stronger input and final product links with OECD countries in North America. For Indonesia, the key OECD partners are those of the Asia Pacific. Russia's dependency is due to its high reliance on trade with OECD countries in Europe prior to its aggression against Ukraine.

Impacts across sectors and across different types of traded products

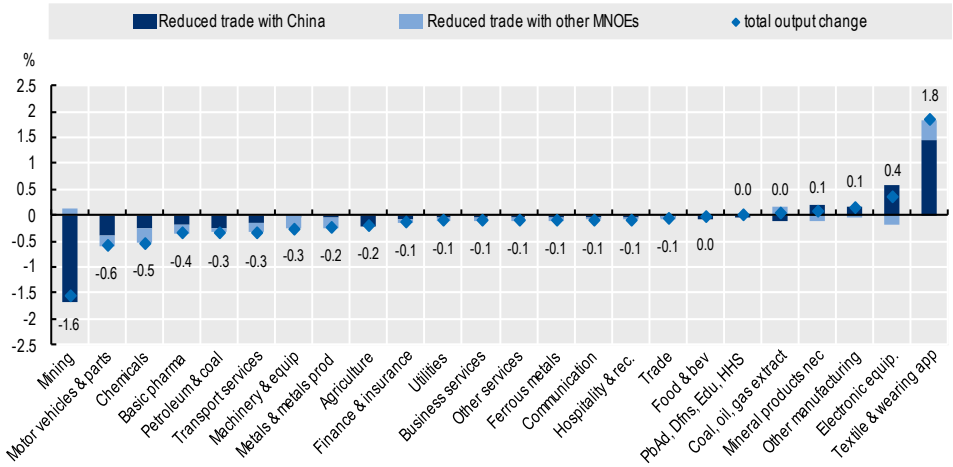
In any given country, not all sectors of the economy are exposed to the considered trade shock to the same degree. The list of the most impacted industries varies from one country to another, but it is fairly common to find the highest levels of exposure in the primary sector and, more specifically, in industries belonging to the mining and quarrying cluster. This is because the trade shock constrains several important flows of mineral resources between OECD and MNOEs. Australia, for example, sells more than four-fifths of its entire output of metal ores directly to China and until recently many European countries relied heavily on Russia for their energy inputs. In addition, it is not uncommon for primary products to be indirectly re-exported as intermediate inputs embodied in other products.

In several cases, the sectors identified as the most heavily dependent on OECD-MNOE trade, represent only small shares of their country's economy. On the other hand, the list of highly impacted industries also includes those of great significance from both a domestic and a global point of view. Most notably, it includes the *electronics* sector in Korea (where it is responsible for 7% of the country's GDP), China (2.5%) and Japan (1.5%). In the same vein, a reduction of trade with OECD countries would also do significant damage to India's large *IT services* sector which accounts for 3.4% of the country's GDP.

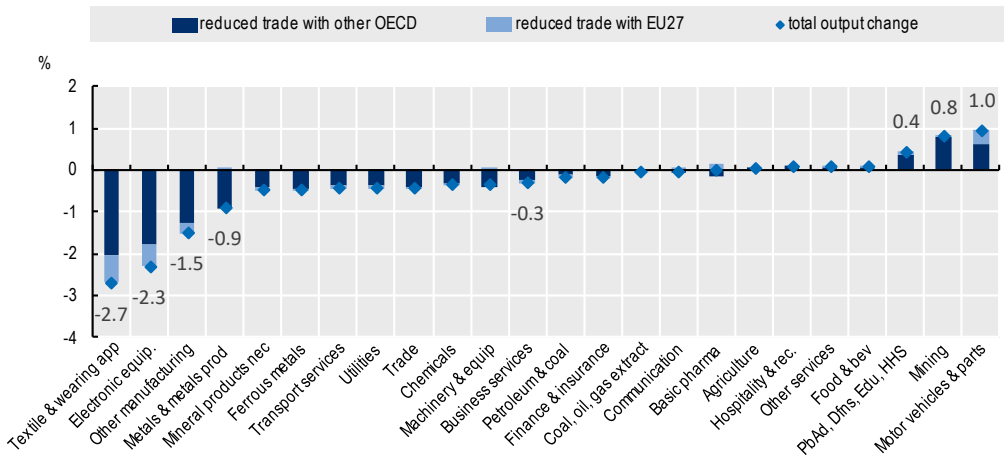
The results of the CGE analysis, which allows for market adjustments, suggest also that impacts of the trade shock in some OECD manufacturing industries, including *electronics* but also *textiles and* wearing *apparel*, can also be positive in the medium term, while impacts on China and other MNOEs are negative (Figure 9). This is because some of the excess demand for these products is diverted towards the OECD producers as a result of the trade shock. However, these sectoral output gains should be seen in the context of economy-wide effects which are negative for most OECD countries.

Figure 9. Impact on sectoral output: The CGE approach

Panel A. OECD region as a whole



Panel B. China



Note: In Panel A, decomposes the impact on sectoral output in OECD when the OECD reduced trade with MNOEs or just China. Panel B, decomposes the impact of sectoral output in China when MNOEs reduce trade with EU27 Members versus other OECD countries.
Source: OECD METRO Model.

When a distinction is made between different destinations of traded products, China stands out in terms of the share of the impact accounted by the final demand channel (44% of the overall GDP impact). This means that more than for other countries, for China the dependence on trade with the OECD countries is mainly related to trade in final products and not inputs into production (either those that China itself uses for production or those that it provides to other global producers). The trade shock would have relatively severe repercussions for China's manufacturing production which is to a very significant degree destined for final consumers in the OECD countries and draws significantly on OECD for inputs.

For comparison, within the OECD, the weight of the final product component tends to be lower for the countries of the Asia Pacific region (25%) and higher in Europe (35% for the EU27) but is relatively low for the Netherlands (29%).

Conclusions and implications

The results of this analysis illustrate some of the concerns that lie beneath the debate in on trade dependencies in the context of increasingly uncertain global economic and geopolitical environments. As documented in this report, global production of products has become increasingly concentrated, and it tends to be increasingly clustered around some countries and regions, notably China and Asia. This is not only due to natural or organic economic factors, such as natural endowments, comparative advantage, economies of scale, or GVC fragmentation, but also policies. Whichever is the principal source of growing concentration, shocks related to climate change, changes in economic policy or geopolitical conflicts, arguably have a higher potential to disrupt commercial links and cause economic or societal damage now than they had in the past. There is also more potential for trade to be used as a tool of economic coercion.

Having said that, the evidence presented also shows that large, if not dominant, portions of global and national trade are relatively well diversified overall, and that international product markets are characterised by a fair amount of competition and limited control over supply or price formation of specific importers or exporters. It is difficult to distinguish those concentrated trade links that could cause problems from advantageous trade linkages. Concerns that policy responses which aim to minimise trade risks and improve supply chain resilience may not be well designed and may unnecessarily undermine the benefits of international trade are therefore legitimate.

Countries typically source their imports from — and ship their exports to — fewer partners than is in principle globally possible. This reflects a combination of natural factors, such as the role of geography and trade costs, but also national preferences and policies. There is thus untapped potential in using international markets to diversify. In fact, our findings suggest that a significant number of OECD countries have been able to take advantage of diversification possibilities offered by international markets, as testified, for example, by declining average rates of import concentrations and bilateral import dependencies. In this sense, trade dependency does not seem to be a generalised phenomenon, but it is rather confined to some specific countries and products.

Which trading partners are the main counterparts in the highly concentrated trade linkages has indeed been raised as one of the key issues in the trade dependency debate. This is a legitimate approach because geographic, economic and geopolitical risks are often related to the country affiliation or location of trading partners. Here, too, some of our findings support a cautious approach to concentrated trade relations, while others are more reassuring.

Dependency on China has increased significantly across all OECD regions since the late 1990s and the country is now the single most important counterpart in trade dependencies of OECD as a whole and of several OECD countries individually. There is thus interest in a better understanding of the reasons for the emergence of China as a source of dependencies. In particular, the contributions of natural and policy-related factors, including policies which may have involved market distortions or targeted non-economic objectives, need to be better understood.

Trade dependencies of OECD economies on China also need to be put in the context of China's dependencies on OECD. OECD as group—and several OECD countries on their own—are a much more important counterparts in dependencies of China. Moreover, China's sectoral dependencies involving OECD countries include several industries in which several OECD countries also depend on China, which signals the mutual character of some trade dependencies.

The current debate on 'de-risking' international trade needs to consider carefully the possible costs and benefits of different policy choices. The different methodologies used to produce evidence unanimously demonstrate a relatively high degree of trade interdependency between the OECD and MNOE countries (and especially between OECD countries and China) as well as potentially high economic costs of significant trade fragmentation. OECD countries in Asia and Pacific come across as bearing the highest cost of fragmentation, followed by Europe (where Germany and the Netherlands are affected more than on average), while OECD countries in North America record lower impacts. MNOEs, including China, tend to be affected relatively more than the OECD.

1. Introduction

As a repercussion of some of the supply disruptions during the COVID-19 pandemic and the Russian Federation's (hereafter "Russia") invasion of Ukraine, and in the context of growing geopolitical and climatic risks, there is a growing interest in identifying commercial links that could cause high economic or societal damage in case of unexpected disruptions, or those that could be used as a tool of coercion or might create national security risks or weigh on countries' sovereignty. At the same time, there is interest in making sure that policy responses designed to minimise trade risks and improve supply chain resilience are well targeted and do not unnecessarily undermine the benefits of international trade enjoyed by modern societies.

Given the non-economic nature of many of the considerations that seem to define such 'trade dependencies' in public debate, economic analysis is clearly not the only analytical approach that should be used to unravel them. Nevertheless, economic analysis can contribute an objective picture of global and national trade linkages, including information on their concentration, possibility of substitution and overall economic importance. While there is no one methodological approach that would allow a reliable joint assessment of these criteria and an objective identification of such trade dependencies, a number of different existing applied trade analysis methodologies can be combined to filter out at least some of the potentially problematic trade links which can be analysed further from more multidisciplinary angles.

This report has been commissioned by the Ministry of Foreign Affairs of the Netherlands with a view of harnessing recent analytical work undertaken in this area at the OECD. The objective is to shed more empirical light on the question of trade dependencies, not only in the Netherlands but also across the wider OECD membership as well as in Brazil, China, India, Indonesia, Russia and South Africa (which are hereafter referred to as major non-OECD economies, or MNOE[13]).

The report consists of a review of the emerging economic literature on trade dependencies (Chapter 2) as well an original empirical analysis by the OECD Secretariat which uses some of the methodological approaches used recently in the literature to measure trade dependencies. The empirical analysis includes, first, descriptive statistical analysis of global trade data at a detailed product level through the lens of trade shares and trade concentration ratios which provide a broad overview of the possible extent, character and evolution of trade dependencies over the last decades (Chapter 3). Given the prominent role of some of the MNOEs in trade dependencies of OECD countries as well as the current geopolitical context, an analysis of possible economic effects of a hypothetical scenario of reduced trade between OECD countries and MNOEs is conducted using Inter-Country Input-Output techniques and Trade in value Added (TiVA) data (Chapter 4) and the OECD's computable general equilibrium (CGE) trade model METRO (Chapter 4). While each of these approaches has its limitations, combined they provide a relatively broad economic perspective on the structure and economic importance of the potential trade dependencies. Chapter 5 concludes and outlines some preliminary policy implications.

The current version of the document takes on board comments received following the presentation of the draft to the Working Party of the Trade Committee on 12-13 December 2023. It is presented for declassification via written procedure.

[13] This focus is purely analytical and is without prejudice to the between the OECD or any of its members and any of the individual countries of this grouping. Brazil, China, India, Indonesia and South Africa have all been designated by the OECD as its Key Partners with a view to enhancing their involvement in the daily work of the OECD, promoting the sharing of perspectives and policy approaches through their partnerships with OECD bodies, promoting adherence to OECD legal instruments and integration in the Organisation's statistical databases and policy indicators (see: https://www.oecd.org/global-relations/keypartners/). In addition, in 2022 the OECD Council opened accession discussions with Brazil and in February 2024 with Indonesia.

2. Literature review

This Chapter takes stock of the rapidly emerging literature on trade dependencies as seen from a public interest standpoint focusing in particular on: (i) methodologies used to identify trade dependencies and measure and assess their economic effects; (ii) the different definitions of 'critical', 'essential' and 'strategic' products; (iii) different categorisations of trading partners used in this context; (iv) profiles of shocks considered in this literature; and (v) key results and policy recommendations of these studies.

2.1. Introduction

Analysis of trade concentration, diversification, or bottlenecks in supply chains, has long been a part of trade and trade policy analysis. Product and country diversification of trade, for example, is often assessed in economic development literature, particularly in the context of countries specialising in agricultural commodities and natural resources. Supply chain risks and resilience have also been studied., Such as in the aftermath of the earthquake and tsunami in Japan and the floods in Thailand in 2011. However, a mainstream surveillance of potentially problematic trade linkages, with a view of identifying those that could cause economic or societal damage when disrupted, is a relatively new focus.

Concerns about supply chain resilience and disruptions in various international markets (trade in goods, services, transport, movement of people) during the COVID-19 pandemic and since Russia's invasion of Ukraine and rising geopolitical tensions between major economies have restarted the debate on whether or not the world economy is facing a period of 'deglobalisation', 'friendshoring', 'nearshoring', creation of 'trading blocks' or 'relocalisation'. Even though at the moment there is limited hard evidence of such a large-scale fragmentation, a number of new policy initiatives and trade measures that are likely to contribute to fragmentation have been documented (IMF, 2023[1]).

Trade linkages have long been known to involve interdependence. Up until recently, interdependence was generally seen in a positive light, principally involving mutually beneficial commercial exchanges, allowing better specialisation and bringing higher productivity and access to a wider pool of capabilities and ideas. However, recent global events disrupting international markets and supply chains have increased concerns about the supply chain resilience and the risks that might be transmitted through international trade linkages. Moreover, rising geopolitical tensions around the world bring additional concerns about what reductions to those trade linkages would mean for an economy. In this context, there is increased interest in identifying trade linkages and dependencies which may have negative economic effects if disrupted.

Responding to the challenge of identifying risks inherent in international trade therefore requires new ways of looking at the data and information, and a change in perception of certain empirical facts, mechanisms as well as assumptions underlying economic analysis. The related literature, which has emerged rapidly over the last few years, is therefore rather fragmented and unsettled.

This chapter provides a review of selected recent contributions organised along some of the common themes and issues addressed in these studies, including the approaches used to define and measure 'trade dependencies' and emerging policy recommendations.

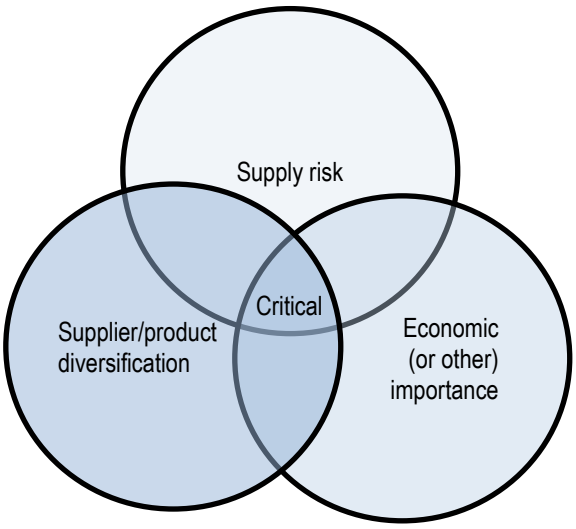
2.2. How can 'vulnerable', 'critical', 'essential' or 'strategic' products be defined?

The terms 'vulnerable', 'strategic', 'critical', 'essential' are some of the key concepts used by policy makers when identifying products trade which may require government attention or intervention ('critical products' or 'critical industries' thereafter in this chapter). These attributes can be evaluated both from an economic and form non-economic perspectives. From a non-economic perspective, these products can be defined as ones that are important for the wellbeing of the general public--for example in areas such as national defence and security, public health, environmental and social protection, or a nation's food system. From an economic perspective, critical products or industries can be usefully defined as ones which are crucial inputs into a wide range of economically important

domestic industries and whose supply failures would have negative impacts across the national economy or is a significant source of national income. The assessment could consider both current requirements as well as projected future needs (e.g. products required for the green transition) (Schwellnus, Haramboure and Samek, 2023[2]).

Products or industries identified as critical are those which are not only vulnerable to global supply chain disruptions but also economically important enough to require increased monitoring. Identifying a product or supply chain as 'critical' from an economic point of view can involve either qualitative or quantitative analysis but it generally combines three criteria: 1) economic importance; 2) probability of disruption or supply risk; 3) and the ability to find alternative sources (Figure 2.1).

Figure 2.1. Critical dependency criteria



Source: Authors' compilation.

Identification of economically important products often involves two stages. First, studies tend examine to what extent a specific imported product is used in the production process of domestic industries, and then whether those industries themselves are important national industries. In some cases, an additional criterion is added which considers whether the absence of the product would cause detrimental harm to the economy. This last consideration requires consultation with industry experts.

For economically important national industries, a disruption in their supply could have economy wide repercussions. These disruptions can occur in different countries or geographical locations. They can have different sources (political, geographical, natural) and they may concern specific products or wide ranges of products. The higher the probability of disruptions, the higher the supply risk, the higher the degree of criticality. However, the risk of supply disruption can be alleviated if there are alternative sources found among trading partners (or among alternative types of products). The less diversified and more concentrated the import sources the less feasible is the ability find alternatives suppliers which increases the degree of criticality.

This is a useful conceptual distinction of the different characteristics that may underpin criticality even if some of the measures that are used to quantify them in analytical work, such as for example trade shares, may be imperfect indicators of these characteristics or may be capturing more than one of them.[14]

[14] For example, trade shares have been used in the literature to capture both the extent of risk, but also the flexibility of supplier diversification in the face of shocks (see discussion below).

2.2.1. How are the different dependency criteria combined and measured?

Studies and methodologies trying to identify critical dependencies often take into consideration at least the economic importance and potential for supply risk of a product. Identifying products that are of economic importance includes an assessment of the extent to which product is used as an input in domestic industries and how import those industries are to the national economy, ideally using data on national production and the inputs to the production process distinguishing imported and domestically source goods at a highly detailed level.

Countries have long been identifying critical minerals and raw materials with potential for supply disruptions, such that the necessary information on raw material use in specific industries are available to determine economic importance of specific raw materials. The EU (European Commission, 2017[3]) as well as United States (2020[4]) (2021[5]) use economic importance as one criterion in compiling their lists, which is measured as the share of a raw material's end use in a sector[15] weighted by the share of that sector's value added in the total value added of the economy.

Several country specific analyses, Flach et al. (2021[6]) and Baur, Flach (2022[7]) and Productivity Commission (2021[8]), expanded the identification of economically important products beyond raw materials to include all goods. While trade data is available to identify sources of imported inputs at a fairly detailed level[16], data on industry use and production at a similar granular level is often unavailable, and studies have to find alternative sources for this information. Flach et al. (2021[6]) and Baur, Flach (2022[7]) used a combination of GTAP data[17]--a global database which includes country level production in 65 different goods and services industries—to identify the Germany's top five goods sectors[18] and US Census Bureau Input-Output tables, which include data on almost 500 products and the inputs into their production processes. The combined the two databases together to identify the top three inputs for the top five goods sectors.[19] Similarly, Australia's Productivity Commission (2021[8]) mapped products found to be vulnerable to foreign supply disruptions that were identified using analyses on detailed trade data to Australia's Input-Output tables containing information on 114 industry and product groups.[20] While Flach et al. (2021[6]) and Baur, Flach (2022[7]) used the GTAP database to identify economically important sectors, the Productivity Commission used a list[21] of 25 I-O sectors deemed essential to meeting the needs of Australians. They then identified the inputs into those essential sectors which were vulnerable to disruptions. Jiang (2021[9]) uses the United Nations Broad Economic Categories (BEC) classification to subset

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[15] In the EU case, the *Nomenclature statistique des Activités économiques dans la Communauté Européenne* (NACE) Rev. 2 2-digit level. For the US case, the most detailed level of industry classification applicable, based on the North American Industry Classification System (NAICS).

[16] For example, global trade data uses the Harmonized Commodity Description and Coding System (HS) nomenclature. At the international level is a six-digit coding system which is comprised of approximately 5 300 different products (See UN Statistics Wiki for details). Country specific coding system can include additional product level detail and use an HS 8-digit coding system as in the case of Australia (Productivity Commission, 2021[8]).

[17] The GTAP database is based on country Input Output tables (among other sources), It covers 121 countries and 20 aggregate regions and 65 sectors. Authors cited data for reference year 2014. For more information see https://www.gtap.agecon.purdue.edu/databases/v10/index.aspx

[18] GTAP sectors are roughly equivalent to 2 digit level ISIC, Rev 4 categories but with more detail in food and agriculture sectors: https://www.gtap.agecon.purdue.edu/databases/contribute/concordinfo.asp

[19] Note that this involved determining a concordance between the product classifications of the GTAP database and the US census I-O tables.

[20] The Australian Productivity Commission also had to construct a concordance between the trade data and I-O data classifications.

[21] The list is based on sectors listed as essential in various regional and national legislations as well as judgment. The Productivity Commission had both a narrow definition of essential, i.e. meeting basic needs like food, water, health among others, and a broad definition that includes sectors that provide income security.

vulnerable Canadian imports at the HS 6 digit to intermediate and capital goods assuming these categories pose a larger risk to supply chain disruptions than final consumer goods.

Some studies use network analysis, a field of study analysing how entities are connected and behave in complex systems, to characterize supply networks and identify those that are more vulnerable to disruptions. Bonneau and Nakaa (2020[10]), when identifying critical products for France, included a metric to identify networks with a limited number of suppliers in highly concentrated supply network using a centrality measure based on (Korniyenko, Pinat and Dew, 2017[11]).

Korniyenko, Pinat and Dew (2017[11]) used the concepts of centrality and clustering to characterize the supplier network and assess the exposure of a country's import basket to trade disruptions. First, the authors looked for the presence of central players by examining the importance of each exporter as a supplier of a product to each importing country measured as the share of total imports of the product. If the standard deviation of the shares is high, then there are likely a few exporters who are playing a central role in the trade network of the product adding to a product's vulnerability. Additionally, if the trade network has many clusters, groups of countries trading the same product more amongst each other than the rest of the world, the more difficult it will be for an importer to find alternative suppliers in case of a supply shock that occurs within the group.

Other methods of characterizing trade linkages and identifying vulnerably products include using trade data to measure the exposure of imports to external supply shocks. Measures of product exposure look at the concentration of imports into a country and the concentration of the global export markets. The heavier the reliance on a few suppliers of product in a market with limited number of suppliers the more vulnerable the product is to a supply risk. Market concentrations if often measured using the Herfindahl-Hirschman Index ((Nassar and Fortier, 2021[5]), (Nassar et al., 2020[4]), (Braun et al., 2023[12]), (Flach et al., 2021[6]), (Productivity Commission, 2021[8])) (HHI thereafter). The higher the index the more imports are concentrated on a small number of trading partner countries (see Chapter 3 for a more detailed discussion of the interpretation of the values of the HHI)[22]. Alternatively, the Australian Productivity Commission (2021[8]) considered products vulnerable to supply shocks if a single supplier accounts for over 80% of the imports as being a highly concentrated. They considered this criterion as the actual risk, while the global market concentration criterion as the potential supply risk.

Supply risk can be attenuated if substitutes for the disrupted import supply can be found. Some studies included in the assessment of criticality a measure of the ability to replace imports by domestic production in case of a supply shock (European Commission, 2021[13]), (Vicard and Wibaux, 2023[14]), (Baur and Flach, 2022[7]), (Flach et al., 2021[6]). For these studies that use the EU bottom-up approach to identify foreign dependencies, total EU exports are used as a proxy for EU production since domestic production is not available at a detailed level studies. Products are considered vulnerable when the imports from extra-EU regions are greater than EU total exports (European Commission, 2021[13]) otherwise, it is assumed, imports could be replaced by production and supply risk is reduced. A similar approach, using exports as proxy for domestic production, is used in identifying vulnerable Canadian imports (Jiang, 2021[9]).

Similarly, if there is a readily available alternative material that could be used in the manufacturing process, then the criticality of the dependency may be reduced because the risk of supply disruption is reduced. The US approach in compiling their list of critical raw minerals includes a general assessment of the industry's ability to cope with disruptions measured as the industry's expenditure on the commodity relative to its operating profits. Industries with limited profits and greater expenditure on a commodity have less flexibility to deal with a supply disruption (Nassar and Fortier,

[22] Most studies provide a qualitative rationale for threshold selection rather than a statistical basis for determining the thresholds. As far as measure of trade exposure are concerned, for example, the threshold is often ">0.5", meaning that foreign sources account for more than half of consumption. This has an intuitive appeal, but, as we show in Chapter 3, trade links where a specific partner accounts for more than half of all imports of a product are relatively few. Using different thresholds clearly affects the results obtained which suggests the need for sensitivity analysis using different thresholds to formulate robust qualitative implications.

2021[5]).[23] The European Commission includes a substitutability index in their supply risk assessment of critical minerals (European Commission, 2017[3]) which includes the possibility of alternative sources of a raw material such as recycling. Korniyenko, Pinat and Dew (2017[11]) also include a product substitutability metric in their assessment of vulnerable product networks at the HS 6-digit level taking into account the variation in human capital intensity across exporters to determine if products were substitutable. High variation of human capital intensity, indicates lower likelihood of being substitutable as inputs into production.

Some studies incorporate non-economic risk characteristics into their assessment of the foreign reliance. For example, researchers at the US Geological survey, tasked on producing and reviewing the US critical minerals list every three years, included both suppliers' ability to supply but also their willingness to supply to the United States to measure the likelihood of foreign supply disruption (Nassar and Fortier, 2021[5]), (Nassar et al., 2020[4]). The ability to supply is based on the exporter's country profile[24] including political stability, labor availability, infrastructure quality, trade regulations among others. The exporter's willingness to supply is a composite of three different indicators: 1) importance of US trade ties, a countries' share of trade with the US as a share of their GDP; 2) shared values with the US, which is the distance between Freedom House measures of political rights and civil liberties.; and 3) if there is a current collective military arrangement with the US. The EU methodology for identifying critical raw materials uses a similar approach (European Commission, 2017[3]) where their supply risk assessment also incorporates non-economic factors such as political instability, government effectiveness and corruption using a Governance Index.

Similarly, in their assessment of dependencies in Germany's foreign supply chain, Flach et al., (2021[6]) combined their findings on product dependencies with risk indicators of different types of risk to discuss the likelihood that a product is at risk based on the risk indicators of its main supplier. The authors examine four risk indicators: economic policy uncertainty; geopolitical risk; climate change risk; and cybersecurity risk[25] which are available at the country level. Subsequently, suppliers in the bilateral trade data of the dependent product are each assigned their level of risk (the normalized risk indices), and a 5-tier ranking is produced for each risk type based on quintiles (very low, low, medium, high, very high) for each risk category. The authors then assessed each critical dependency in the context of the "riskiness" of the main suppliers of each product to determine if the risk was critical or not. For example, the study found that, although there is a high degree of foreign dependence for lactams (chemical substances used in the production of medicines) they were not considered critical because they sourced from comparatively "safe" trading partners in terms of each of the four considered risk types.

Studies previously referenced in this section identify vulnerabilites by first identifying products critical products with the pontential for disruption and then identify the source, however some studies first identify potential sources of supply disruptions and then find countries and sectors most exposed based on the characteristics of the product supply network. For exaple, Braun et al. (2023[12]) first identified critical products where a disruption from Russia or Ukraine could expose countries to disruptions in trade by identifying the products where Russia or Ukraine are important suppliers based total export values or revealed comparative advantage (RCA) indices[26]. Among the products where the two countries have RCA, the authors selected those where many regions depend on imports of the product from these two countries and where therefore substitution may be more constrained in the face of shocks.

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[23] These authors argue that the expenditure on commodity as a share of profit combines both the importance of the commodity in the industry and the industry's ability to find substitutes in the event of a supply disruption.

[24] Produced by the Fraser Institute Annual Survey of Mining Companies 2020.

[25] The risk indicators are either published by an organisation or based on a methodology found in the literature. All indictors are based on a multi-year average, except for the Cybersecurity Risk indicator, which is only available for 2020, and are normalised to have values between 0-1.

[26] RCA indices intend to measure a country's relative ability to produce the good relative to other goods and regions because of its underlying productivity or resource endowments, i.e. their comparative advantage.

It is noteworthy that most existing studies on critical dependencies focus on the risk of a supply disruption examining foreign supplier reliance, import dependencies, and the ability to find alternative suppliers. and this is reflected in this literature review. As discussed in Chapter 3, this may be explained by the fact that concentration of exports of products across supplying countries tends to be higher than the concentration of imports across importing countries. However, in principle some countries may be relatively heavily reliant on exports and similar analyses may be warranted from the perspective of the demand side and the risk to domestic suppliers. For example, China being the largest market for semi-conductor was noted as a supply chain risk in the White House 100 Day Supply Chain report (The White House, 2021[15]). Australia's Productivity Commission assessed their domestic sectors vulnerabilities to both disruptions in foreign supply of inputs as well as external markets for exported products as some export sectors are important sources of national income and disruptions to the export markets could have consequential effects on national wellbeing (Productivity Commission, 2021[8]).

2.2.2. How are trading partners categorised?

The probability of some disruptions may be determined — or strongly influenced — by the country location or affiliation of suppliers. This is why most existing analyses of trade dependencies make some kind of differentiation among the different partner countries. While often closely intertwined with each other, the three types of supply risk which are correlated with the country affiliation or location can be broadly categorised as geographic, economic or geopolitical. Geopolitical risks in particular — defined broadly as those related to political power attached to geographic space (territorial waters, land territory and other natural resources) — have recently attracted much attention in the context of growing geopolitical tensions.

In the context of the EU Members in particular, the geographic, economic and geopolitical proximity is so high that it is logical to only consider non-EU partners as potential sources of risk and several studies make such a delineation. It has to be mentioned, however, that, albeit at a different level, the structure of trade interdependencies within the EU as well as heterogeneity (both across products and across partners) across the EU membership *vis-à-vis* external partners are also relevant for policy. First, it is of an internal interest to understand differences in exposures to possible supply disruptions within the EU to make sure that, if needed, the necessary micro- and macroeconomic adjustments can be supported by appropriate policies. Second, different EU Members may be exposed differently to different external geopolitical risks and pressures.

In the aftermath of the COVID-19 pandemic, and in the context of global geopolitical divisions that have been emerging before — and deepened after — Russia's invasion of Ukraine, several papers have looked into the economic impacts of possible "friendshoring" or "geopolitical fragmentation" scenarios, whereby the existing trade links would reconfigured through trade and trade-related policies so as to encourage trade between 'friendly' or 'like-minded' trading partners and to limit trade vis-à-vis geopolitical rivals. In this context, several studies considered different fragmentation scenarios leading to a polarised world economy, in particular different versions of a two-polar world, with a set of countries aligning themselves with the United States and European Union and another with closer relations to China.

Bolhuis, Chen and Kett (2023[16]) aimed to quantify the economic cost of trade fragmentation of commodities by considering various scenarios where countries align themselves with the US and the or China by imposing trade barriers on China and vice versa, where the alignment is based on while the other countries economically realign themselves with one of these two blocks based on historical trade ties: countries who have traded more with the US were categorised into one group while those with closer ties to China were categorised into the other group. An alternative scenario was also considered where countries were assigned into the US-centred and China-centred blocks based on

an objective measure of political distance between countries, based on the historical voting behaviour of countries in the UN General, i.e. the so-called Ideal Point Estimate (IDP)[27] between two countries.

The same IDP measure was also used in a study of geopolitical fragmentation of the international trade by the WTO (2022[17]) as well as of geopolitical fragmentation of foreign direct investment (IMF, 2023[18]). The study by the (IMF, 2023[18]) categorised countries into five groups based on their distance from the US using quantiles to form five equal groups those very close to the US, close, medium distance, far, and very far.

Existing studies looking into the economic impact of Russia tend to explicitly group the countries politically based on their stance on the war or the sanctions ((Arriola et al., 2023[19]), (Chepeliev, Hertel and van der Mensbrugghe, 2022[20]), (Rose, Chen and Wei, 2022[21])). The studies referenced in this paper that look into the impact of Russia's war against Ukraine and subsequent oil ban and sanctions had very similar country groupings. The studies looking into sanction grouped countries into those sanctioning Russia versus those did not. Moreover, the studies that focused on energy (Arriola et al., 2023[19]), (Chepeliev, Hertel and van der Mensbrugghe, 2022[20]) as well as non-energy (Rose, Chen and Wei, 2022[21]) commodities included countries or regions that were both main producers or consumers each commodity.

2.2.3. What types of shocks are considered?

Disruptions in the global economy have many characteristics which filter through into the analysis of those disruptions. Within the literature, different types of shocks are examined, including supply and demand, sector-specific or economy-wide, and specific to supply chains or goods versus services, depending on the specific effects that researchers aim to analyse.

Grassia et al. (2022[22]) focused on shocks to domestic food production in order to analyse how shocks in food products propagate to other countries and if access to international markets helps to mitigate the negative effects. Similarly, Arnold et al., (2023[23]) focused on global supply chains of the mining sector. This analysis used a CGE model and shocked production in the mining, metals, motor vehicles sector each region of the model to assess the exposure of the mining sector in Latin America. While Arriola et al. (2020[24]) and Schwellnus, Haramboure and Samek (2023[2]) looked at reduced supplies to international markets across all sectors in all regions, much like the effects seen in 2019 due to the COVDI-19 pandemic. Jiang and Scarffe (2021[25]) examined vulnerabilities of Canadian imports and exports to logistic disruptions creating vulnerability indices by modes of transportation as well as Canadian port of entry and exit.

Russia's war of aggression against Ukraine has prompted research on the impact of the war and sanctions on the global economy. The war itself has disrupted trade on products for which Russia or Ukraine are important global suppliers. Rose, Chen and Wei (2022[21]) examined the impact of reduced exports of agricultural commodities, minerals and metals. While several studies looked into the Russian oil ban, which reduced demand of Russian oil by a set of countries ((Arriola et al., 2023[19]); (Chepeliev, Hertel and van der Mensbrugghe, 2022[20])). Arriola et al. (2023[19]) included an Input-Output and CGE analysis to analyse a hypothetical decline in trade with Russia on all sectors due to sanctions put in place by a set of countries. Moreover, the CGE analysis decomposed the shocks to be able to compare shocks on goods versus services and sanctions on exports to Russia versus imports from Russia. The study found that restrictions on exports of goods and services to Russia adds at least as much economic pressure as oil sanctions.

As researchers think ahead on the future of global value chains, the distinction between goods versus services may become more important. Baldwin and Freeman (2022[26]) point out that digital technology (digitech) and artificial intelligence (AI) will change the landscape of global supply chains.

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[27] Bailey, Strezhnev and Voeten (2016[52]) used observed voting behaviour during the United Nations General Assembly the authors estimated the ideal point estimate which represents the policy or ideological position of a country from which they produced bilateral geopolitical distance between two countries.

For one thing, if labour-cost shares in manufacturing fall but the separation costs (the additional cost of extra coordination, communication, and trade costs that separation entails) do not fall as much, then they expect firms to reduce global supply chain trade and produce more stages locally. This outcome would be the result of long-term trends in industrial automation and of the fact that most non-labour costs are trade costs. Moreover, they argue that digital technology will make services more tradeable. As result "the future of international supply chain trade lies increasingly in services and decreasingly in goods" (Baldwin and Freeman, 2022[26]).

2.3. Overview of methodologies used to define trade dependencies and assess their economic effects

Economic studies on trade dependencies and vulnerabilities use a range of methodologies and frameworks. For a comprehensive assessment of supply risks and their impact on manufacturing industries, granular data allows for a more thorough and realistic assessment. Aggregated data can mask vulnerabilities associated with producing and trading products. For example, according to the ITC Trade Map database[28], while the top five exporters of Electrical machinery (HS code 85) accounted for just over half of all exports in 2022, the concentration of light emitting diodes supplies, also known as LEDs (HS8541.41) was even higher, with the top five exporters accounting for almost 80% of the market. However, relying solely on granular trade data does not capture the direct trade-production (or 'input-output') linkages which may underestimate dependencies and exposure of national industries. Furthermore, gross trade does not capture vulnerabilities from indirect linkages embedded in global supply chains where, for example, computer monitors produced in South Korea may indirectly depend on copper production in Chile that is used to produce the wiring of the LEDs from China used in the South Korean computer monitors. Due to limitations of a single methodology, studies often use a mix of methodologies or find innovative ways to address these limitations.

Trade dependency analysis can be characterized as falling under four types of methodologies. Each approach has strengths and limitations. By employing a combination of methods, the analysis can gain from the strengths of each approach.

2.3.1. First approach: Using granular data to identify critical products

Using granular data has the advantage of allowing for more precise analysis of dependencies and vulnerabilities allowing policy makers to make targeted decision about the response required. Studies using this approach use detailed gross trade data to measure supply risk, often with network analysis (concentration and centrality of suppliers) to determine a country or sector's exposure to supply disruptions ((Bonneau and Nakaa, 2020[10]), (Korniyenko, Pinat and Dew, 2017[11]), (Braun et al., 2023[12]), (Baur and Flach, 2022[7]), (European Commission, 2021[13]), (Productivity Commission, 2021[8])). In some cases, supply risk assessments includes metrics beyond the characteristics of the supply network, like a partner's ability or willingness to supply ((European Commission, 2017[3]), (Nassar and Fortier, 2021[5]), (Nassar et al., 2020[4])) or a partner's susceptibility to non-economic risks such as climate change or cyber attacks (Flach et al., 2021[6]). This is also the approach followed in this study's Chapter 3.

(Bonneau and Nakaa, 2020[10]) studied trade data at the detailed, HS 6-digit level, combined with network analysis concepts of concentration and centrality to identify products that have high potential for foreign supply disruption that is those that are characterized by heavy reliance on foreign sources for a product with only a few main suppliers. Korniyenko, Pinat and Dew (2017[11]) used a similar approach and argued that finding alternative suppliers increases in difficulty if regions trade within different clusters or the products across different exporters (even at the HS6 level) are not

[28] See https://www.trademap.org/.

substitutable[29]. The granular data approach was also used by Braun et al. (2023[12]) to identify regions exposed to imports from Russia or Ukraine first identified products where the two countries played important and central roles as exporters.

The European Commission (2021[13]) also used granular data in their "bottom-up" approach to identify products to monitor in the context of their review of strategic dependencies. These were identified as products with high foreign (extra-EU) reliance on a concentrated set of non-EU exporters which could not be substituted with EU production. Since production data was not available at this granular level, intra-EU imports were used as a proxy. Vicard and Wibaux (2023[14]) use granular trade data and the EU bottom-up methodology to analyse how EU-27 trade dependencies have evolved over time.

In studying Germany's global value chains, Flach et al., (2021[6]) used a database at a somewhat aggregated level to get information about the country's sectoral production and linked it with a more detailed input-output table of over 500 products describing inputs into production of its most important industries. The authors selected the top 5 inputs for each economically important products and then evaluated Germany's dependency on foreign suppliers by identifying the corresponding HS 6-digit code for each input. The authors included an evaluation of the risk exposure of suppliers to various types of risks, both economic and non-economic.

The Australian Productivity Commission (2021[8]) produced a framework they deemed "data-with-experts" and applied it Australia's exports and imports in order to identify supply and products that critical to the Australian Economy and wellbeing of its citizens which are vulnerable to disruptions lasting 6 months. The approach is similar to the EU's "bottom-up" methodology. Using highly detailed, HS 8-digit level data, on Australian imports, the authors identified products where a single exporter accounted for at least 80% of the imports into the country and where the exporter market had a limited number of alternative suppliers (HHI based on HS-6 digit data above a certain threshold). The authors then identified which of these vulnerable products are used in the sectors considered essential by mapping the products from the trade data to the inputs in the Australian I-O table. Last step, not actualised in the report, would be to consult with industry experts to identify those that are critical because readily available substitutes do not yet exist.

The minerals sector is one industry where there is data on both production and trade at the granular level. This sector is often considered strategic and therefore data available is often not an issue. Examples of studies of dependencies on critical raw materials using this approach include (European Commission, 2017[3]), (Nassar and Fortier, 2021[5]), (Nassar et al., 2020[4])).

2.3.2. Second approach: Input-Output data to measure dependencies through global value chains

A second method is to measure exposure using the traditional input-output data which captures input linkages and output allocation to better capture supply and demand dependencies as well as indirect linkages (Ayadi et al., 2021[27]), (Baldwin and Freeman, 2022[26]), (Schwellnus et al., 2023[28]), (Schwellnus et al., 2023[28])), (Inomata and Hanaka, 2021[29])). Using Input-Output data in principle captures the exposure to the entire global supply chain. This is also the approach followed in this study's Chapter 4.

Using a Multi-Region Input-Output database, Ayadi (2021[27]) measured supply and demand side exposure for a set of Mediterranean countries. The authors compute GVC indicators that describe a countries exposure on both the demand side (as a supplier or demander of Value Added for exports) as well as the supply side (as the ultimate destination of VA). Baldwin and Freeman (2022[26]) produced similar metrics: a Foreign Input Reliance (FIR) Index which measures countries' total

[29] If there is a high variation of human capital intensity, there is a high likely hood that production methods are different and have lower likelihood of being substitutable as inputs into the different production process across the regions (Korniyenko, Pinat and Dew, 2017[11]).

reliance on foreign production on the sourcing side; and Foreign market reliance (FMR) index which measures countries' reliance on foreign markets on the sales side. They added that measurements could be based on value added or gross output. Using gross trade and gross output rather than value added, would account for the fact that longer supply chains may involve a higher risk of disruption since using gross trade adds the same value added each time a product moves across borders as it moves through production stages. Schwellnus et al. (2023[28]) produced the FMR and FIR indicators using the OECD input-output database as well as two indictors that capture whether a region-sector is a potential choke point in the value chain either upstream (average FIR across buying sector-country) or downstream (average FMR across given supplying sector-country).

As a complement to these standard volume or value based methods of measuring exposure to supply chain disruptions, Inomata and Hanaka (2021[29]) measured exposure to risk as the frequency of engagement with foreign industrial sectors. They computed a pass-through frequency (PTF) indicator that represents the average number of times a particular supply chain passes through a target sector in a given production system. They argued that a frequency measure relates to "probability" aspect of supply chain risk and could complement conventional methods.

2.3.3. Third approach: Modelling approaches to measure exposure to shocks

A third method of measuring exposure utilises modelling frameworks to measure a country's exposure to shocks across all or specific sectors (Grassia et al., 2022[22]); (Arriola et al., 2020[24]); (Arriola et al., 2023[19]), (Chepeliev, Hertel and van der Mensbrugghe, 2022[20]); (Rose, Chen and Wei, 2022[21]). The principal interest in using models is that they incorporate behavioral responses and subsequent adjustments. This is also the approach followed in this study's Chapter 5.

The Netherland Bureau for Economic Policy Analysis in conjunction with Statistics Netherlands studied China's economic interwovenness with the EU and the Netherlands using a combination of approaches (2022[30]). Using an international input output analysis with a nonlinear optimization framework to allow for industry response, they measured the degree of Dutch-China dependency using a potential impact factor (PIF) which measures the change in gross production (output) of an industry relative to the size of the shock — which was a 25% reduction in trade between the EU Members and China. The authors also used a gravity model to assess the economic benefit of lowering import tariffs by increasing the tariffs to 1990 levels (25 ppt higher than current situation in both directions).

Grassia et al. (2022[22]), Arnold et al. (2023[23]) and Arriola, Kowalski and van Tongeren (forthcoming[31]) employed similar methodologies but using different modelling approaches to assess regions' exposure to idiosyncrtic production shocks. Grassia et al (2022[22]) used bilateral trade and production data of food in a shocks diffusion model to measure regions exposure to food production shocks. The authors reduced food production in each region in the model where the directly impacted countries adjust exports or imports to try and eliminate the demand deficit. This adjust would result in demand deficits in partner countries, who then respond by reducing their exports. The shock diffusion stops when no country facing a positive demand deficit can further reduce its exports to try to meet domestic food demand. A country's exposure to food shocks is the average food demand deficit induced by each shock. A similar approach on a broader set of sectors was applied using a global CGE model to identify regions and sectors exposed in Latin America to supply disruptions in the mining, steel and motor vehicle industries (Arnold et al., 2023[23]). Authors simulated positive and negative production shocks in each of the three sectors, one sector at time in one region at time. The extent of exposure of a national industry to these three industries was by a 'maximum negative exposure' measure, which is the total decline in production if all shocks negatively impacting the sector were to happen concurrently. One advantage of using a CGE model to measure exposure is the inclusion relative price effects as well as economy linkages that allows sectoral production and consumption to change as part of a country's response.

Recent global events have highlighted sector- and country exposures to disruptions in supply chains. Most recently, Russia's war of aggression against Ukraine has spurred tense analysis on regions' exposure to commodities trade with both Russia and to some extent Ukraine. Braun et al. (2023[12]) found that many regions were exposed to Russian energy and food commodities, particularly wheat,

trade with the two countries. Accordingly, several studies were produced analysing the economic impact of sanctions on Russian energy using a CGE model (Chepeliev, Hertel and van der Mensbrugghe, 2022[20]) and of major disruptions of exports of grains and metals (Rose, Chen and Wei, 2022[21]) commodities markets because of war. Global CGE models capture medium run impacts of the disruptions to the economy since they include both general equilibrium effects as well as economy wide linkages between sectors, between regions and between supply and demand. To measure overall economic impact of the disruption, both studies use GDP or real household income changes when assessing the overall impact. In addition to examining the macroeconomic impact of sanctions, Arriola et al. (2023[19]), used both Input-Output analysis as well as a global CGE model to measure a region and sectors exposure to Russian sanctions. Using both an Input-Output analysis and a CGE analysis gives the ability to decompose the short-term effect of the oil sanctions with the medium run affect after all markets adjust, although the two approaches often use different sources of data which complicates comparison of results.

2.3.4. Fourth approach: Case studies and surveys for in-depth reviews

Lastly, while the data driven approach to measuring trade dependencies and exposure to shocks is transparent and allows for targeted policy measures, the complexity of the market, length of the supply chain, or lack of available data require additional types of analyses to provide further insights to policy makers. Incorporating insights from industry experts and stakeholders complements data analysis to provide an even deeper analysis of the risks and linkages that make a product critical or economically important.

In depth reviews and case studies have indeed been used to provide a richer analysis at the granular level once a dependent product has been identified ((European Commission, 2021[13]), (European Commission, 2022[32]), (The White House, 2021[15])). And firm level surveys have offered a deeper understanding of firms strategies for addressing dependencies and risks (Flach et al., 2021[6]) and (Baur and Flach, 2022[7])). A number of in-depth studies on interdependencies incorporated one or more of these methodologies to account for the limitations of an individual approach ((Flach et al., 2021[6]), (CPB, 2022[30]), (Arriola et al., 2023[19])).

For example, the European Commission used the granular data approach as a first step in identifying vulnerable products (European Commission, 2021[13]). Once a product was identified as vulnerable, an in-depth review is undertaken calling on industry experts and stakeholders to provide additional market insight for each product to help identify critical products in strategic sectors. Products in six selected strategic areas were reviewed: Raw materials; Active pharmaceutical ingredients; Li-ion batteries; Hydrogen; Semiconductors; and Cloud and Edge Computing. An even deeper review followed on raw and processed materials, chemicals, cloud and edge services as well as photovoltaic panels, and cybersecurity as part of the second stage of the review (European Commission, 2022[32]).

Similarly, the United States government called for their own comprehensive review of critical US supply chains considered important to the economy (The White House, 2021[15]). There was much overlap with the European list of critical sectors: semiconductors manufacturing and advanced packaging; large capacity batteries; critical minerals and materials; and pharmaceuticals and active pharmaceutical ingredients.

Two studies from the same instutite used on-line firm level surveys to get more insights on firms' strategies related to the supply chain risks and dependencies in general and with respect to their import relationship with China. Flach et al. (2021[6]) asked 5 000 firms in the manufacturing and service industries about procurement strategies including finding suppliers closer to home. Baur and Flach (2022[7]) used the surveys to get more insight on firms' exposure to trade with China by conducting a firm-level survey of 4 000 German firms in manufacturing, wholesale and retail trade. Firms were asked if they relied on key inputs from China; whether the inputs came from their own production facilities in China or Chinese manufacturers; whether they plan to reduce their imports from China in the future, if so, how (e.g. replace with European alternatives) and why. The surveys allowed the authors to analyse responses by firm characteristics, like the size of the firm, which are not available using sectoral data such BACI or UN Comtrade.

Box 2.1. Related OECD work

(Arriola et al., 2020[24]) used detailed trade and Trade in Value Added (TiVA) statistics to identify some of the potential supply chain bottlenecks in the context of trade cost shocks similar to those seen during the COVID-19 pandemic. The analysis also used the OECD computable general equilibrium (CGE) trade model METRO to broadly compare economic efficiency and international transmission of trade cost shocks under different assumptions about countries' openness, support to domestic industries and flexibility of adjustments in international supply chains. In a follow up work, Arriola, Kowalski and van Tongeren (forthcoming[31]) are undertaking exploratory CGE modelling research on how shocks of a different nature may combine in the global economy and cause stress on specific products, trade routes or transport modes.

More recently, Arriola et al. (2023[19]) used similar techniques (i.e. detailed trade data, TiVA data and Inter-Country Input-Output (ICIO) techniques, as well as CGE modelling) to assess the exposure to trade with Russia and considered the economic costs of reduced trade scenarios for Russia and the countries imposing on it economic sanctions. The study proposed a simple method for classifying bilateral import links of OECD countries as 'dependencies' based on a combination of criteria involving non-OECD partner trade shares, overall concentration of imports and the extent of sourcing of similar products from other OECD countries. The method of classifying trade flows was also recently used in a study focusing on raw materials used intensely in green transition technologies in order to shed light on the extent of dependence of OECD countries on sourcing such raw materials from outside the OECD membership (Kowalski and Legendre, 2023[33]). Schwellnus, Haramboure and Samek (2023[2]) used an econometric model to estimate the relationship between domestic output changes and disruption of foreign supply, first in the context of the COVID-19 pandemic. The authors then applied the framework to run counterfactual simulations to assess the impact of various strategies thought to cushion domestic production from foreign supply shocks: supplier diversification; partial onshoring; and technological innovation.

2.4. Key conclusions and policy recommendations from the literature

Several insights can be gleaned from the existing literature. Firstly, there is no one single method that would allow a reliable identification of such trade dependencies: different approaches or even different thresholds and parameters used within the same approach can yield somewhat different lists of products that meet diverse criticality criteria. However, despite their shortcomings, these methodologies and different thresholds and parameters can still be used to filter out the potentially problematic trade links which can be analysed further from more multidisciplinary angles.

The structure of international trade is highly heterogenous: many trade links do not meet any of the criticality criteria but also quite a few meet one or more of them. The lists of dependencies also change over time. In several studies that include a time dimension, the number of dependent products has varied over time, and there was also a churn of the specific products that have been identified as dependent over the last decade (Vicard and Wibaux, 2023[14]). In addition, the supply risk of a commodity can change with market dynamic (Nassar et al., 2020[4]) and with natural, economic and geopolitical developments. These findings suggest that the identification of critical dependent products should be done on a rolling window basis or some other methodology that takes multiple years into account (e.g. multi-year averages or totals).

While supplier diversification can in principle be a strategy to reduce supply risk failures, market concentration may impede a firm's ability to use this strategy to hedge risk. Vicard and Wibaux (2023[14]) found a shift in the origin of dependent products towards China, especially on highly concentrated products, which would bring into question the possibility of finding other suppliers. Bonneau and Nakaa (2020[10]) found that some dependent products are concentrated across EU Member states, which reduces the cushion from supply risk brought by relying on EU suppliers.

Firm-level strategies to mitigate the risk of supply failures depend on firm characteristics. Supplier diversification may be cost prohibitive for small and medium sized enterprises (SMEs) as they tend to

use stockpiling as a risk mitigation strategy while larger firms prefer procurement diversification and supply chain monitoring (Flach et al., 2021[6]). In this respect, the authors suggest more SME-friendly designs of trade agreements, citing harmonization of standards and rules of origin as a good place to start as it would reduce the cost of diversifying suppliers. In fact, these harmonization of rules and standards would help all types of firms and not just SMEs (Arnold et al., 2023[23]). Additionally, the harmonization of technical standards would facilitate product substitution (Arriola et al., 2020[24])as would lowering tariff and non-tariff barriers (Arnold et al., 2023[23]) which would also mitigate the negative impact of a supply shock.

There is an economic cost of reducing trade exposure by bringing production closer to home. Modelling analyses have been used to economically assess decoupling, reshoring or near-shoring as a way to protect domestic industries from supply shocks (Bolhuis, Chen and Kett, 2023[16]), (Flach et al., 2021[6]) (CPB, 2022[30]) (Arnold et al., 2023[23]) (Arriola et al., 2020[24]). The studies find that there are economic costs to reducing trade with important partners. While more localised regimes may cushion domestic industries from shocks originating in other regions, these types of regimes also mean less diversification in suppliers, less scope for adjustments once a shock occurs, and increased the exposure to domestic shocks, while lowering economic efficiency. Moreover, moving some or all of production closer to home requires some large up-front investment costs and could result higher production costs. Countries may also lack the ecosystem of specialised suppliers and high-skilled workers (Schwellnus, Haramboure and Samek, 2023[2]).

There is strength in numbers. While a single country might not have the same economic leverage *vis-à-vis* a large trading partner such as China, groups of countries taken together could be more economically relevant as a trading partner. This is important in the context of calls for decoupling from certain partners to protect domestic industries from supply failures that may result from changing geopolitical relations. For example, Baur and Flach (2022[7]) argue the EU as a whole is the most important supplier of intermediate inputs and the second most important sales market for China from a value-added perspective, which should in principle enable the EU to take a clear and self-determined stance towards China. Therefore, the goal of policy in Europe should not be ‘decoupling’ from China, but primarily the avoidance of one-sided dependencies.

Several studies focused on Europe recommend more cooperation and dialogue across the EU and member states (Baur and Flach, 2022[7]) and (Bonneau and Nakaa, 2020[10])) to consult with Member states on supply chain vulnerabilities, develop a common definition of goods and services considered “critical”, and strengthen the EU common market. There are also benefits to be gained through cooperation at the multi-lateral level (Bonneau and Nakaa, 2020[10]) in ensuring that unilateral initiatives to strengthen and secure supply chains comply with global trading rules or finding a multi-lateral approach to supply chain issues (The White House, 2021[15]).

Whatever policy interventions governments prescribe, the policy needs to match the problem and should be grounded in business reality ((Baldwin and Freeman, 2022[26]) citing Miroudot, 2020). There are some “no-regret” policies for governments, such as improving information and timely data to help monitor and identify supply chain vulnerabilities, risks, and bottlenecks in critical sectors ((Baldwin and Freeman, 2022[26]), (Bonneau and Nakaa, 2020[10]), (Flach et al., 2021[6]), (Korniyenko, Pinat and Dew, 2017[11]), (Arriola et al., 2020[24])). Moreover, government should include businesses and other economic actors in the discussions of vulnerabilities in supply (Flach et al., 2021[6]). Governments also could organised supply chain stress tests and crisis scenario simulations to identify weak points in the supply chain ((Flach et al., 2021[6]), (Arriola et al., 2020[24])). If under exceptional cases deemed important to national security or public health, governments decide to intervene, the policy should be based on a transparent catalogue of ideas and designed in accordance to WTO law (Baur and Flach, 2022[7]), and the case for intervention needs to demonstrate that its benefit outweighs its cost (Productivity Commission, 2021[8]).

3. Identifying trade dependencies using detailed merchandise trade data

Analysis presented in this chapter builds on an approach to identifying trade dependencies using detailed trade data employed earlier at the OECD (Arriola et al., 2023[19]), (Kowalski and Legendre, 2023[33]) and elsewhere [(McKinsey Global Institute, 2023[34]), (European Commission, 2021[13]), (Vicard and Wibaux, 2023[14]), (Jiang, 2021[9]), (Productivity Commission, 2021[8]).Trade dependencies are identified using combined criteria of high bilateral trade shares and high overall concentration of trade.

Conducted at HS 6-digit level of product classification, as well as some of the more aggregated product categories based on the HS classification (including some of those that have been identified in the recent literature as 'strategic', i.e. Hung (2023[35]) and IMF (2023[18])), this approach allows painting a fairly granular picture of trade linkages across diverse products (5022 products) and a comprehensive coverage of trading countries (238 countries). To study the evolution of dependencies in time, this work covers a relatively long historical period for which internationally-comparable data at the detailed product level is available (1995-2021).

While the analysis is global in its design, the presentation of results focuses on the main characteristics of trade linkages of the OECD membership as a group; individual G7 economies (Canada, France, Italy, Japan, Germany, the United Kingdom and the United States); Australia and Korea, the Netherlands as well as three other larger individual EU countries (Spain, Poland, Sweden); EU27 as a block; and the MNOE countries (Brazil, China, India, Indonesia, Russia, and South Africa) individually and as a group.

3.1. Introduction

Identification of specific products or trade links which might meet the trade dependency criteria [1) high risk of disruption; 2) high economic (or other) importance; and 3) constrained possibility of substitution] can be performed on a case-by-case basis, drawing on expert knowledge of specific industries, firms, products or commercial links. However, countries typically trade thousands of products with tens or hundreds of partners and such an approach can be quite resource-intensive unless there are strong *a priori* indications which trade links should be spotlighted.

Such prioritisation can therefore be facilitated by a large-scale quantitative analysis of trade indicators which aim to capture some of the above criteria of trade dependency, such as, for example, the economic significance and possibility of substitution. This can help sift through a large number of bilateral trade relationships at a detailed product level and help identify the potential dependency candidates, which can be studied further by exports and can include separate geopolitical (or other) assessments of potential disruption risks.

Such a large-scale identification of possible cases of trade dependencies based on objective trade indicators, and a broad assessment of their economic significance, structure and evolution in time, is the approach adopted in the analysis presented in this chapter. The analysis builds on an approach to identifying trade dependencies used earlier at the OECD (e.g. (Arriola et al., 2023[19]), (Kowalski and Legendre, 2023[33])) and outside (e.g. (McKinsey Global Institute, 2023[34]), (European Commission, 2021[13]), (Ambroziak et al., 2023[36]), (Vicard and Wibaux, 2023[14]), (Jiang, 2021[9]), (Productivity Commission, 2021[8])) which combines an analysis of bilateral trade shares and trade concentration ratios. Conducted at the 6-digit level of the UN's Harmonised System (HS6 thereafter) using detailed gross import and export data from the 2023 version of CEPII's BACI dataset[30] and more

[30] Note that, as pointed out by (Thissen, Ivanona and Mandras, 2019[53]), in the CEPII's BACI dataset, data for EU Members is not adjusted for re-exports or re-imports. The authors of this current report are also not aware of any other trade dataset at the detailed product level, and with a global coverage, that consistently incorporates such an adjustment (e.g. UN Comtrade data suffers from the same problem). This is why CEPII BACI was

aggregated product categories derived from the HS classification (including some of those that have been identified in the recent literature as 'strategic' (Hung, 2023[35]) and (IMF, 2023[18])) this approach allows painting a fairly granular picture of trade linkages across diverse products (5 022 products)[31] and a comprehensive coverage of trading countries (238 countries).

To study the evolution of dependencies in time, the analysis covers a relatively long historical period for which harmonised trade data at the product level is available (1995-2021). Since trade values can vary a lot from one year to another, especially for more disaggregated HS product categories, three-year[32] averages are calculated to track evolution of dependencies in time for the following six sub-periods: 1997-99; 2002-04; 2007-09; 2012-14; 2017-19; and 2020-21.

While the analysis is global in its design, the presentation of results focuses on trade linkages of the OECD countries as a group; individual G7 economies (Canada, France, Italy, Japan, Germany, the United Kingdom, and the United States); Australia and Korea, the Netherlands as well as three other larger individual EU countries (Spain, Poland, Sweden), EU27 as a block, and the MNOE countries (Brazil, Russia, India, Indonesia, China, and South Africa) individually and as a group.

3.2. Global concentrations of imports and exports

The methodology which uses the concept of trade concentration as an approach to identifying trade dependency in this chapter is discussed in Annex 8.1.1.

Exports of HS6 products are on average two times more concentrated across exporting countries than imports are across importing countries (Figure 3.1). For exports, the average value of HHI has been approaching the value of 0.2 prior to the COVID-19 pandemic (the period 2017-19), which, as discussed above, can be considered as indicating a moderately high level of concentration.

One possible explanation of the higher global concentration of exports is provided by the theory of international trade based on the concept of comparative advantage: countries differ more with respect to what they supply to world markets (i.e. they specialise in production of some products due to different natural endowments or technologies) than with respect to what they source from world markets (i.e. consumers in different countries have relatively similar preferences and consume similar bundles of products). Note also that this is consistent with the pre-occupation with import dependencies as seen from the national perspectives in the recent public debates. This is further explored in Section 3.4.

Both export and import concentration ratios have been increasing gradually since the late 1990s until the COVID-19 pandemic. This possibly reflects the growing levels of specialisation in global value chains (GVCs) which proliferated during this period. In GVCs, specialisation occurs at a finer — intermediate input — level and this has resulted in a growing number of traded intermediate products

chosen as an appropriate dataset for this analysis. Still, for many countries, including the Netherlands due to the role of the port of Rotterdam as a gateway to EU trade, re-exports may play an important role depending on product traded. Therefore, some of the import dependencies calculated for countries for which re-exports are an important phenomenon in this report may be exaggerated in the sense that these products do not end up being used by domestic producers or consumers but are re-exported. On the other hand, some of the services industries which are handling the re-exporting activity (e.g. shipping and transport services), and which may still have an important share in the country's GDP and income, would still be 'dependent' on such re-exports. Note also that Chapter 4 and Chapter 5 of this report on the results of analysis, which is based, respectively, on the OECD Inter-Country Input Output tables and GTAP database, which are both adjusted for re-exports, do not suffer from this problem. However, they incorporate trade data at a much higher level of product aggregation.

[31] Note that while the level of aggregation at which the analysis is conducted is as granular as available data allows, it is still a potential constraint as most products are highly differentiated by a myriad of characteristics which determine uniqueness and substitutability. This heterogeneity may not be well captured even by the relatively disaggregated HS6 trade data used in the paper. Policies aiming to minimise trade risks may be not based on the aggregated categories that are included in the analysis, but rather more detailed supply chain analyses. For more discussion of this issue, see Annex 8.1.1.

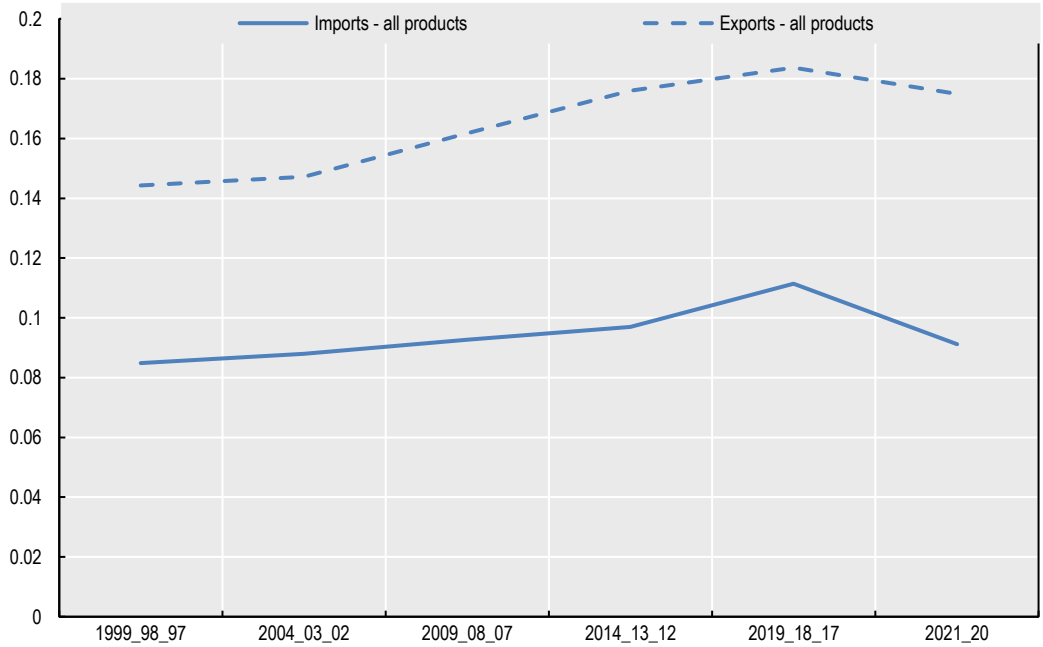
[32] A two-year period is considered for the most recent years 2020-21.

and inputs which in turn is consistent with growing levels of trade concentration. While likely indicating the growing specialisation of production and trade in GVCs, at the same time — and in line with the logic of concentration as a factor contributing to trade dependency — the increase in global trade concentrations ratios may also be indicative of the perception of a global increase in vulnerabilities to unexpected trade shocks.

However, there is also considerable variation around the mean values of the concentration indices across all HS6 products. For example, in the period 2017-19, fifty-two out of 4 839 HS6 products with active trade links, which were equivalent to approximately 1% of all active links, were exported by only one country (i.e. they had HHI=1). More than ninety exported products had HHI readings equal or higher than 0.75 (2% of all active links). In contrast, 3 502 products — or 72% of exported products — had global export HHIs lower than or equal to 0.2. This suggests that exports of an overwhelming majority of traded products were relatively well diversified but exports of close to 30% of traded products were relatively highly concentrated.

Figure 3.1. Global concentration of exports and imports has been increasing prior to COVID-19

Average country concentration of world exports and imports across all HS6 products, Herfindahl-Hirschman Index



Note: The export and import concentration indices which are presented in this and subsequent figures are calculated first for each specific HS6 product and then averaged for the purposes of presentation across the different product categories (i.e. global 'averages' for all trade in this case).
Source: OECD calculations using the BACI data.

3.2.1. Global concentrations of exports and imports across HS2 sectors

There are also considerable deviations from the time trend of increasing export concentrations across products and across periods: for some products and in some periods global concentrations of exports and imports actually fell.

A considerable volatility of global concentration ratios in time observed for some products makes it difficult to clearly establish for which sectors export concentration changed the most.[33] However, if we

[33] For example, for some products which have recorded high average increases in HHI values these increases have been quite volatile within the period, reflecting increases in some periods followed by falls in others.

take the simple measure of average relative change in the value of HHI of each sector (HS2) from the beginning until the end of the pre-COVID period, we see that the list of 30 HS2 sectors with the largest increases is rather diverse (Figure 3.2, left hand panel). It contains some raw, or semi-processed, industrial materials such as tin, lead, copper, or ceramic and glass products, but it also contains several materials and finished and semi-finished of the textiles and apparel industry as well as some manufactured products.

The list of sectors where the increases in export concentration have been the smallest (or negative, meaning that global export concentration has actually fallen, Figure 3.2, right-hand panel) is also revealing as it contains several technologically advanced manufacturing sectors, such as machinery and equipment, optical and precision equipment, iron and steel, motor vehicles, aircraft, pharmaceutical products, mineral fuels, nickel, fertilisers but also animal products, cereals and dairy products.

Several sectors which experienced the largest (smallest) increases in export concentration ratios were also the sectors with the most (least) concentrated exports at the end of the pre-COVID19 period (Figure 3.3).[34]

Figure 3.2. Thirty sectors with largest and smallest average increases in global export concentration between 1997-99 and 2017-10

Values of HHI calculated over all exporters in 1997-99 and 2017-19

Top 30 products with largest increases		1997-99	2017-19
All products		0.14	0.18
80 - Tin and articles thereof	(…)	0.15	0.38
78 - Lead and articles thereof	(…)	0.10	0.23
14 - Vegetable plaiting materials; vegetal	(…)	0.18	0.40
63 - Other made up textile articles; sets;	(…)	0.11	0.25
58 - Special woven fabrics; tufted textile	(…)	0.12	0.25
55 - Man-made staple fibres	(…)	0.12	0.24
52 - Cotton	(…)	0.11	0.21
65 - Headgear and parts thereof	(…)	0.14	0.28
61 - Articles of apparel and clothing acce	(…)	0.11	0.21
41 - Raw hides and skins(other than furs	(…)	0.11	0.20
66 - Umbrella, sun umbrellas, walking-sti	(…)	0.28	0.51
94 - Furniture; bedding, mattresses, mat	(…)	0.13	0.23
37 - Photographic or cinematographic go	(…)	0.17	0.29
96 - Miscellaneous manufactured articles	(…)	0.13	0.23
74 - Copper and articles thereof	(…)	0.11	0.19
60 - Knitted or crocheted fabrics	(…)	0.12	0.22
64 - Footwear, gaiters and the like; parts	(…)	0.15	0.27
57 - Carpets and other textile floor cover	(…)	0.12	0.21
54 - Man-made filaments; strip and the li	(…)	0.12	0.21
53 - Other vegetable textile fibres; paper	(…)	0.24	0.41
83 - Miscellaneous articles of base metal	(…)	0.11	0.19
62 - Articles of apparel and clothing acce	(…)	0.11	0.19
92 - Musical instruments; parts and acce	(…)	0.20	0.33
82 - Tools, implements, cutlery, spoons a	(…)	0.12	0.19
46 - Manufactures of straw, of esparto or	(…)	0.24	0.38
33 - Essential oils and resinoids; perfume	(…)	0.14	0.22
43 - Furskins and artificial fur; manufactu	(…)	0.16	0.25
69 - Ceramic products	(…)	0.13	0.20
70 - Glass and glassware	(…)	0.12	0.18
13 - Lac; gums, resins and other vegetat	(…)	0.18	0.27

Top 30 products with smallest increases		1997-99	2017-19
All products		0.14	0.18
36 - Explosives; pyrotechnic products; m	(…)	0.15	0.16
84 - Nuclear reactors, boilers, machinery	(…)	0.13	0.14
1 - Live animals; animal products	(…)	0.14	0.14
20 - Preparations of vegetables, fruit, nut	(…)	0.15	0.15
90 - Optical, photographic, cinematograp	(…)	0.16	0.16
15 - Animal or vegetable fats and oils an	(…)	0.20	0.19
89 - Ships, boats and floating structures	(…)	0.11	0.11
12 - Oil seeds and oleaginous fruits; mis	(…)	0.19	0.19
39 - Plastics and articles thereof	(…)	0.13	0.12
17 - Sugars and sugar confectionery	(…)	0.16	0.15
7 - Edible vegetables and certain roots a	(…)	0.19	0.18
30 - Pharmaceutical products	(…)	0.14	0.14
72 - Iron and steel	(…)	0.13	0.12
87 - Vehicles other than railway or tramw	(…)	0.15	0.14
97 - Works of art, collectors' pieces and a	(…)	0.17	0.16
47 - Pulp of wood or of other fibrous cell	(…)	0.21	0.19
16 - Preparations of meat, of fish or of cr	(…)	0.15	0.14
27 - Mineral fuels, mineral oils and produ	(…)	0.16	0.15
8 - Edible fruit and nuts; peel of citrus fru	(…)	0.19	0.17
21 - Miscellaneous edible preparations	(…)	0.09	0.07
45 - Cork and articles of cork	(…)	0.33	0.29
22 - Beverages, spirits and vinegar	(…)	0.23	0.19
10 - Cereals	(…)	0.21	0.17
2 - Meat and edible meat offal	(…)	0.20	0.16
88 - Aircraft, spacecraft, and parts theree	(…)	0.19	0.15
75 - Nickel and articles thereof	(…)	0.17	0.13
4 - Dairy produce; birds' eggs; natural ho	(…)	0.14	0.11
19 - Preparations of cereals, flour, starch	(…)	0.14	0.10
31 - Fertilisers	(…)	0.20	0.12
24 - Tobacco and manufactured tobacco	(…)	0.14	0.08

Source: OECD calculations using the BACI data.

Overall, the list of top 30 HS2 sectors with the highest average export-concentration in 2017-19 (Figure 3.3) is not obviously dominated by products that are typically seen on lists of 'strategic' products. Instead, it features several products of light manufacturing industries, mostly notably from textiles and footwear and headgear industries. Some animal and vegetable products also feature on

[34] The lists of products with largest and smallest increases in global import concentration is not presented here but it offers a similarly diverse picture.

this list, as do products of a few manufacturing industries such as inorganic chemicals (HS28), and some metals such as tin and lead (HS80 and HS78 respectively).

Amongst others, this may suggest that the concentration reflects natural and economic factors, such as natural endowments, comparative advantage and low costs of production and processing in some locations (including economies of scale). On average there seems to be a fair amount of competition in world markets and that specific exporters and importers have a limited control over price formation. In addition, these moderate global concentrations also mean that in principle international markets offer good options for diversification of both export and imports at the national level It seems therefore that economic factors, rather than strategic or geopolitical factors, are some of the main drivers of these global export concentrations.

Figure 3.3. Top thirty most and least concentrated HS sectors in 2017-19

Global export concentration

30 most export-concentrated	HHI value	30 least export-concentrated	HHI value
14 - Vegetable plaiting materials; vegetable pı (...)	0.38	32 - Tanning or dyeing extracts; tannins and t (...)	0.09
80 - Tin and articles thereof (...)	0.38	8 - Edible fruit and nuts; peel of citrus fruit or ı (...)	0.09
92 - Musical instruments; parts and accessor (...)	0.28	10 - Cereals (...)	0.08
95 - Toys, games and sports requisites; parts (...)	0.25	94 - Furniture; bedding, mattresses, mattress (...)	0.08
93 - Arms and ammunition; parts and access (...)	0.25	22 - Beverages, spirits and vinegar (...)	0.08
78 - Lead and articles thereof (...)	0.22	20 - Preparations of vegetables, fruit, nuts or ((...)	0.08
53 - Other vegetable textile fibres; paper yarn (...)	0.22	40 - Rubber and articles thereof (...)	0.08
26 - Ores, slag and ash (...)	0.21	17 - Sugars and sugar confectionery (...)	0.08
37 - Photographic or cinematographic goods (...)	0.20	72 - Iron and steel (...)	0.07
41 - Raw hides and skins(other than furskins) (...)	0.19	24 - Tobacco and manufactured tobacco subs (...)	0.07
44 - Wood and articles of wood; wood charco (...)	0.19	49 - Printed books, newspapers, pictures and (...)	0.07
33 - Essential oils and resinoids; perfumery, ((...)	0.19	84 - Nuclear reactors, boilers, machinery and (...)	0.07
66 - Umbrella, sun umbrellas, walking-sticks, (...)	0.18	54 - Man-made filaments; strip and the like of (...)	0.07
43 - Furskins and artificial fur; manufactures t (...)	0.18	96 - Miscellaneous manufactured articles (...)	0.07
67 - Prepared feathers and down and articles (...)	0.17	18 - Cocoa and cocoa preparations (...)	0.06
64 - Footwear, gaiters and the like; parts of sı (...)	0.17	89 - Ships, boats and floating structures (...)	0.06
74 - Copper and articles thereof (...)	0.16	39 - Plastics and articles thereof (...)	0.06
81 - Other base metals; cermets; articles the (...)	0.16	73 - Articles of iron or steel (...)	0.06
47 - Pulp of wood or of other fibrous cellulosic (...)	0.16	60 - Knitted or crocheted fabrics (...)	0.06
9 - Coffee, tea, matT and spices (...)	0.16	83 - Miscellaneous articles of base metal (...)	0.06
13 - Lac; gums, resins and other vegetable sa (...)	0.15	31 - Fertilisers (...)	0.06
12 - Oil seeds and oleaginous fruits; miscella (...)	0.15	82 - Tools, implements, cutlery, spoons and f (...)	0.06
63 - Other made up textile articles; sets; worn (...)	0.15	69 - Ceramic products (...)	0.06
3 - Fish and crustaceans, molluscs and other (...)	0.15	4 - Dairy produce; birds' eggs; natural honey; (...)	0.06
45 - Cork and articles of cork (...)	0.15	19 - Preparations of cereals, flour, starch or m (...)	0.05
6 - Live trees and other plants; bulbs, roots ar (...)	0.15	76 - Aluminum and articles thereof (...)	0.05
11 - Products of the milling industry; malt; sta (...)	0.15	36 - Explosives; pyrotechnic products; match (...)	0.05
25 - Salt; sulphur; earths and stone; plasterin (...)	0.15	35 - Albuminoidal substances; modified starch (...)	0.05
91 - Clocks and watches and parts thereof (...)	0.15	59 - Impregnated, coated, covered or laminate (...)	0.05
71 - Natural or cultured pearls, precious or se (...)	0.14	21 - Miscellaneous edible preparations (...)	0.03

Source: OECD calculations using the BACI data.

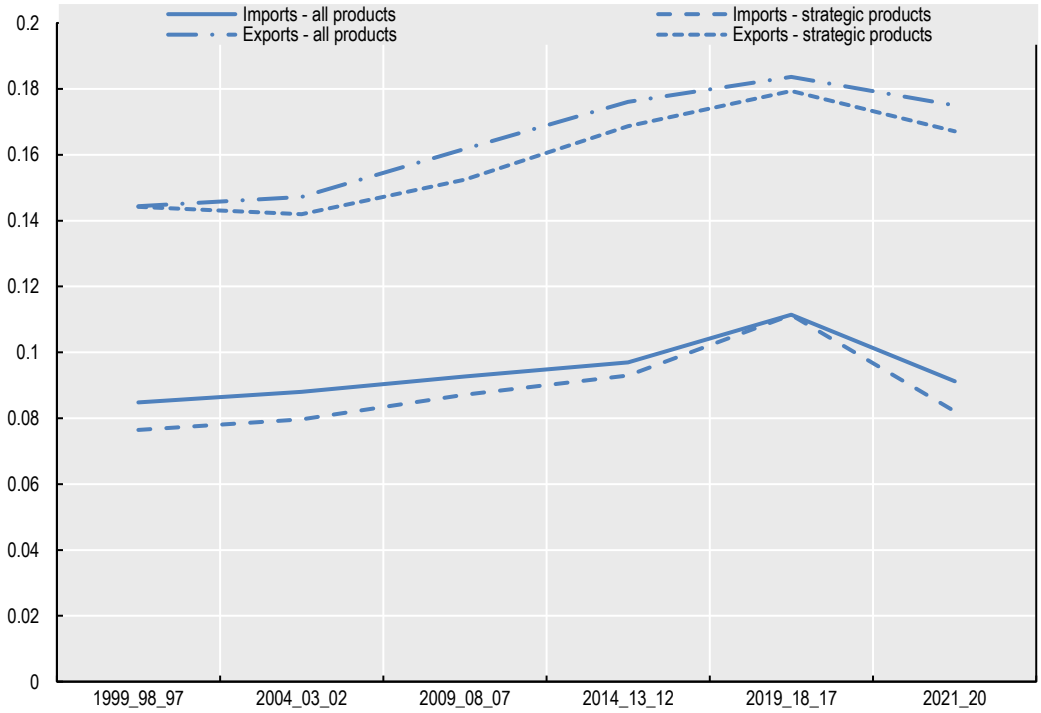
3.2.2. Global export and import concentrations in 'strategic' sectors

Indeed, using the IMF list of strategic products and its mapping to the International Standard Industrial Classification of all economic activities (ISIC, Revision 4) [(IMF, 2023[1]), and Annex 8.1] we see these strategic products are on average both less export- and import- concentrated than all traded HS6 products (Figure 3.4). This suggest that the global trade of products of some of the industries that are qualified as strategic based on expert or political judgment is actually relatively well diversified. This means that these strategic products can be sourced from — or exported to — a larger number of countries than, on average, all traded products. This finding is similar to the one in Kowalski and Legendre (2023) who found that on average trade of materials critical for green transition is lower than that of all merchandise products.

Among the strategic products, there are some that are more, and there are some that are less, concentrated. Manufacture of electronics[35], with the global import HHI approaching 0.3 in 2017-19, comes through as the most export-concentrated strategic sector, followed by mining of uranium and thorium ores, manufacture of other porcelain and ceramic products and manufacture of domestic appliances. In the 2017-19 period, for all four of these top export-concentrated sectors, the HHIs exceeded 0.2. We also see that, in these and other most export-concentrated sectors, concentration has increased significantly since the 1990s, and that this increase was indeed the most significant for the manufacture of electronics (Figure 3.6).

Figure 3.4. Global export and import concentrations of 'strategic' products are actually lower than concentrations of all merchandise products

Average country concentration of world exports and imports across 'strategic' and all HS6 products

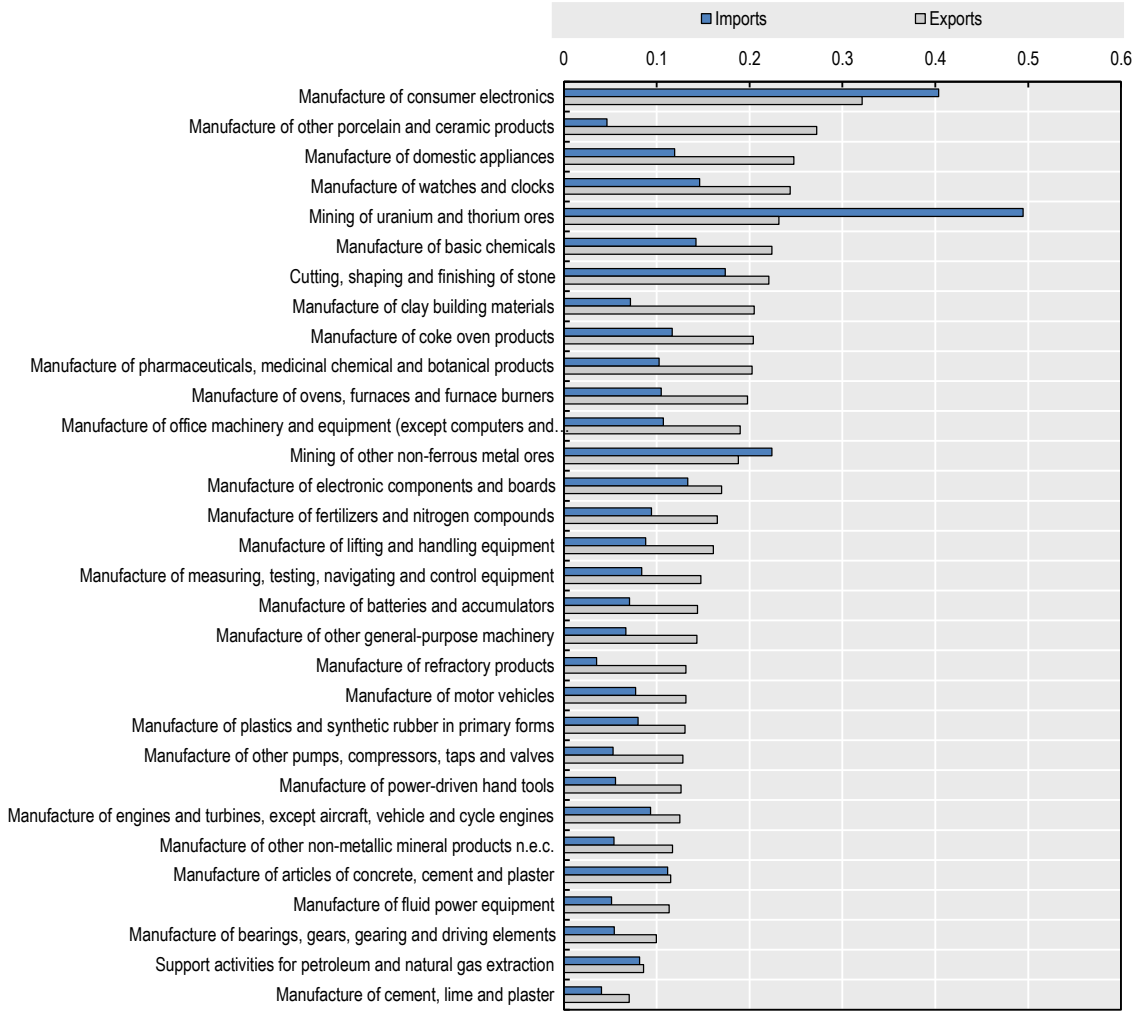


Note: 'Strategic' products are those identified on the Atlantic Council/IMF lists and concorded to HS classification.
Source: OECD calculations using the BACI data.

[35] Note that this sector is different from Manufacture of electronic components and boards, which is characterised by relatively low absolute and relative values of global export concentrations (Figure 3.5).

Figure 3.5. Global export and import concentrations of 'strategic' sectors

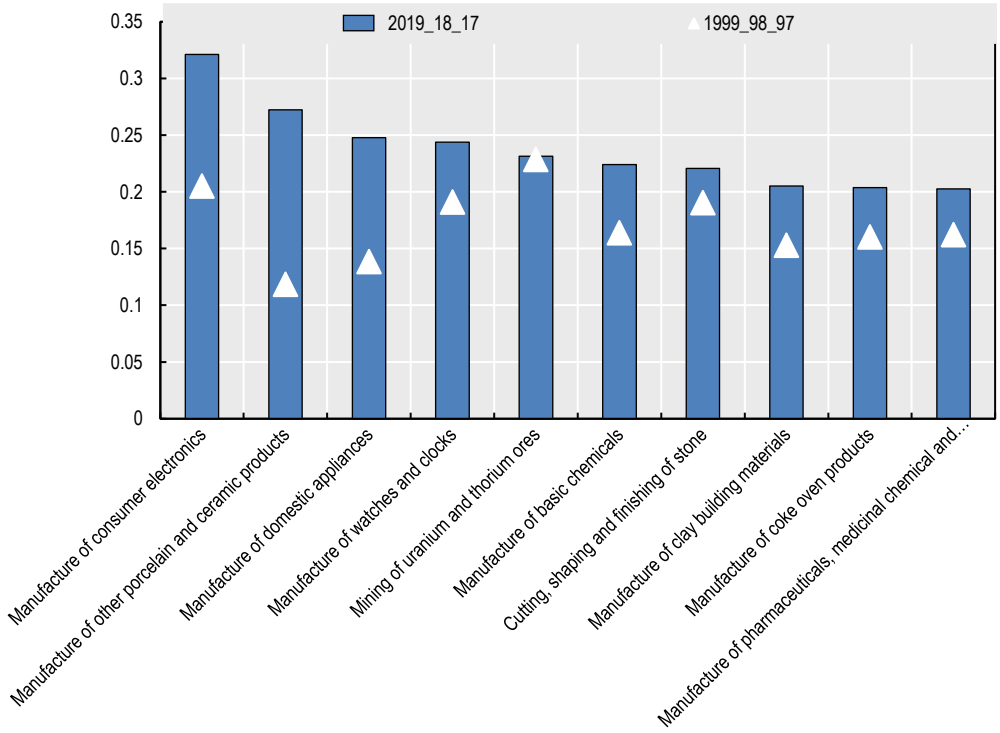
Average country concentration of world exports and imports across 'strategic' HS6 products belonging to the given strategic ISIC industry, 2017-19



Note: Sorted by the average value of HHI index for exports.
Source: OECD calculations using the BACI data.

Figure 3.6. Evolution of global export concentration in the ten most export-concentrated 'strategic' sectors

Average country concentration of world exports across HS6 products belonging to the given 'strategic' ISIC sector



Source: OECD calculations using the BACI data.

3.3. Country-level concentrations of imports and exports

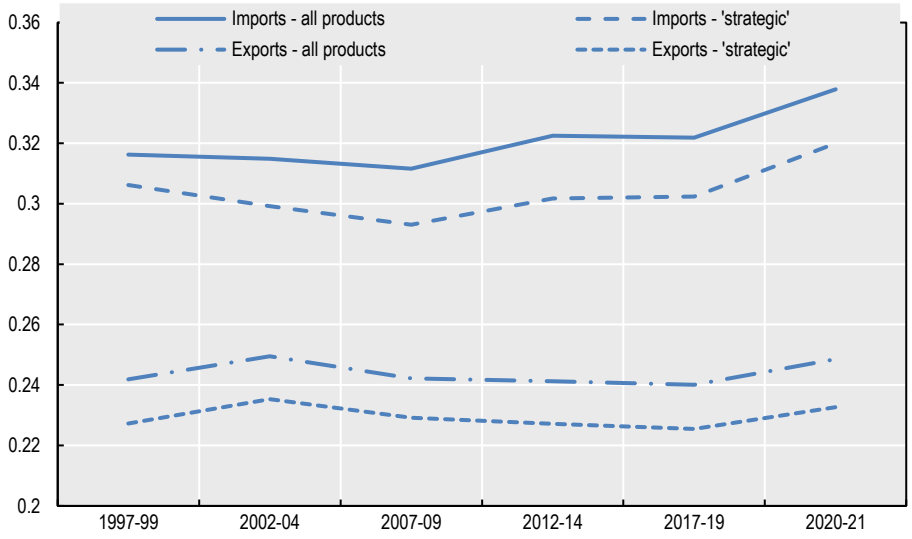
The corresponding country-level concentrations of imports and exports are higher than the global concentrations. That is, countries typically source their imports from — and send their exports to — fewer partners than it is in principle globally possible. On average, both country-level imports and exports are relatively moderately concentrated with HHI values exceeding 0.3 for imports and 0.2 for exports (Figure 3.7).[36] Country-level concentrations are also higher than the global ones for products on our 'strategic product' list. In addition, at the country level, imports have become visibly more concentrated throughout the investigated period while export concentration has also grown, albeit less quickly.

The higher country-level concentrations likely reflect a combination of natural factors, such as the role of geography and trade costs particularly in the context of GVC integration which is highly regional as well as preferences and policies (e.g. existence of regional and preferential trade agreements which by design tend to lower trade costs and give other advantages to selected trade partners). Strategic economic policies of importers and exporters could also have played a role. On the export side, China may be a case in point as the overall rise in national import concentrations has coincided with raising shares of China as a source of imports (Figure 3.7, Panel B).

[36] Note also that country-level Import concentrations are higher than country-level export concentrations. This finding is consistent with the finding that at the global level exports are more concentrated than imports (recall Figure 3.1 and the associated interpretation: country-level imports are expected to be more concentrated than country-level exports because countries differ more in terms of what they produce than in terms of what they consume).

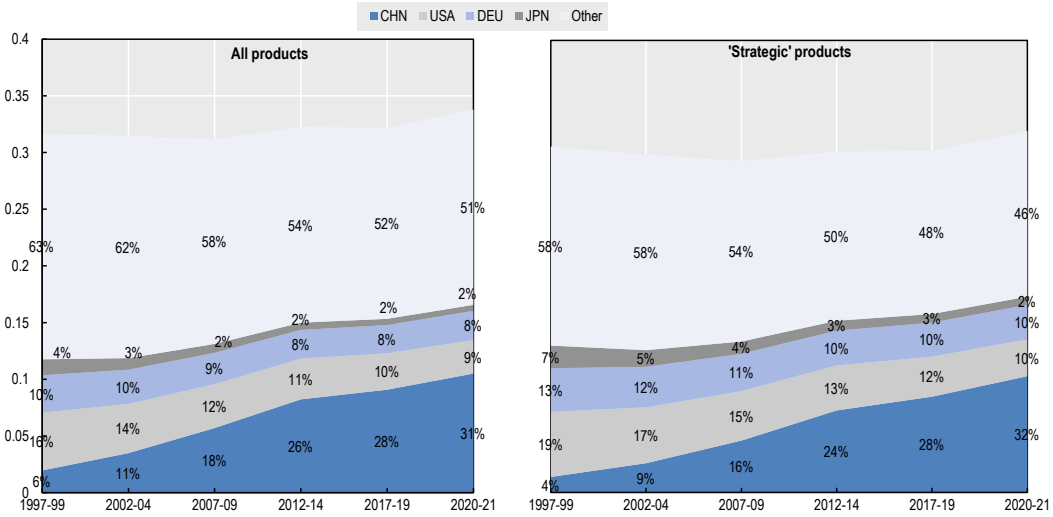
Figure 3.7. Country-level concentration of exports and imports of strategic sector and all merchandise products

Panel A. Average country-level concentration* of exports and imports across 'strategic'** and all HS6 products



Notes: *This measure is obtained by calculating, first, for each HS6 product and, for exports (imports), each exporting (importing) country an index of concentration (HHI) across all importers (exporters) from (to) that country, and second by averaging across all relevant 'strategic' and 'all' product lists. '1999_98_97', '2004_03_02', etc., denote the averages for the three-year periods 1999, 1998 and 1997; 2002, 2003 and 2004; and so on.
**'Strategic' products are those identified on the Atlantic Council/IMF lists and concorded to HS classification, see also Annex 8.1.

Panel B. Contributions of China to average country-level import concentrations



Note: Panel B. shows the decomposition by selected exporters of the above values of the HII index for imports of all and 'strategic' products.
Source: OECD calculations using the BACI data.

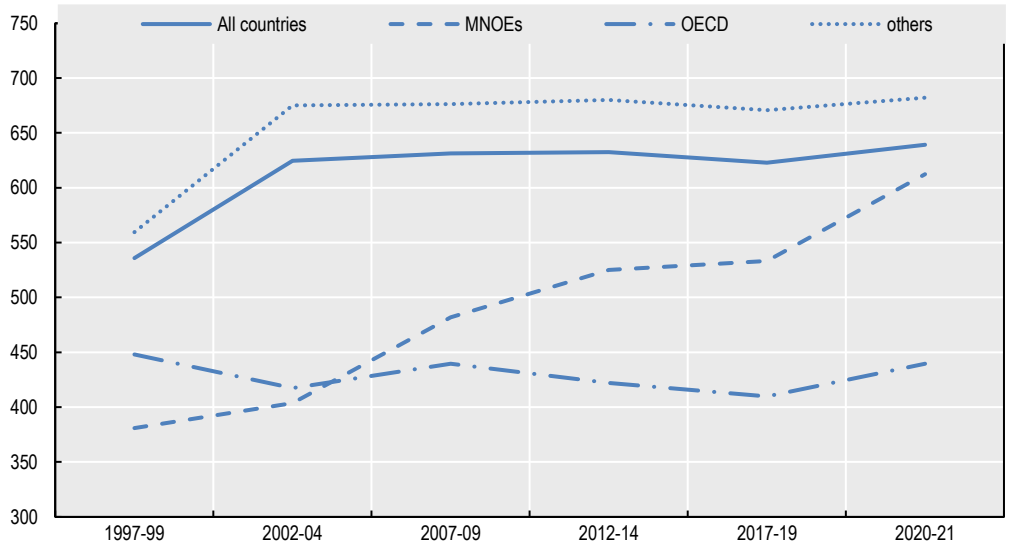
Building on the observation of differences between the global and national trade concentrations, a recent study by McKinsey Global Institute (2023[34]) suggests there is interest in distinguishing cases of traded products where countries rely on significantly fewer suppliers or customers than is offered by the global economy as ones where "concentration is coming from economy-specific choices".

Building on this suggestion, the data on global and country-level concentration has been used to evaluate the incidence of such 'excessive' concentration cases for imports. To do so, an arbitrary criteria regarding the relative values of the respective global and country-level HHIs had to be applied. Excessive concentration of imports has been defined where the value of country-level HHI for example is more than double the value of the corresponding HHI for global exports (so the national concentration of imports of a given product across all supplying countries is at least two times higher than the concentration of global exports of the same product). To further constrain the spectrum of cases of excessive concentration, an additional minimum cut-off value of HHI calculated for global product-level exports was set at 0.2. This means that only products with a global exports HHI of at least 0.2 and products with country-level imports HHI of at least 0.4 were considered as excessively concentrated.

Figure 3.8 shows the average per country incidence of HS6 products with such excessive import concentration for all countries in the sample, OECD countries, MNOES and all other countries (i.e. countries which are not members of either the OECD or MNOE grouping). Interestingly, the global incidence of excessive concentration has been on the rise in the investigated period, and this has been accounted for mainly by the MNOE and other countries, while excessive import concentration has decreased on average for the OECD grouping. We also see that this decline for the OECD was interrupted by two periods of small increases around the Global Financial Crisis and around the COVID-19 pandemic.

Figure 3.8. Average incidence of 'excessive' import concentration by country grouping

Average number of imported HS6 products with 'excessive' import concentration per country in each of the country groupings



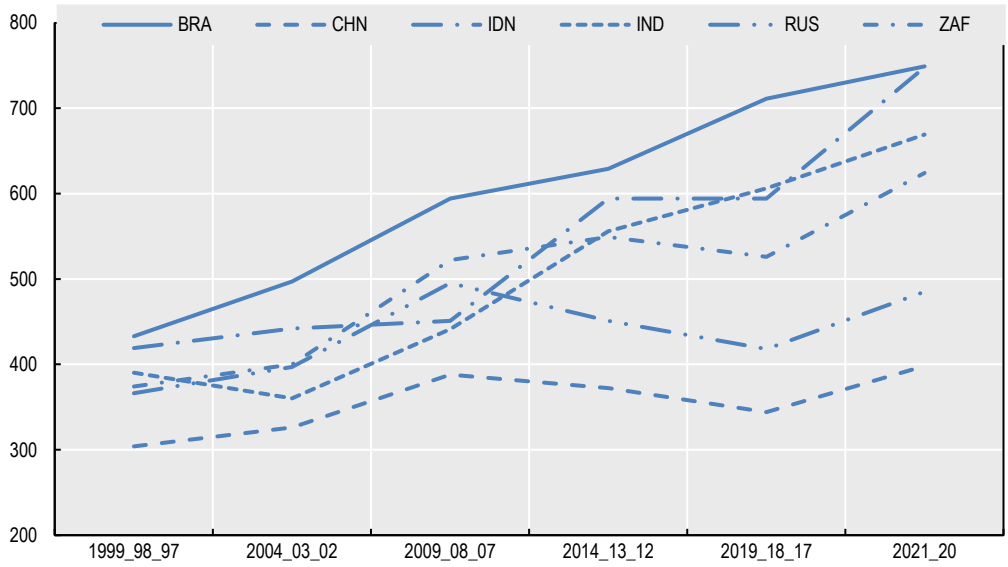
Note: "Excessive import concentration is defined in cases of bilateral import links at the product level where the value of country-level HHI for imports is more than double the value of the corresponding HHI for global exports. To further constrain the spectrum of cases of excessive concentration, an additional minimum cut-off value of HHI calculated for global product-level exports was set at 0.2. This means that only products with a global exports HHI of at least 0.2 and products with country-level imports HHI of at least 0.4 were considered.
Source: OECD calculations using the BACI data.

For the MNOE grouping, excessive import concentration has increased in each or the periods and more markedly than for other non-OECD countries. In the period 2020-21, a MNOE country had on average twice as many products with excessive import concentrations than in 1997-99 and 40% more than an average OECD country (Figure 3.9). There is also interesting heterogeneity across the MNOE countries. Throughout the investigated period, China had the smallest average number of excessive concentrations and for China this number increased the least among the MNOEs. Somewhat similarly to China, Russia started with the second lowest number of excessive import concentrations, and it

had the second lowest growth rate of such concentrations. Brazil on the other hand had the largest number of concentrations among the MNOES while Indonesia recorded the highest growth rate of excessive import concentrations.

Figure 3.9. Incidence of 'excessive' import concentration in MNOEs

Number of imported HS6 products with 'excessive' import concentration



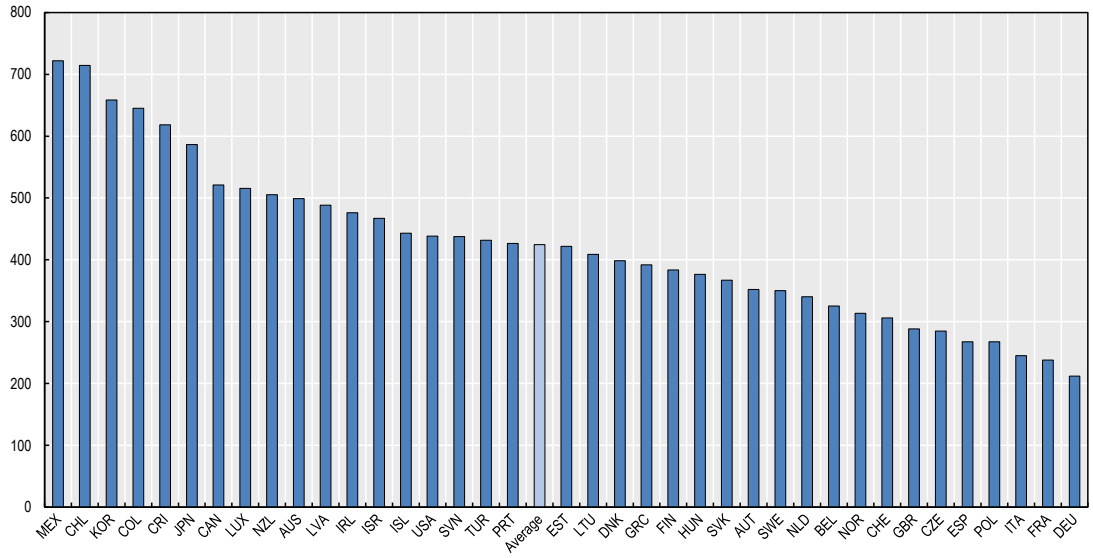
Note: "Excessive import concentration is defined in cases of bilateral import links at the product level where the value of country-level HHI for imports is more than double the value of the corresponding HHI for global exports. To further constrain the spectrum of cases of excessive concentration, an additional minimum cut-off value of HHI calculated for global product-level exports was set at 0.2. This means that only products with a global exports HHI of at least 0.2 and products with country-level imports HHI of at least 0.4 were considered.
Source: OECD calculations using the BACI data.

There is also a considerable variation in the incidence of excessive import concentration among the OECD countries. EU Members, particularly Germany, France, and Italy, which have the lowest incidence of excessive import concentrations in this grouping, have on average around three times fewer excessive import concentrations than OECD countries with the highest number of concentrations (Mexico, Chile, Korea) (Figure 3.10). We also see that Germany, France and Italy have reduced their excessive import concentration in the investigated period while Mexico, Chile, and Korea have increased it (although Mexico also decreased its excessive import concentrations in the first half of the period) (Figure 3.11). Note that similarly to the other moderately sized EU economies, the Netherlands' position is much below the OECD average but above the countries with the fewest excessive concentrations.

We also see that the countries with the highest incidence of such concentrations globally do not belong to either the OECD or the MNOE grouping, and they tend to have up to three times as many excessive concentrations than an average OECD or MNOE country. Many of these countries have much lower per capita incomes as compared with the OECD and MNOES and several of them are landlocked and have recently suffered, or are currently suffering, from a military conflict (Figure 3.12).

Figure 3.10. Incidence of 'excessive' import concentration in the OECD

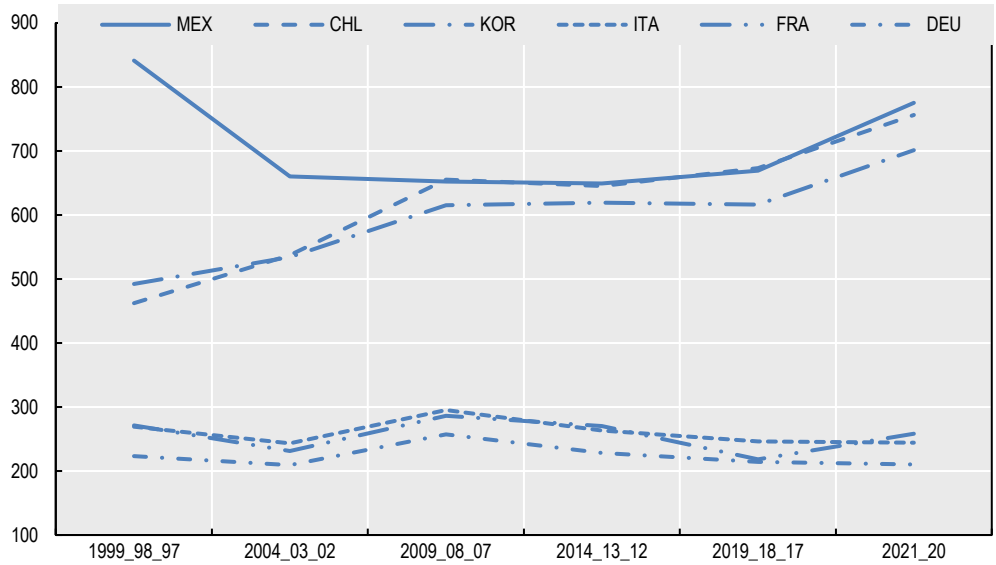
Number of imported HS6 products with 'excessive' import concentration
(average for the periods 2017-19 and 2020-21)



Note: "Excessive import concentration is defined in cases of bilateral import links at the product level where the value of country-level HHI for imports is more than double the value of the corresponding HHI for global exports. To further constrain the spectrum of cases of excessive concentration, an additional minimum cut-off value of HHI calculated for global product-level exports was set at 0.2. This means that only products with a global exports HHI of at least 0.2 and products with country-level imports HHI of at least 0.4 were considered.
Source: OECD calculations using the BACI data.

Figure 3.11. Evolution of 'excessive' import concentration in the OECD

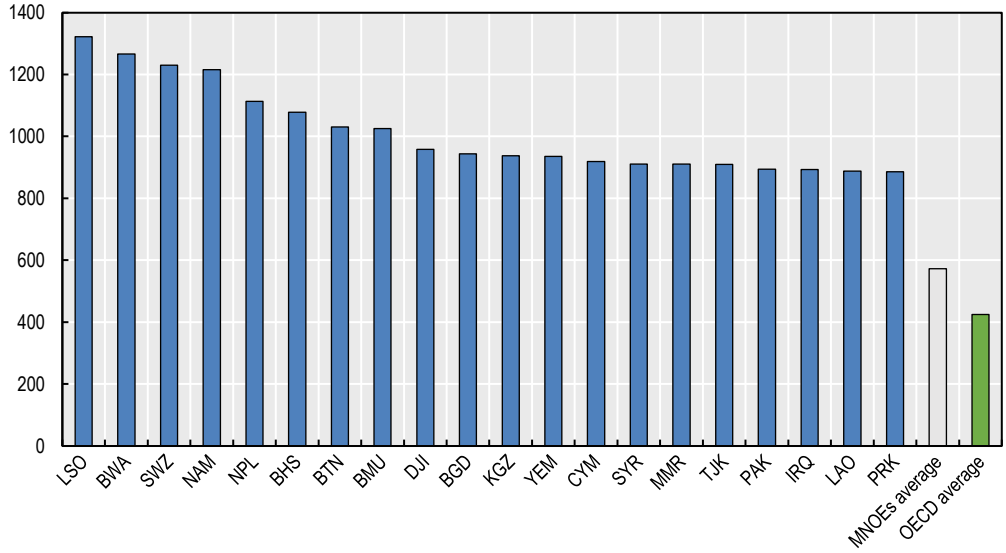
Number of imported HS6 products with 'excessive' import concentration, for top 3 and bottom three countries with highest and lowest incidence of excessive import concentration



Note: "Excessive import concentration is defined in cases of bilateral import links at the product level where the value of country-level HHI for imports is more than double the value of the corresponding HHI for global exports. To further constrain the spectrum of cases of excessive concentration, an additional minimum cut-off value of HHI calculated for global product-level exports was set at 0.2. This means that only products with a global exports HHI of at least 0.2 and products with country-level imports HHI of at least 0.4 were considered.
Source: OECD calculations using the BACI data.

Figure 3.12. Incidence of 'excessive' import concentration in non-OECD and non-MNOE countries

Number of imported HS6 products with 'excessive' import concentration
(average for the periods 2017-19 and 2020-21)



Note: "excessive import concentration is defined in cases of bilateral import links at the product level where the value of country-level HHI for imports is more than double the value of the corresponding HHI for global exports. To further constrain the spectrum of cases of excessive concentration, an additional minimum cut-off value of HHI calculated for global product-level exports was set at 0.2. This means that only products with a global exports HHI of at least 0.2 and products with country-level imports HHI of at least 0.4 were considered. The 3-digit ISO codes denote: LSO – Lesotho; BWA – Botswana; SWZ – Swaziland; NAM – Namibia; NPL – Nepal; BHS – the Bahamas; BJI – Djibouti; BGD – Bangladesh; KGZ – the Kyrgyz Republic; YEM – Yemen; CYM- Cayman Islands; SYR – the Syrian Arab Republic; MMR – Myanmar; TJK- the Republic of Tajikistan; PAK – Pakistan; IRQ – Iraq; LAO – the Lao's People's Democratic Republic; PRK – the Democratic People's Republic of Korea.
Source: OECD calculations using the BACI data.

3.4. Bilateral trade dependencies

The bilateral dimension of trade dependencies is perhaps of the most interest. This is because different trading partners may specialise in production (and consumption) of different products and some risks of trade disruptions may be determined at a partner country or bilateral level. In addition, the bilateral dimension of trade dependency underpins the adopted empirical approach as the HHI used earlier to measure the country-level import and export concentration is in fact a summary measure of all the bilateral shares that account for a country's imports (or exports) of a given product.

Defined according to the methodology described in Annex 8.1.1, dependencies account for 4.9% of all active bilateral import links across the OECD and for 4.6% across the MNOES and, in value terms, they account for respectively 42 and 45% of the total values of imports of these country groups (Table 3.1). This again suggest that the bulk of imports of OECD countries and MNOEs can be attributed to relatively few highly concentrated import links. This suggests that beyond being of interest to specific countries, sectors and products, dependencies also matter across the economy as a whole.

Import dependencies are also more important than export dependencies across the OECD and MNOE groupings both in terms of counts and import shares. In the most recent period, the share of dependencies in all active bilateral export flows (i.e. the share of count of these export links in all active export links) was at, 2.4% and 1.7% for, respectively, the OECD and the MNOE country groupings (Table 3.2). The corresponding shares in the total value of exports were 25% and 14%.

Table 3.1. Counts and shares of OECD countries' and MNOEs' bilateral imports meeting different 'dependency' criteria

OECD

description	number of concerned tariff lines	% of all tariff lines	Value (bln USD)	% of total value
all bilateral flows of OECD countries as exporters	5,508,144	100.0%	11,200	100%
of which meeting the following criteria:				
exports are overall highly concentrated (HHI >= 0.2)	3,170,405	57.6%	6,090	54%
export from any partner accounts for a high share in country's exports (>=0.1)	439,835	8.0%	7,510	67%
flows with high HHI and bilateral share	270,873	4.9%	4,690	42%

MNOEs

description	number of concerned tariff lines	% of all tariff lines	Value (bln USD)	% of total value
all bilateral flows of OECD countries as exporters	907,228	100.0%	2,720	100%
of which meeting the following criteria:				
exports are overall highly concentrated (HHI >= 0.2)	541,595	59.7%	1,570	58%
export from any partner accounts for a high share in country's exports (>=0.1)	67,068	7.4%	1,850	68%
flows with high HHI and bilateral share	42,041	4.6%	1,230	45%

Note: These statistics refer to 2019, the last year before the COVID-19 pandemic. The COVID019 pandemic saw large (but possibly temporary) changes in product structure and geographical directions of trade.

Table 3.2. Counts and shares of OECD countries' and MNOEs' bilateral exports meeting different 'dependency' criteria

OECD

description	number of concerned tariff lines	% of all tariff lines	Value (bln USD)	% of total value
all bilateral flows of OECD countries as exporters	8,281,641	100.0%	10,600	100%
of which meeting the following criteria:				
exports are overall highly concentrated (HHI >= 0.2)	2,776,535	33.5%	3,450	33%
export from any partner accounts for a high share in country's exports (>=0.1)	383,993	4.6%	5,450	51%
flows with high HHI and bilateral share	202,792	2.4%	2,620	25%

MNOEs

description	number of concerned tariff lines	% of all tariff lines	Value (bln USD)	% of total value
all bilateral flows of OECD countries as exporters	1,741,248	100.0%	3,880	100%
of which meeting the following criteria:				
exports are overall highly concentrated (HHI >= 0.2)	457,744	26.3%	752	19%
export from any partner accounts for a high share in country's exports (>=0.1)	62,744	3.6%	1,630	42%
flows with high HHI and bilateral share	29,158	1.7%	530	14%

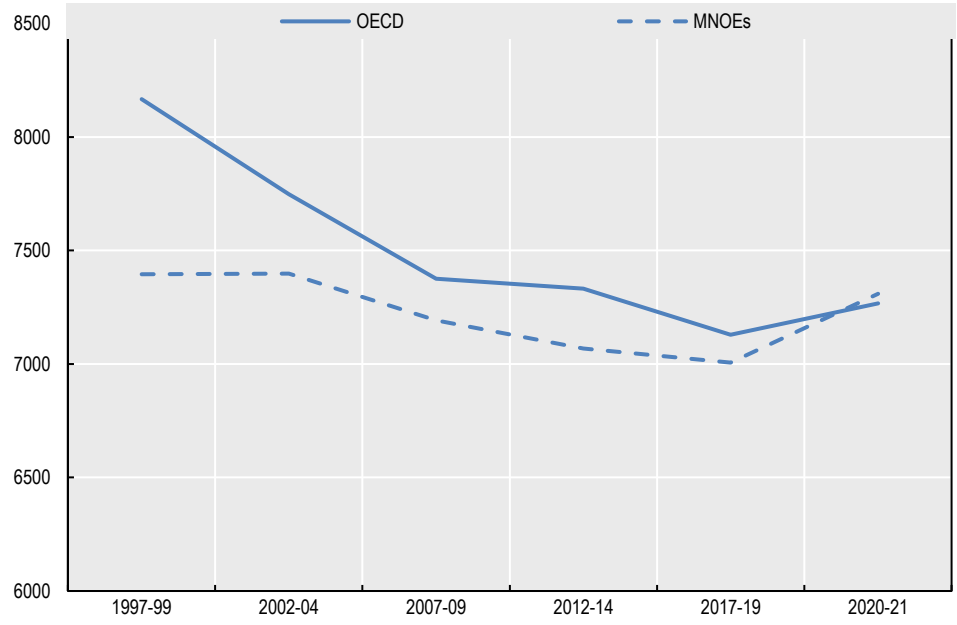
Source: OECD calculations using the BACI data.

3.4.1. Evolution of bilateral import dependencies[37]

The first insight from the numbers is that import dependencies declined between 1997-99 and 2017-19, both across the OECD and the MNOEs. The decline was more rapid for OECD countries. Both groupings also experienced an increase in import dependencies in the COVID-19 pandemic period (2020-21) (Figure 3.13). Second, zooming in on strategic products, the decline of average incidence of dependency is confirmed for both country groupings (Figure 3.14).

Figure 3.13. Bilateral import dependencies have been falling faster in the OECD than in the MNOE grouping

Average number of bilateral import dependencies per country in each of the country grouping

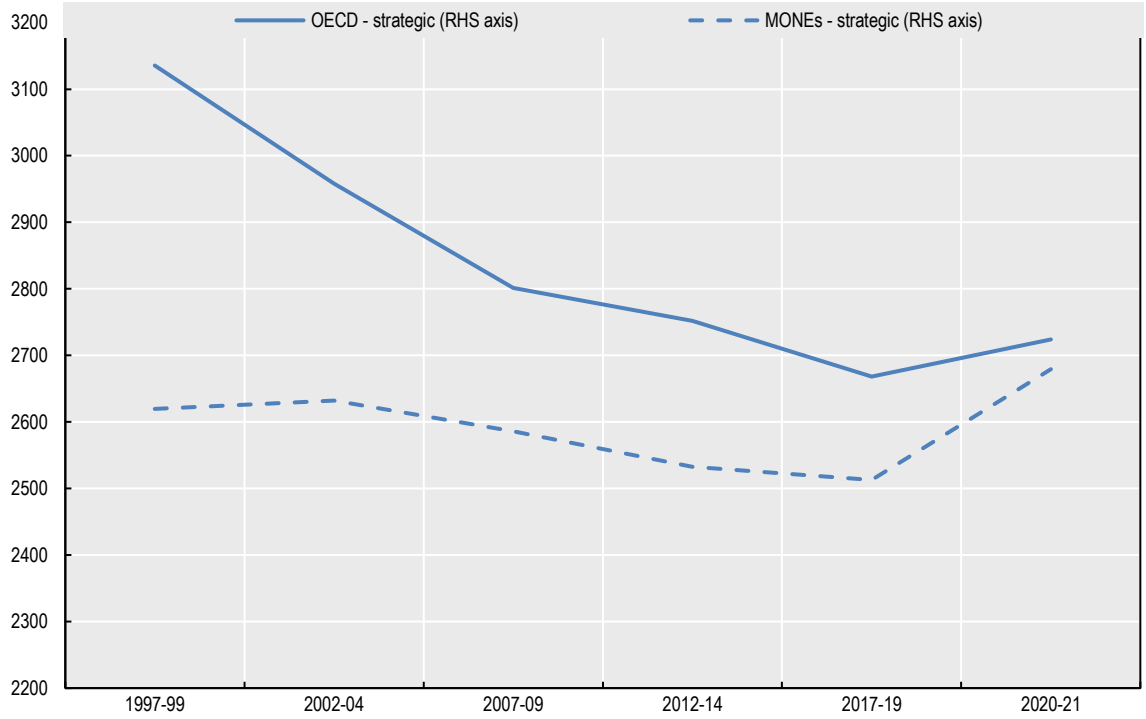


Source: OECD calculations using the BACI data.

[37] Bilateral export dependencies have been assessed in a similar way, but the presentation in this Chapter focuses on import dependencies.

Figure 3.14. Bilateral import dependencies in 'strategic' sectors have been falling in the OECD and increased in MNOEs

Average number of bilateral import dependencies per country in each of the country grouping

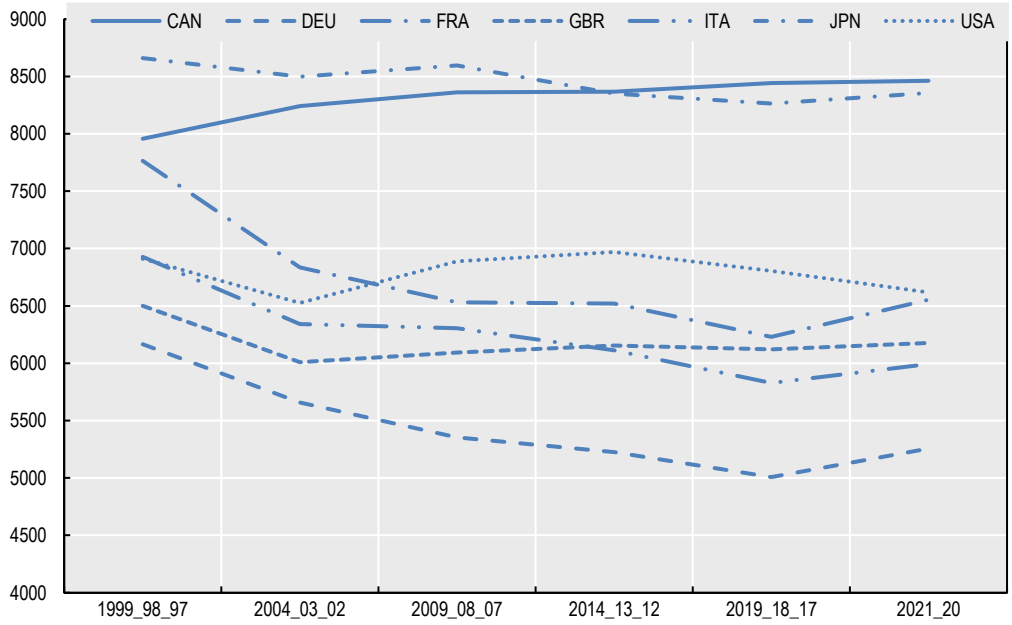


Source: OECD calculations using the BACI data.

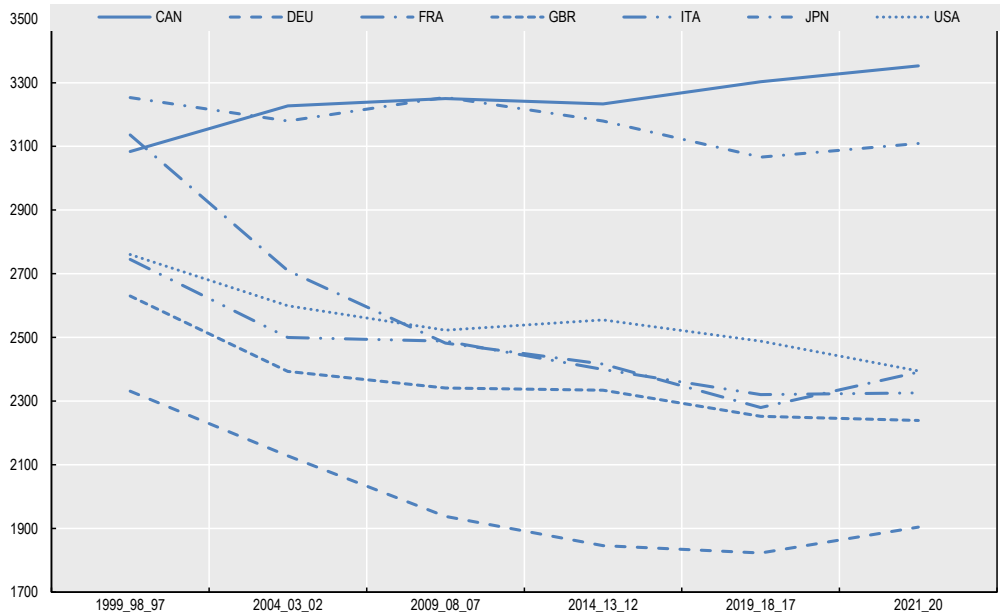
Canada has overtaken Japan in the mid-2010s and was the G7 country with the highest number dependencies for both all and strategic product lists in the most recent periods (Figure 3.15). Both these countries had markedly higher levels of import dependencies than the other G7 countries where all and strategic dependencies generally decreased in the main period, although the United States saw a temporary increase in dependencies in the aftermath of the Global Financial Crisis (GFC) of 2008-09. In all G7 countries but the United States, import dependencies increased in the COVID-19 period. Interestingly, in Germany, the number of all import dependencies has been falling constantly in the pre COVID-19 period while the number of strategic dependencies first fell and then started increasing after the GFC (Figure 3.15, Panel B).

Figure 3.15. Bilateral import dependencies in the G7 grouping

Panel A. Number of all bilateral import dependencies for each G7 country



Panel B. Number of bilateral import dependencies in strategic sectors



Source: OECD calculations using the BACI data.

Among the other OECD countries, Korea has had a markedly higher level of all and strategic dependencies than other countries in this grouping, even if it reduced them somewhat throughout most of the period (Figure 3.16). The other countries in this grouping had somewhat similar levels of all and strategic dependencies and, except Australia, all of these countries reduced dependencies in the main period before seeing an increase in the COVID-19 period.

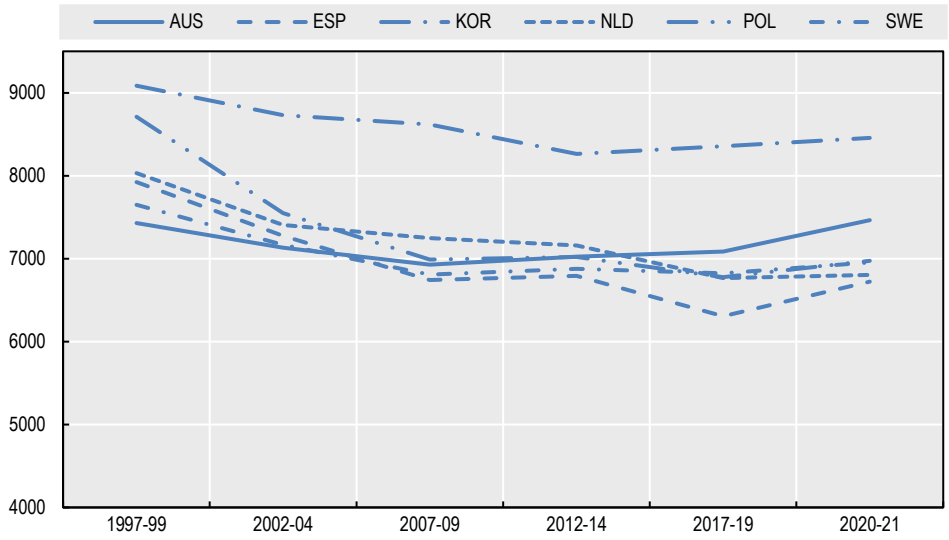
The Netherlands had been gradually reducing all and strategic dependencies in the pre-COVID period.

The MNOE grouping presents a less uniform picture. Indonesia's count of dependencies has remained stable and the country maintained the highest level of dependencies among MNOEs. South Africa and India have gradually increased their dependencies, while China, Brazil and Russia reduced them. All MNOEs but Brazil (and including China) saw their import dependencies increase in the COVID-19 period (Figure 3.17, Panel A).

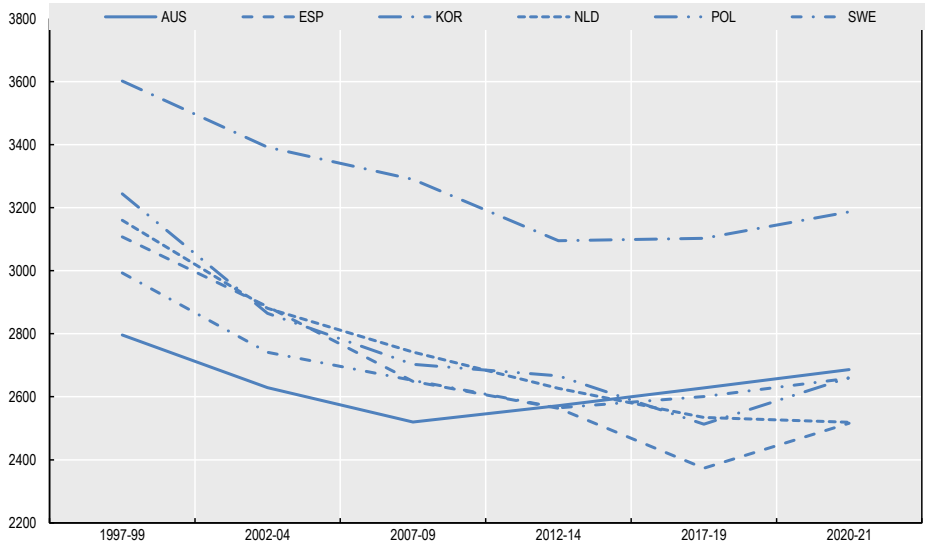
The MNOE grouping presents a more diverse picture as the levels of dependency across all products were more stable than across 'strategic' products, for which dependencies increased gradually on average in this country grouping (Figure 3.17, Panel B). In India and Indonesia, the growth of strategic dependencies has been the most pronounced. Russia saw a decrease in strategic dependencies in the period 2007-19 which was nevertheless reversed in the period 2020-21. China gradually decreased its strategic import dependencies in the pre-COVID19 period.

Figure 3.16. Bilateral import dependencies in selected other OECD countries

Panel A. Number of bilateral import dependencies for each OECD country (all products)



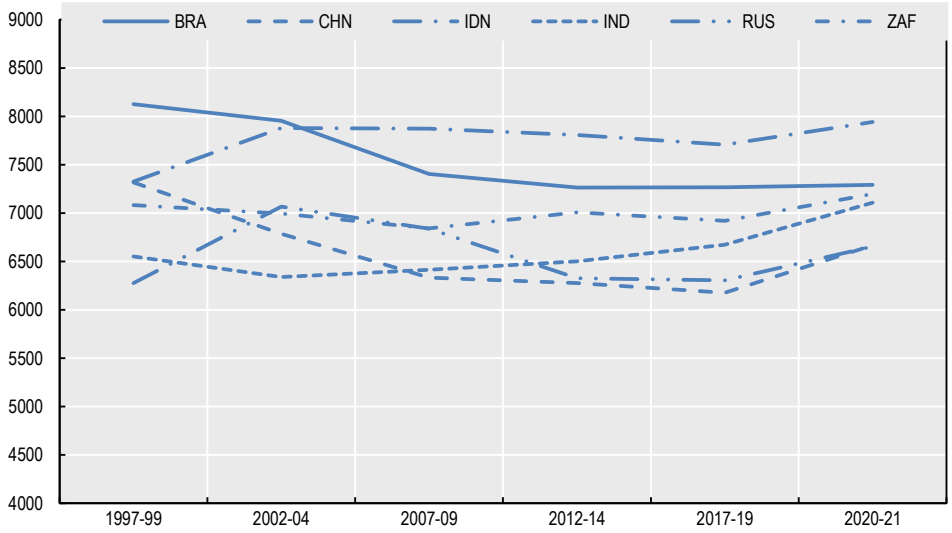
Panel B. Number of bilateral import dependencies for each OECD country (products in strategic sectors)



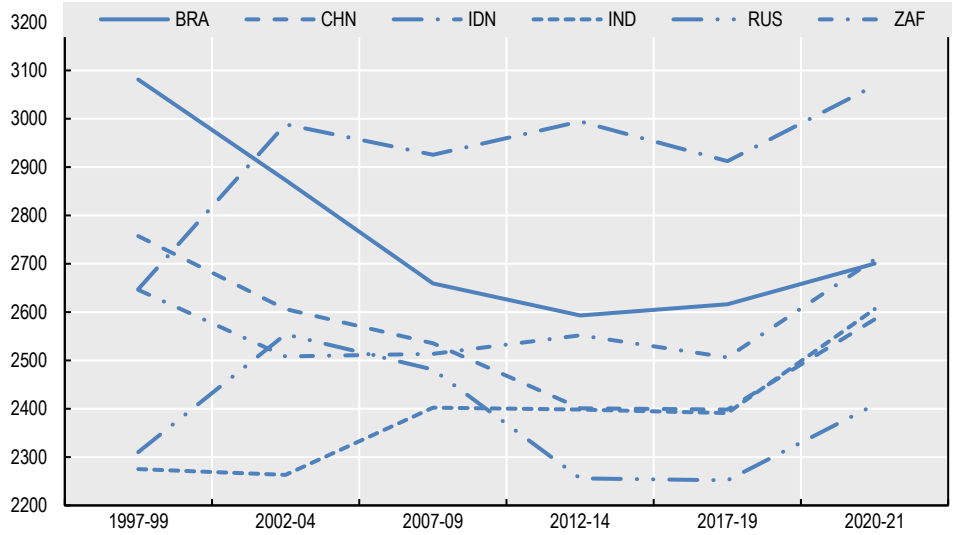
Source: OECD calculations using the BACI data.

Figure 3.17. Bilateral import dependencies in MNOE countries

Panel A. Number of bilateral import dependencies for each MNOE country



Panel B. Number of bilateral import dependencies in strategic sectors



Source: OECD calculations using the BACI data.

3.4.2. Regional dimensions of dependencies

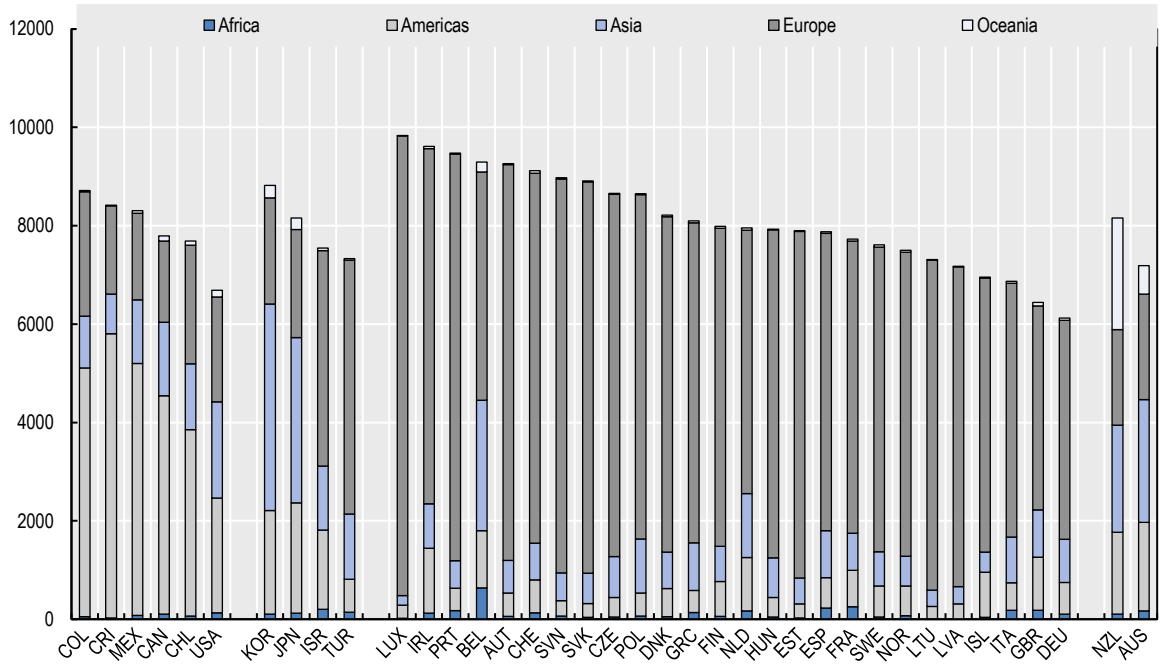
Import dependencies tend to be concentrated regionally, both across all products and across strategic sectors.[38] Among OECD countries, for example, Canada, Mexico and the United States tend to have a relatively high proportion of dependencies with each other and with other countries in the Americas. Similarly, the bulk of import dependencies in EU is with other EU countries (Figure 3.18). Such regional concentration of dependencies is consistent with the regional nature of integration in GVCs, which is

[38] This sub-section discusses developments for all products, but the findings for strategic products are qualitatively similar. The next sub-section zooms in on dependencies in strategic products.

centred around the three large manufacturing hubs and consumer markets of the United States, the European Union and China (e.g. Kowalski (2015[37]).

Figure 3.18. Regional dimension of import dependencies across OECD countries

Number of import dependencies across all products by region of exporter 2017-19



Source: OECD calculations using the BACI data.

For EU Members in particular, an overwhelming majority of their dependencies is with other EU Members (77% on average, Figure 3.20). For some of the most dependent import-dependent EU countries such as Slovakia or Luxembourg these ratios are even higher (82 and 87%, respectively) (Annex Figure 8.6). The United Kingdom and the Netherlands, on the other hand, are the two European countries with the lowest — even if still quite high — shares of dependencies with EU Members: 56 and 58% respectively (Annex Figure 8.6). For comparison, in OECD countries located in the Americas, only 44% of dependencies on average originate within the Americas, while for the Asian OECD countries approximately 51% of dependencies on average originate within Asia.

For EU Members, these findings reflect the high levels of trade integration in the European single market. Some types of idiosyncratic shocks are less likely within the European single market and its institutions are helping with adjustment to various asymmetric shocks through provisions aiming to establish free movement of goods, services, people and capital between participating countries.[39] Taking into account the depth of international economic and political integration within the EU, which is higher than in any other OECD region, the EU comes across as the least externally exposed region of the OECD.

[39] The trade and substitution elasticities used in the METRO model are differentiated by sector and not by region, so the model does not capture any preferences in the EU for other EU goods. Or how EU goods might be more substitutable than non-EU goods in EU countries in terms of intermediate inputs into production.

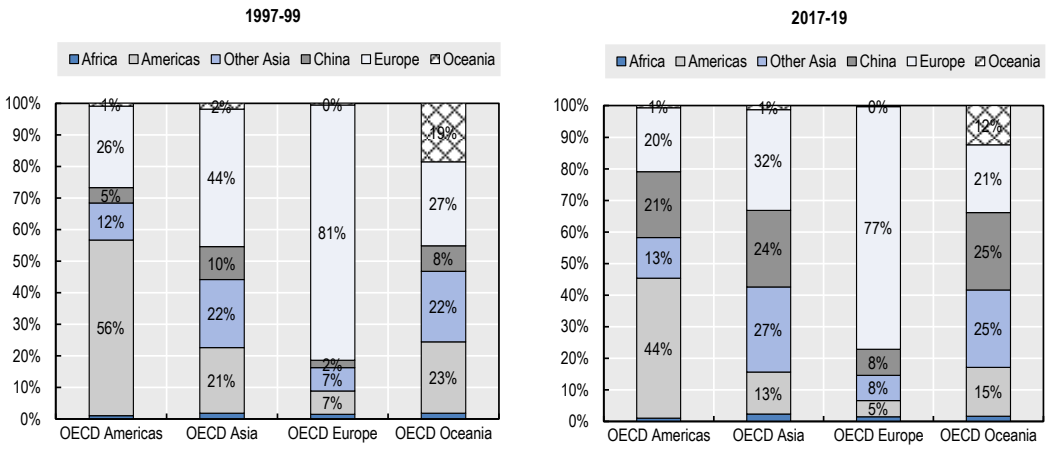
However, there are also noteworthy trans-regional patterns and developments. First, OECD countries in the Americas are a lot more dependent on European countries (20% of these countries' dependencies originate in Europe, Figure 3.20) than European countries are on countries located in the Americas (5%).

Interestingly, Asia is the most prominent trans-regional source of import dependencies (Figure 3.19) and this dependency has increased significantly across all OECD regions since the late 1990s. For example, while in the period 1997-99 Asia accounted for on average 17 and 10% of dependencies in, respectively, the Americas and Europe, in the 2017-19 these shares were at 34 and 16% (Figure 3.19). The expansion of import dependencies on Asia was the most prominent for the two OECD countries located in Oceania (Australia and New Zealand): it increased from 30% of all import dependencies in 1997-99 to 49% in 2017-2019. This region is in fact the only one in which the share of dependencies originating in Asia exceeds the share of intra-regional ones (12% of all dependencies in 2017-19).

The distinction between China and other Asian countries in Figure 3.20 reveals that the bulk of the increase in dependency on Asia was accounted for by China. The shares of import dependencies of OECD Europe and OECD Americas accounted for by China increased from, respectively, 5 and 2% in 1997-99 to 21 and 8% in 2017-19 (Figure 3.19).

Figure 3.19.Regional and trans-regional dimensions of import dependencies across OECD regions – evolution in time

Share of import dependencies across all products by region of exporter 1997-99 and 2017-19



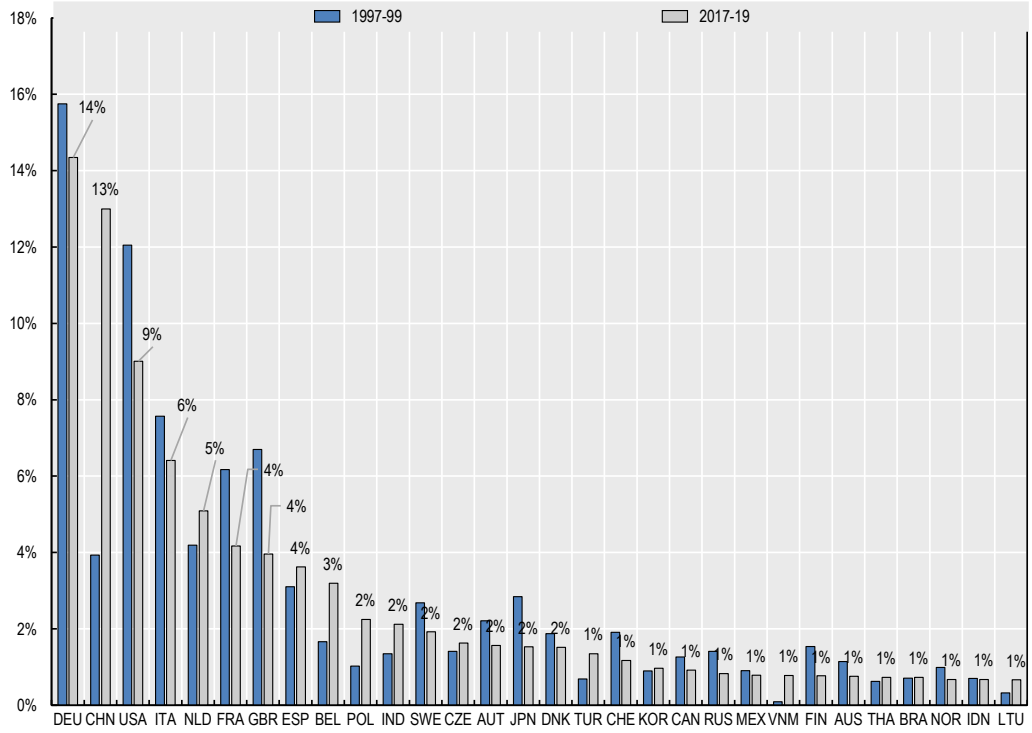
Source: OECD calculations using the BACI data.

Overall, in the period 2017-19 China accounted for 13% of all OECD import dependencies, more than three times as much as in 1997-99 (4%), while dependency shares of the most prominent OECD partners such as Germany or the United States declined (Figure 3.20, Panel A). China also dwarfed other partners in terms of the increase in the number of import dependencies of OECD countries (Figure 3.20, Panel B).

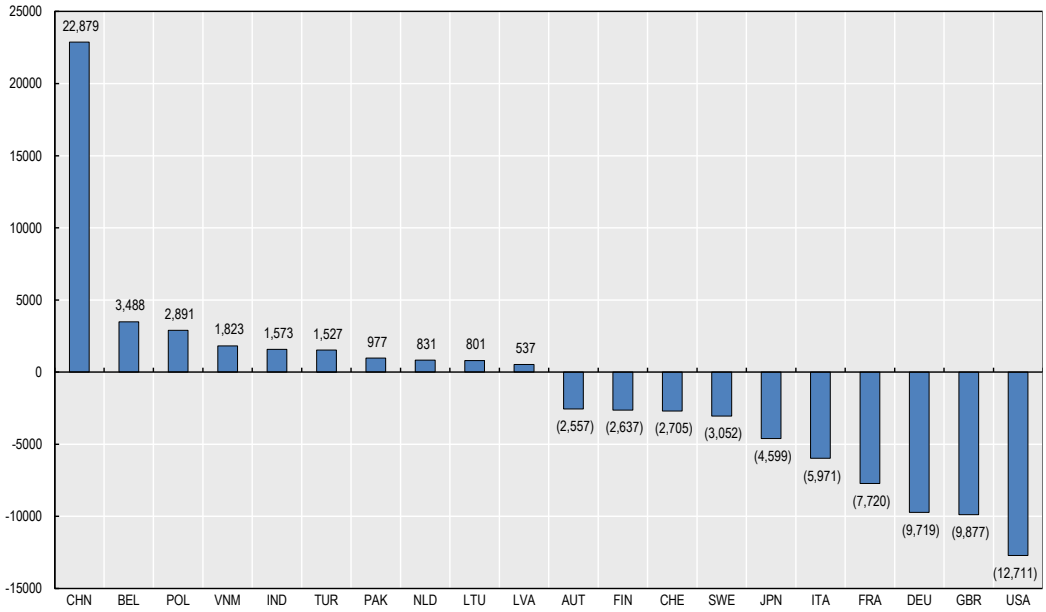
Moreover, despite the globally decreasing total number of OECD import dependencies, the number (and thus the share) of OECD dependencies on China has actually increased (recall Figure 3.13 and see Figure 3.21). A yet more pronounced expansion of dependency on China can be observed in the MNOE grouping where the share of dependencies on China increased from approximately 6% in 1997-99 to 24% in 2017-19 (Figure 3.22).

Figure 3.20. Which partners do OECD countries depend on for imports

Panel A. 30 countries with the highest shares of OECD's all import dependencies (1997-99 and 2017-19)



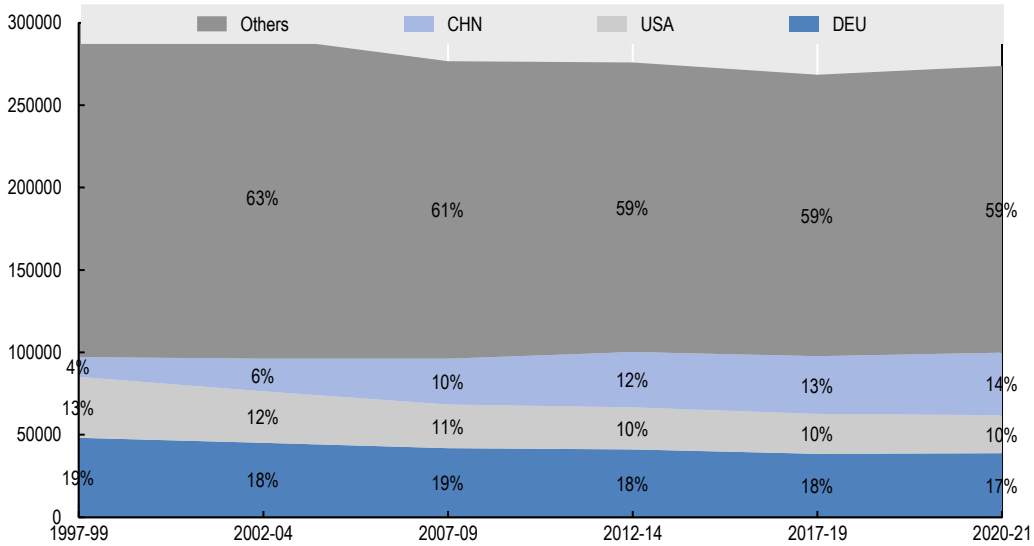
Panel B. Top and bottom 10 exporting countries with largest increases and decrease of OECD import dependencies between 1997-99 and 2017-19



Note: In Panel B, the numbers in labels are the numbers of new cases of bilateral trade dependencies at the HS6 product level. Example: in the period 2017-19, China accounted for 22 879 more bilateral import dependencies of OECD countries than it did in 1997-99, while the United States accounted for 12 711 less.
Source: OECD calculations using the BACI data.

Figure 3.21. Evolution of OECD countries' import dependencies, by major exporting country

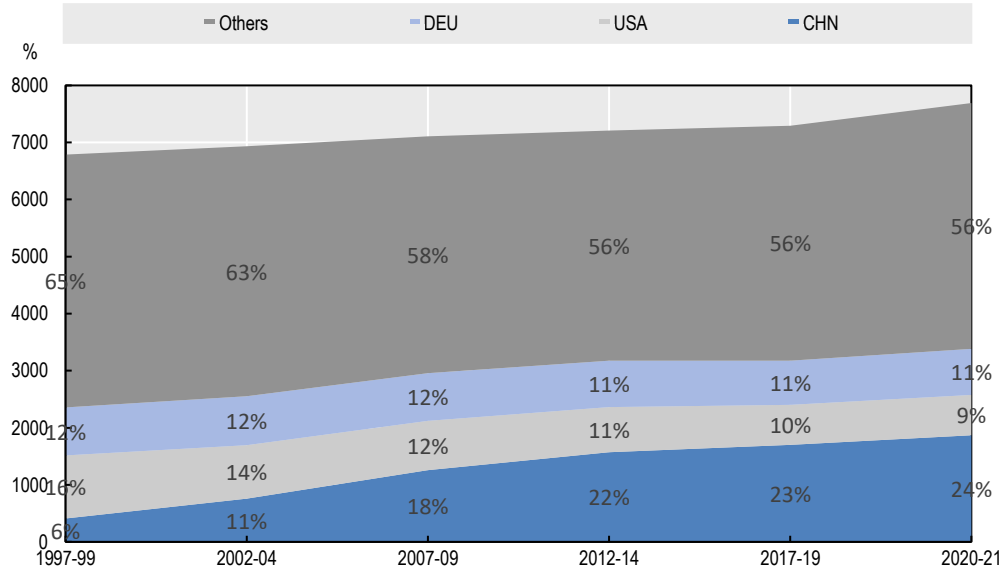
All products: Total number of OECD countries' import dependencies on the United States, China, Germany, and other countries (shares in labels)



Source: OECD calculations using the BACI data.

Figure 3.22. Evolution of MNOE countries' import dependencies, by major exporting country

All products: Total number of MNOE countries' import dependencies on the United States, China, Germany, and other countries (shares in labels)



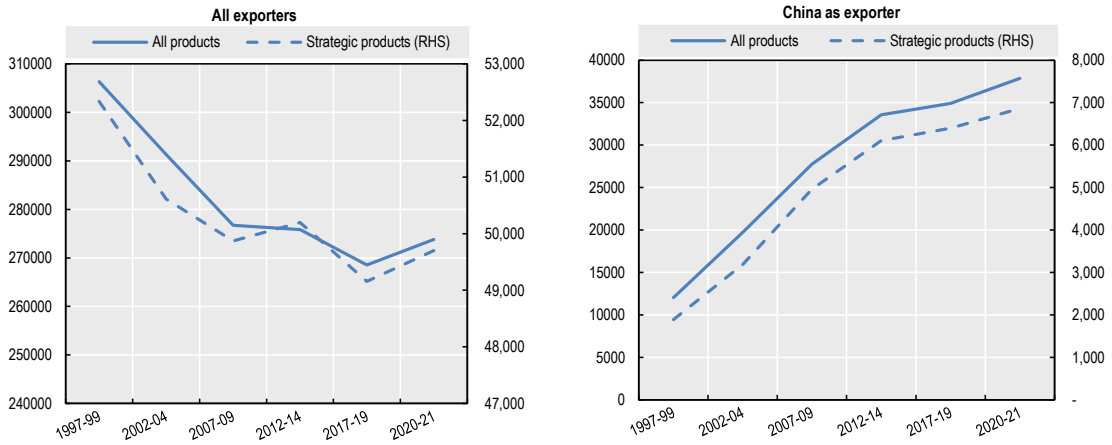
Source: OECD calculations using the BACI data.

3.5.4 Evolution of bilateral dependencies in strategic products

When all trading partners are considered, import dependencies of OECD countries in both all and in strategic sectors fell. However, they almost tripled for imports from China of all products (190% increase between 1997-99 and 2017-19, Figure 3.23) and they more than tripled for strategic products (240% increase between 1997-99 and 2017-19).

China is also the exporter for which the number of OECD dependencies in strategic products increased by far the most across all the exporters (Figure 3.24). While the numbers are much smaller than for China, the list of exporting countries accounting for the largest increases in OECD's dependencies in strategic sectors features also other Asian exporters such as India, Thailand, Viet Nam and Malaysia, as well as some dynamically growing OECD exporters such as Korea or Poland (Figure 3.24).

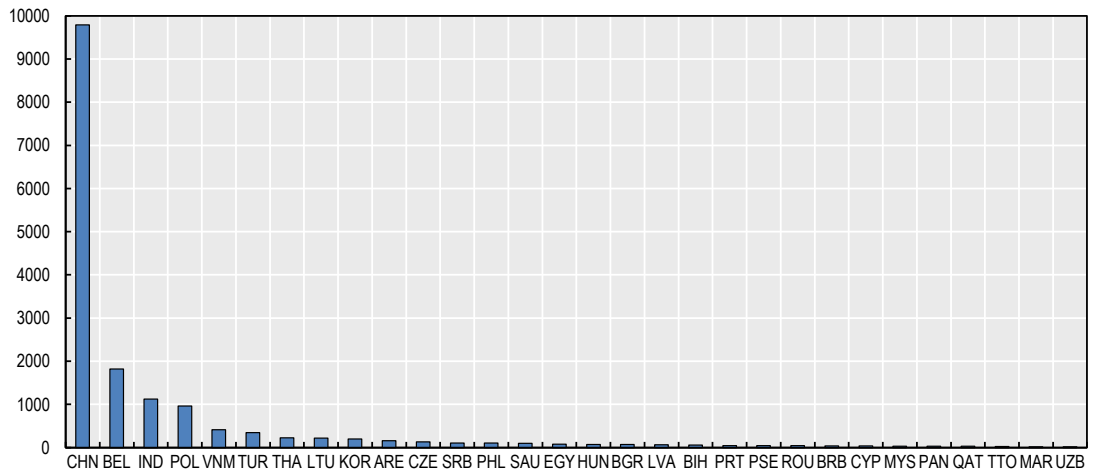
Figure 3.23. Import dependencies of OECD countries: All products and strategic products



Source: OECD calculations using the BACI data.

Figure 3.24. Exporters accounting for the highest increase in OECD import dependencies in strategic products

Increase in total number of dependencies between 1997-99 and 2017-19, top 30 exporting countries with the largest increases in dependencies



Source: OECD calculations using the BACI data.

When all trading partners are considered, the product structure of OECD' strategic dependencies has been rather stable and, in terms of the absolute numbers, it has been dominated by the *manufacture of cement lime and plaster*. The shares of other strategic products with largest numbers of OECD's import dependencies (such as *manufacture of fertilizers and nitrogen compounds, manufacture of plastics and synthetic rubber in primary forms, manufacture of watches and clocks and mining of other non-ferrous metal ores*).

However, when these shares are scaled by the number of HS6 products that belong to each of these larger strategic product categories, the rankings of products with the highest incidence of dependencies change quite significantly. Such 'scaled' rankings of products with most dependencies are presented in Figure 3.25 for the OECD as whole, for the EU as a whole and for the Netherlands.

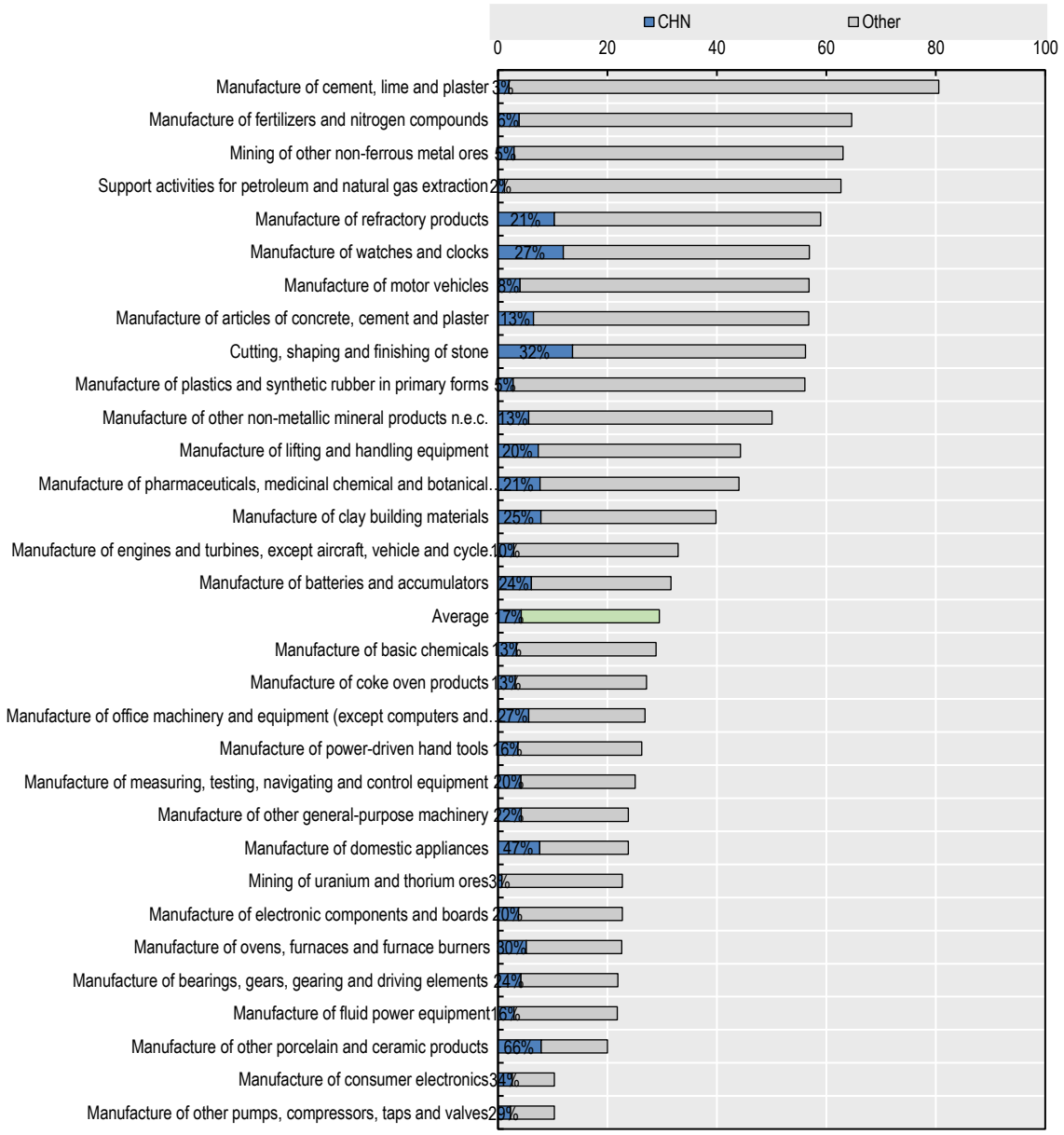
Figure 3.26 shows the expansion (or the lack of such expansion) of dependency on all trading partners and on China for the top six 'strategic' products with the highest incidence of dependencies for the OECD as a whole and Figure 3.27 shows the equivalent information for the EU as a whole. For the OECD as a whole, the shares of China have grown visibly for the manufacture of chemicals, domestic appliances and cutting, shaping and finishing of stone, but not for the other three products. For the EU, China's expansion among the top dependent products is even less prominent.

Overall, the extent of import dependency on China across OECD countries varies considerably across the different OECD sectors and countries. For the OECD and EU groupings, as well as for the Netherlands individually, China normally does not manifestly account for unusually high shares of dependencies in 'strategic' product categories where these regions record the highest overall levels of dependency (e.g. *manufacture of cement, lime and plaster, manufacture of fertilizers and nitrogen compounds, manufacture of plastics and synthetic rubber in primary forms, manufacture of watches and clocks and mining of other non-ferrous metal ores*).

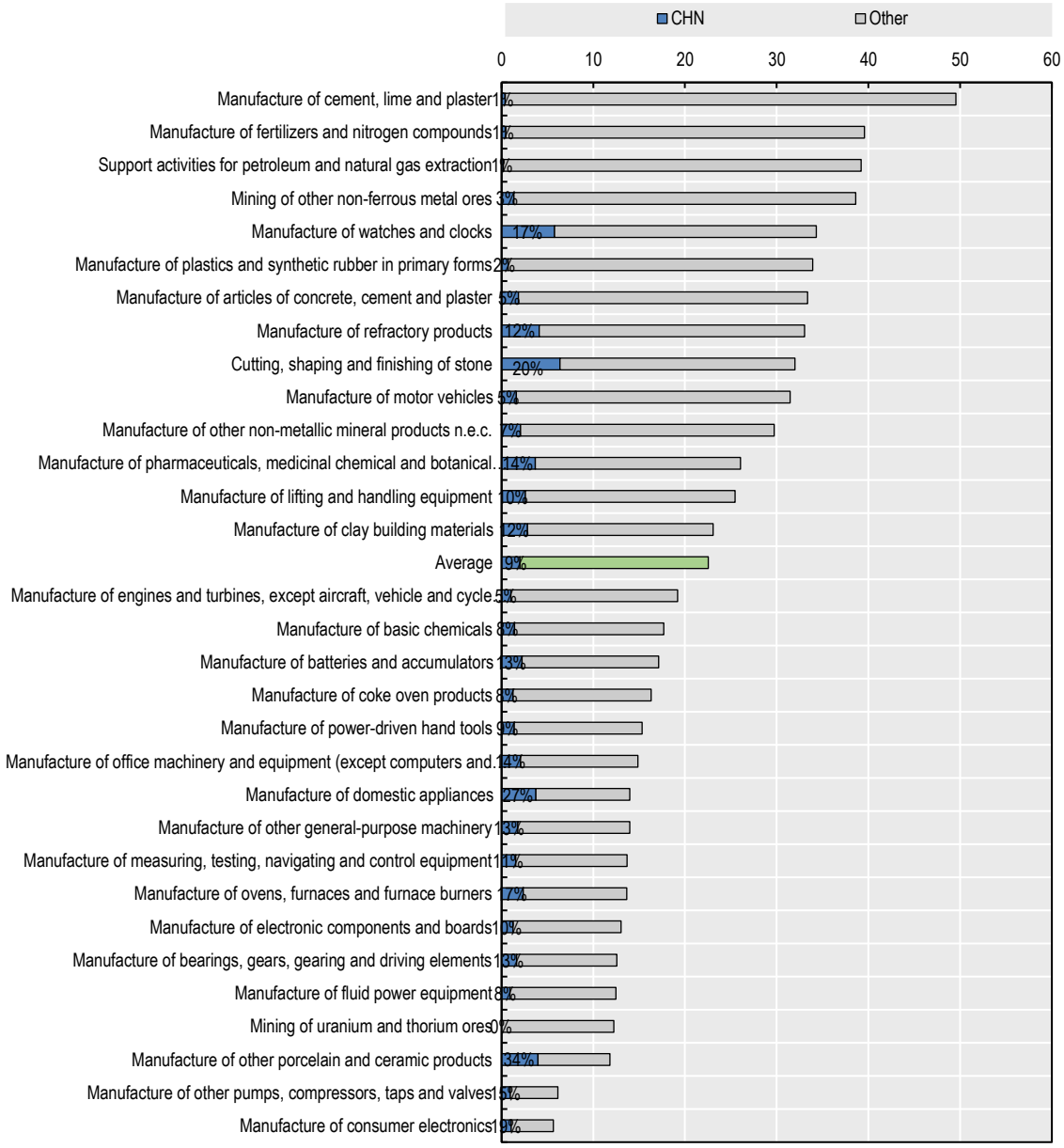
Nevertheless, for the OECD as whole, as well as in most cases for the EU, China's share of dependencies exceeds 10% in several 'strategic' industries such as *manufacture of refractory products*, *cutting, shaping and finishing of stone, manufacture of pharmaceuticals, medicinal chemical and botanical products, manufacture of lifting and handling equipment*, *manufacture of consumer electronics*, and *manufacture of electronic components and boards*) (Figure 3.25).

Figure 3.25. Ranking of sectors with highest incidence of import dependencies across OECD and EU countries (average 2017-17/2020-21)

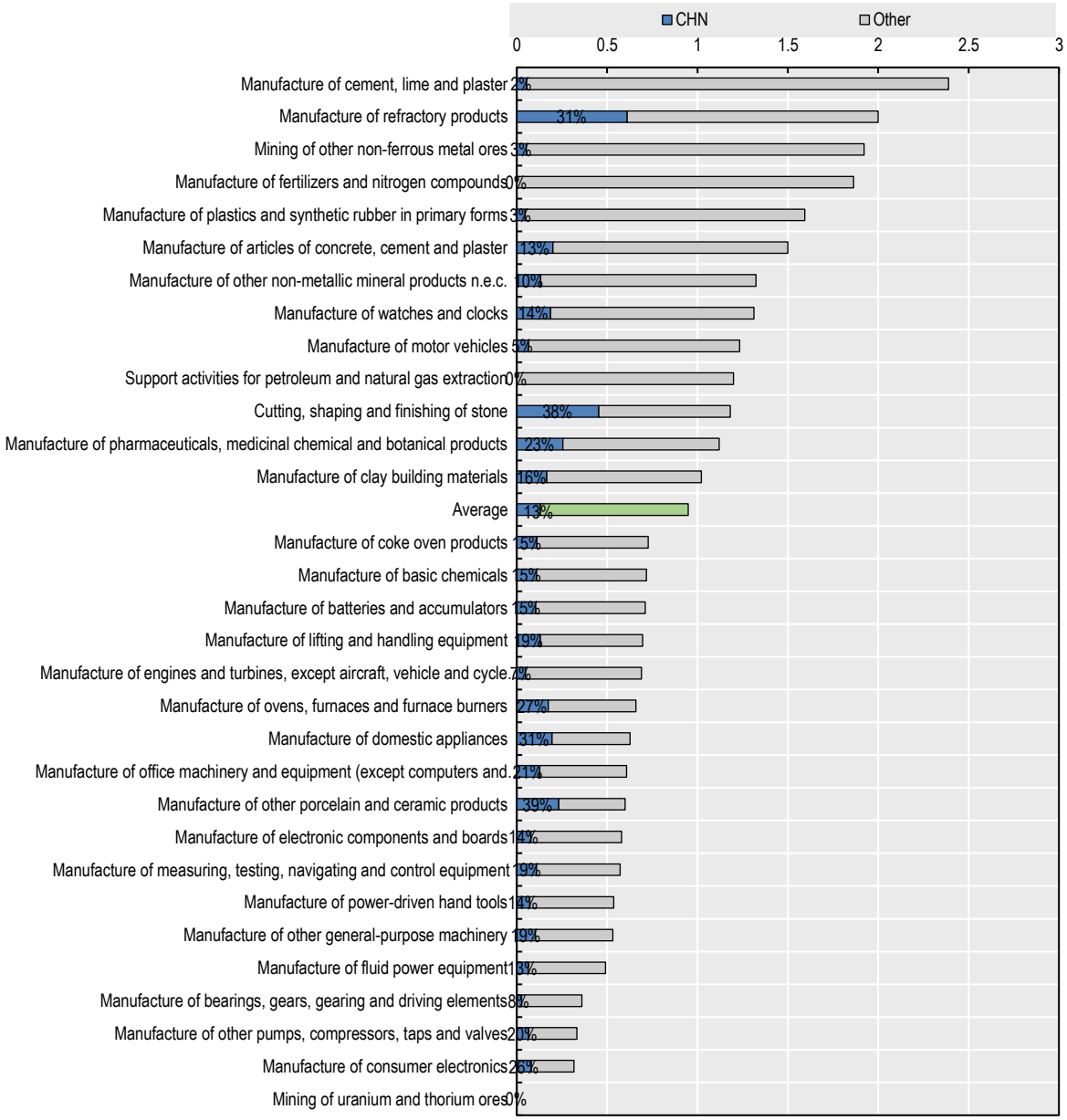
Panel A. OECD countries, all exporters and the contribution of China as exporter



Panel B. EU countries, all exporters and the contribution of China as exporter



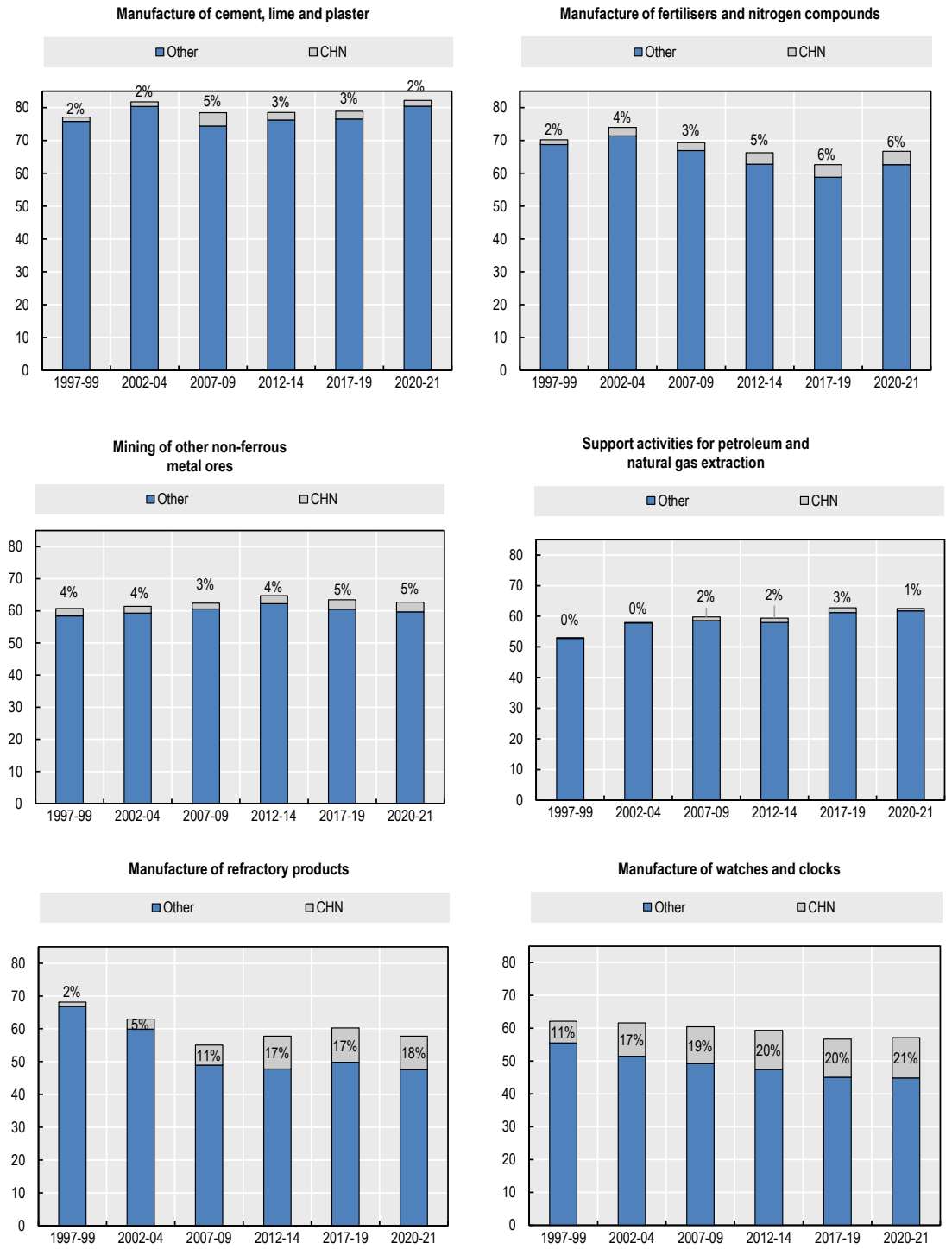
Panel C. The Netherlands, all exporters and the contribution of China as exporter



Note: The bars show 'per product line' incidence of import dependencies which is obtained by dividing the number of all (or attributed to China) dependencies by the number of product lines which belong to the given 'strategic' sector. The data shown here refer to average per product line incidence in the period 2017-21. They are ordered by sector with the highest incidence when all exporters are taken into account.
Source: OECD calculations using the BACI data.

Figure 3.26. Shares of China as exporter in OECD's top six import dependent industries

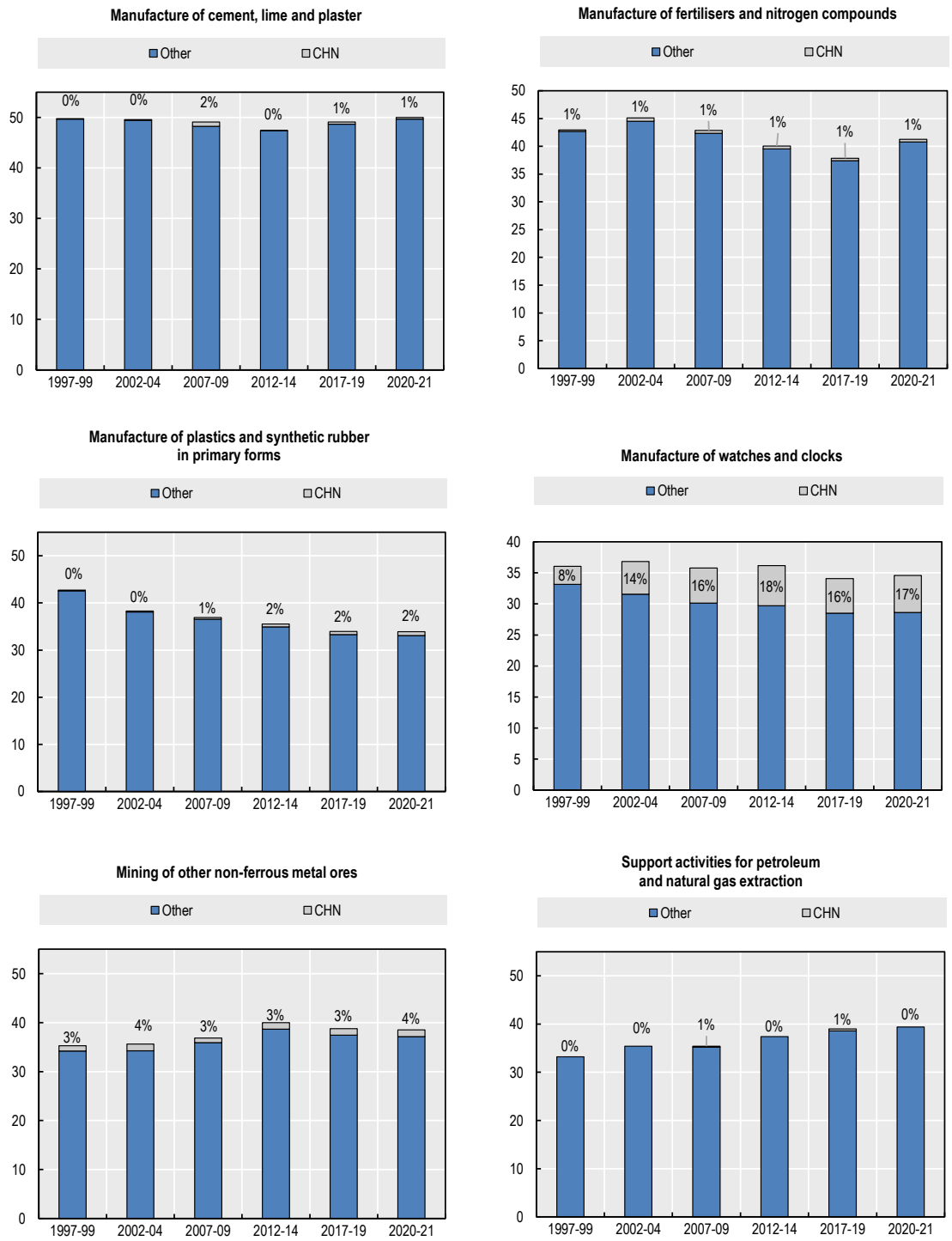
Incidence of import dependencies and % share for China in labels



Note: The bars show 'per product line' incidence of import dependencies which is obtained by dividing the number of all (or attributed to China) dependencies by the number of product lines which belong to the given 'strategic' sector. They are ordered by sector with the highest incidence when all exporters are taken into account.
Source: OECD calculations using the BACI data.

Figure 3.27. Shares of China as exporter in EU's top import dependent industries

Incidence of import dependencies and % share for China in labels

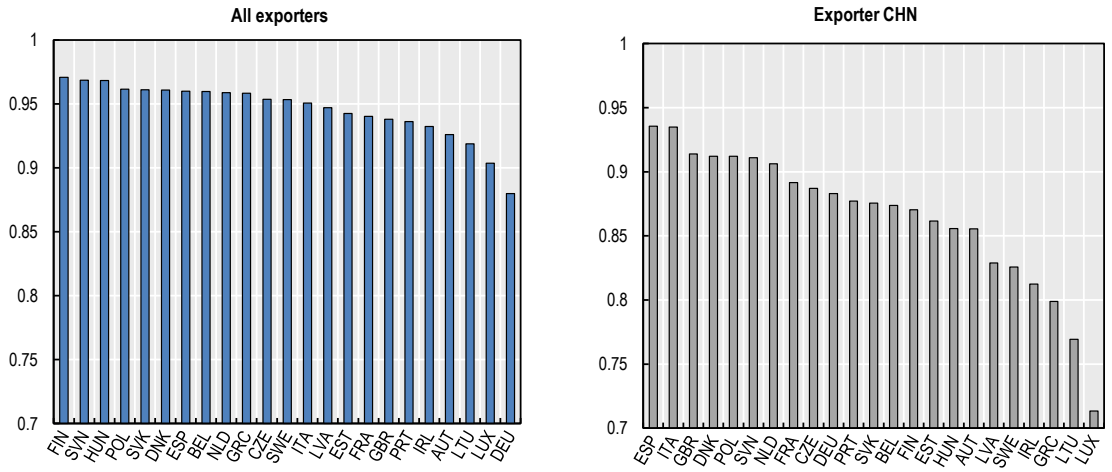


Note: The bars show 'per product line' incidence of import dependencies which is obtained by dividing the number of all (or attributed to China) dependencies by the number of product lines which belong to the given 'strategic' sector. They are ordered by sector with the highest incidence when all exporters are taken into account.
Source: OECD calculations using the BACI data.

When individual EU countries are considered separately, they display fairly similar structures of strategic import dependency when all partners are considered and a somewhat less similar structure when only China is considered (Figure 3.28). This suggests that EU Members may have more similar sectoral interests when it comes to reducing the overall import dependencies than they have when it comes to reducing import dependencies on China. For Finland, for example, the strategic sector structure of import dependencies on all partners has a 97% overlap with the corresponding structure for the EU as a whole, while for Germany this overlap is at approximately 87%. However, when it comes to dependency on China, while Spain sectoral structure overlap by some 94%, those for Luxembourg or Lithuania overlap by 'only', respectively, 71 and 77%. For the Netherlands, the overlaps with the EU as a whole are relatively high for both dependencies on all partners (96%) and on China (90%). This suggests that it has a relatively high interest in co-ordinating policy responses at the EU level.

Figure 3.28. Individual EU countries: Similarity of sector structure of import dependencies in strategic sectors with that of the EU as a whole

Finger-Kreinin index of similarity of the structure of import dependency with that for the EU as a whole (2017-19)



Note: This figure shows the Finger-Kreinin of trade similarity applied to the sectoral structure of import dependencies for each individual country and compared with the corresponding sectoral structure of import dependencies for the EU as whole. The values of the index vary between 0 and 1. A value of 1 means that a given EU country's dependencies are identical in their sectoral structure to those for the EU as a whole. A value of 0.7 can in turn be approximately interpreted as representing a 70% overlap in dependency structures between the given country and EU as a whole.
Source: OECD calculations using the BACI data.

Bilateral import dependencies of the Netherlands

The list of the Netherlands' top strategic sectors with highest incidence of import dependencies is indeed similar to that for the EU as a whole (Panels B and C of Figure 3.25) although there are also some differences. For example, for the EU as whole and the Netherlands, the *manufacture of other porcelain and ceramic products*, while not one of the most dependent of the 'strategic' sectors, records the highest shares of dependency on China (34% of dependencies in the EU and 39% in the Netherlands). However, some of the imports which are quite dependent on China in the Netherlands are not that dependent on China for the EU as a whole.

Figure 3.29 presents a detailed *summary* of the Netherland's import dependencies in strategic sectors given the overall counts of dependencies at the product level (in this case not scaled by the number of corresponding product lines) and the shares in these counts of China. Sectors with highest dependency on China were those with fewer overall number of dependencies, such as *other porcelain and ceramic products* (44% of dependency on China in 2017-19), *cutting, shaping and finishing of stone* (36%) or manufacture of refractory products (32%). In several other sectors the dependency on China has also reached relatively high levels in different periods, but there are also a range of products where the Netherlands has import dependencies, but they tended to be not with China.

Focusing on non-EU sources of dependencies in the six strategic sectors with the largest numbers of import dependencies, we find that for the *manufacture of basic chemicals* and *manufacture of coke oven products*, more dependencies were accounted for by the non-OECD partners, most notably and to some extent India (Figure 3.30).

Figure 3.29. Summary table of the Netherlands' import dependencies in strategic sectors

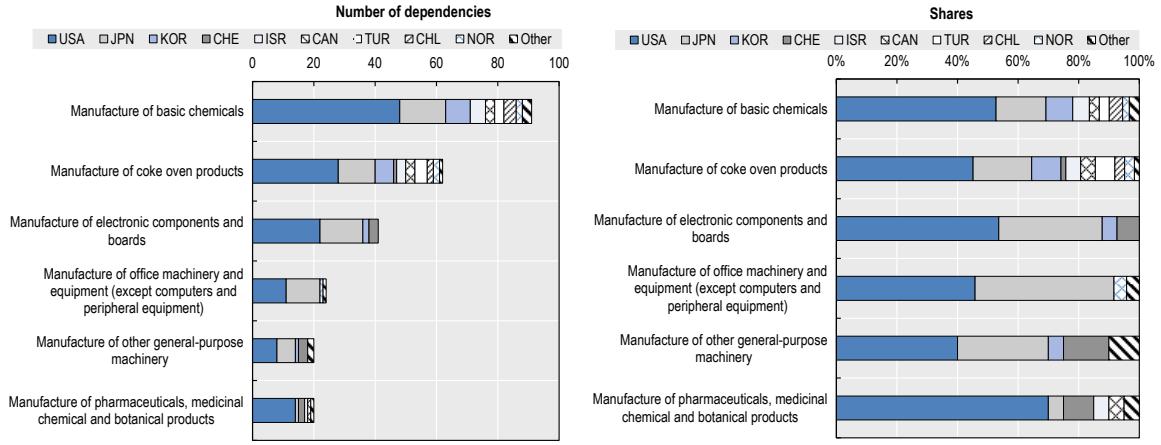
Number of all bilateral imports at HS6 level belonging to a strategic sector which have been classified as bilateral dependencies (right panel: % of these dependencies account for by China)

	All exporters						of which China (%)					
	1997-99	2002-04	2007-09	2012-14	2017-19	2020-21	1997-99	2002-04	2007-09	2012-14	2017-19	2020-21
Manufacture of basic chemicals	574	569	516	494	488	466	7%	8%	11%	14%	16%	15%
Manufacture of coke oven products	428	416	392	365	385	381	6%	10%	11%	16%	15%	15%
Manufacture of electronic components and boards	358	261	268	261	252	229	4%	5%	9%	13%	13%	15%
Manufacture of office machinery and equipment (except computers and peripheral equipment)	284	242	253	277	225	238	3%	7%	17%	21%	21%	21%
Manufacture of other general-purpose machinery	210	171	123	149	148	141	2%	8%	10%	17%	17%	22%
Manufacture of pharmaceuticals, medicinal chemical and botanical products	155	168	137	155	145	135	12%	12%	19%	16%	20%	26%
Manufacture of plastics and synthetic rubber in primary forms	140	129	128	125	113	126	1%	1%	0%	3%	3%	3%
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	145	101	103	85	94	88	1%	2%	3%	6%	6%	8%
Manufacture of measuring, testing, navigating and control equipment	109	103	90	85	77	73	3%	8%	14%	15%	17%	22%
Manufacture of watches and clocks	105	99	85	75	72	75	7%	12%	15%	19%	15%	13%
Manufacture of fertilizers and nitrogen compounds	66	70	67	60	64	59	2%	0%	0%	0%	0%	0%
Manufacture of fluid power equipment	69	76	68	61	56	49	0%	1%	6%	10%	9%	18%
Manufacture of power-driven hand tools	56	56	57	52	52	51	2%	4%	4%	8%	10%	18%
Manufacture of other non-metallic mineral products n.e.c.	65	47	63	41	47	43	2%	2%	8%	7%	9%	12%
Mining of other non-ferrous metal ores	45	43	45	48	35	38	7%	5%	2%	4%	3%	3%
Manufacture of motor vehicles	57	50	38	34	33	41	0%	0%	3%	6%	6%	5%
Manufacture of ovens, furnaces and furnace burners	39	38	38	35	38	45	5%	13%	21%	17%	26%	27%
Manufacture of consumer electronics	28	45	46	33	23	20	14%	27%	11%	24%	22%	30%
Manufacture of lifting and handling equipment	38	27	36	28	19	34	3%	4%	8%	21%	21%	18%
Manufacture of domestic appliances	26	28	31	24	28	36	8%	14%	19%	33%	29%	33%
Manufacture of clay building materials	30	22	24	26	25	24	3%	5%	13%	19%	16%	17%
Manufacture of articles of concrete, cement and plaster	25	25	22	19	23	22	0%	0%	5%	16%	13%	14%
Manufacture of cement, lime and plaster	17	18	22	19	19	24	0%	0%	5%	0%	0%	4%
Manufacture of refractory products	23	23	15	20	19	17	4%	9%	13%	30%	32%	29%
Cutting, shaping and finishing of stone	17	13	15	9	14	12	12%	15%	33%	56%	36%	42%
Manufacture of other pumps, compressors, taps and valves	13	9	12	8	11	9	8%	11%	17%	25%	18%	22%
Manufacture of batteries and accumulators	7	9	13	5	10	17	0%	11%	23%	40%	10%	18%
Manufacture of bearings, gears, gearing and driving elements	15	9	15	9	6	7	0%	0%	7%	11%	0%	14%
Support activities for petroleum and natural gas extraction	7	8	12	11	4	8	0%	0%	0%	0%	0%	0%
Manufacture of other porcelain and ceramic products	6	5	7	13	9	9	0%	0%	29%	38%	44%	33%
Mining of uranium and thorium ores	3	1	1	1		2	0%	0%	0%	100%	0%	0%
Grand total	3160	2881	2742	2627	2534	2519	5%	7%	11%	15%	15%	16%

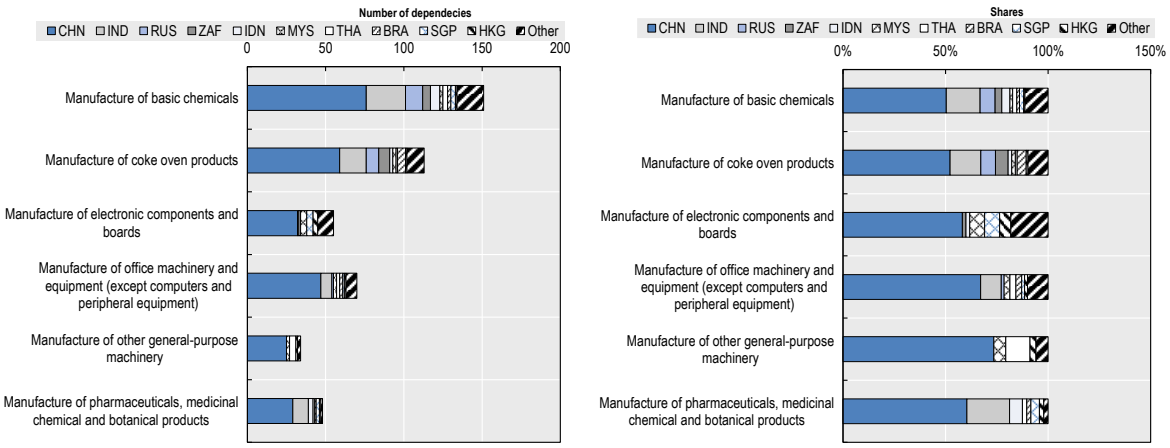
Note: Ordered by the number of dependencies in 2017-19.
Source: OECD calculations using the BACI data.

Figure 3.30. Summary table of the Netherlands' import dependencies in six strategic sectors with the highest numbers of dependencies

Panel A. Non-EU OECD exporters



Panel B. Non-OECD exporters



Note: Numbers of dependencies mean the counts of actual HS6 products bilateral dependencies in the period 1997-99, as defined at the beginning of Section 3.5, have been established.
Source: OECD calculations using the BACI data.

Bilateral import dependencies of China

The preceding figures illustrate that China is an important and growing counterpart in OECD import dependencies. But equivalent calculations for China suggest that OECD countries are an even more important counterpart in import dependencies for China. This subsection provides an overview of China's own import dependencies while paying special attention to the position of the EU and the Netherlands as exporters.

In the most recent periods, OECD countries as a whole accounted for approximately 70% of China's import dependencies in 'strategic' products. Japan and the United States are the countries which have accounted for the highest shares of China's dependencies in all products as well as in 'strategic' products throughout the period Japan and the United States are the two individual OECD countries which continue to account for the highest shares of these dependencies (respectively 12 and 10%, Figure 3.31).

Nevertheless, the EU as group has become progressively more important and most recently accounted for 29% up from 19% in the late 1990s.

This is more than twice as much as the share of China in EU countries' import dependencies in strategic products, more than individually Japan and United States, and more than any other of the following country groupings: all other OECD countries (14%); other MNOEs (10%); and all other non-OECD, non-MNOE countries (21%). Also, in contrast to Japan and the United States, the share of the EU in China's 'strategic' dependencies grew over the investigated period. This suggest that the EU is overall the most — and increasingly — important counterpart for China's in terms of its import dependencies.

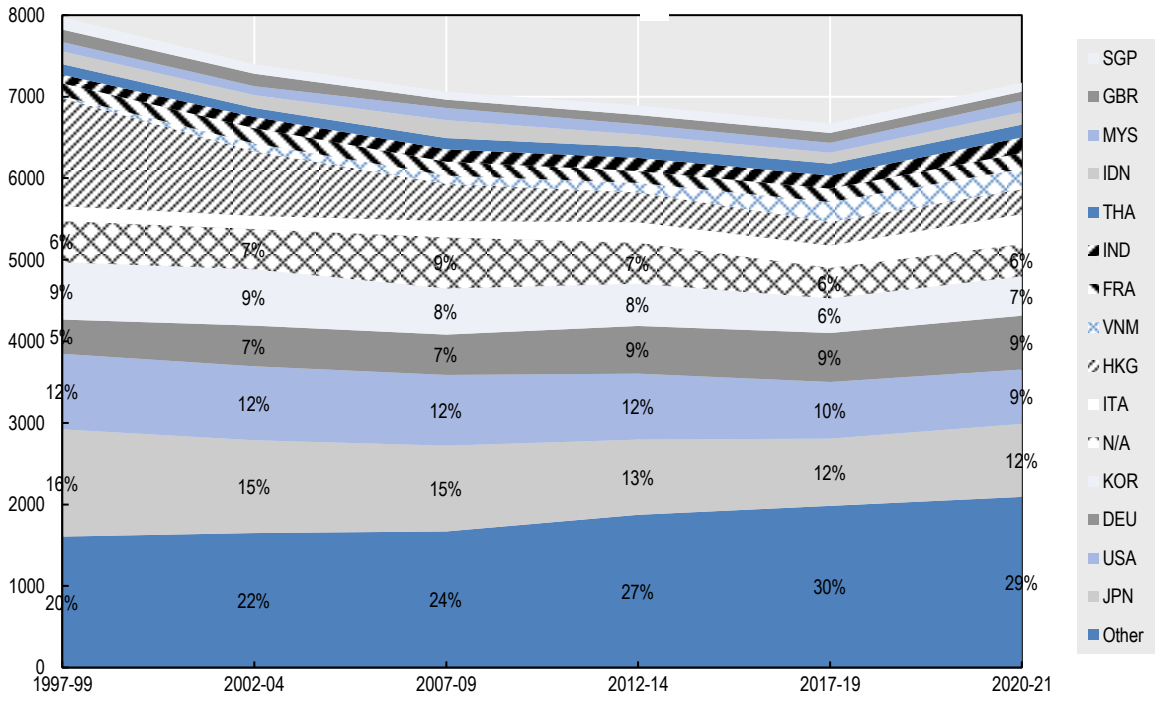
Together with Germany, Italy, France and Sweden, the Netherlands is currently in the top-5 EU countries with highest shares of China's import dependencies in strategic products, accounting itself for 2% of them in 2020-21. Interestingly, and in contrast to Japan and the United States, these countries have gradually increased their shares in China's dependencies in the investigated period.

These high levels of import dependency of China on OECD can be seen across most 'strategic' industries. The EU on its own accounts for more than 40% of China's import dependencies in industries such as *manufacture of motor vehicles*, *manufacture of pharmaceuticals, medicinal chemical and botanical products, manufacture of bearings, gears, gearing and driving elements, manufacture of lifting and handling equipment, manufacture of ovens, furnaces and furnace burners* (Figure 3.32).

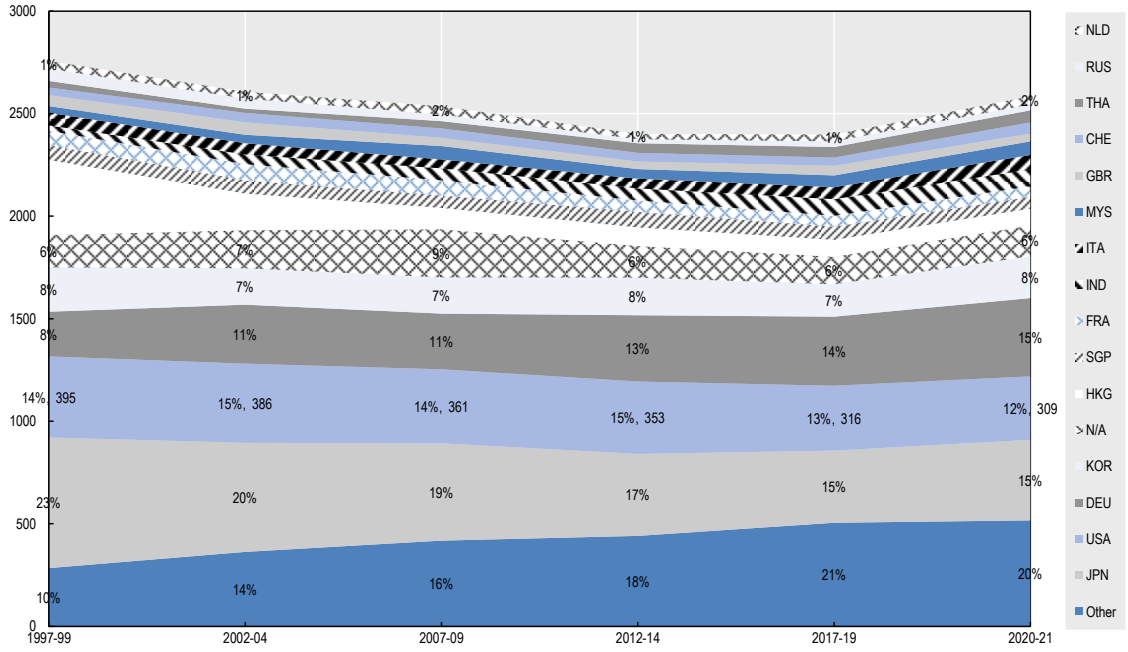
This list clearly includes several industries in which many OECD countries are also significantly dependent on China, which underscores the mutual character of these dependencies.

Figure 3.31. Evolution of China's import dependencies, by major exporting country or region

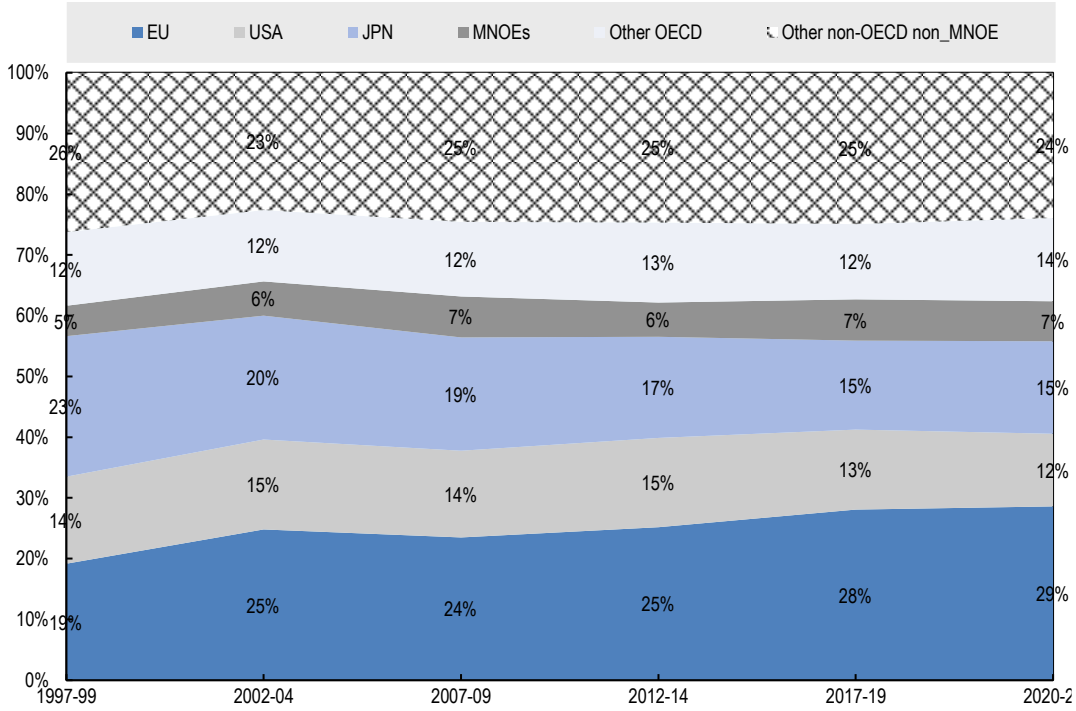
Panel A. All products: total number of China's import dependencies for top 15 exporters accounting for the largest shares (% share in labels for top 5)



Panel B. 'Strategic' products: total number of China's import dependencies for top 15 exporters accounting for the largest shares (% share in labels for top 5)

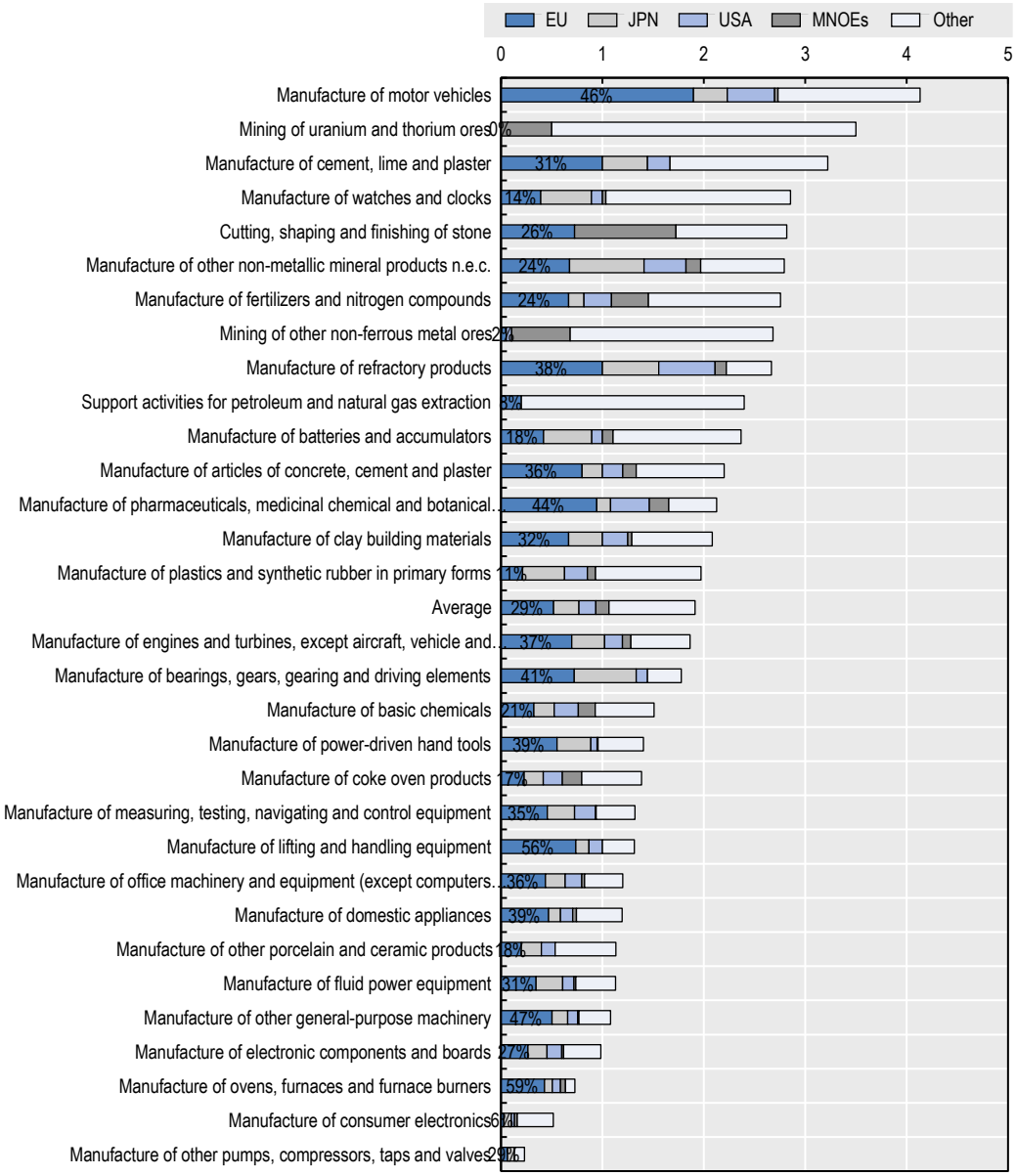


Panel C. Share in China's 'strategic' dependencies by exporting country/region



Note: In Panel C: *Other OECD are all the OECD countries except the United States, Japan and OECD countries of the EU.
Source: OECD calculations.

Figure 3.32. Ranking of sectors with highest incidence of import dependencies of China by exporter



Note: The bars show 'per product line' incidence of import dependencies which is obtained by dividing the number of all (or attributed to a given region) dependencies by the number of product lines which belong to the given 'strategic' sector. The data shown here refer to average per product line incidence in the period 2017-21. They are ordered by sector with the highest incidence when all exporters are taken into account.
Source: OECD calculations using the BACI data.

3.5. Conclusions from detailed trade data analysis

The results of this analysis confirm that there is a merit in the ongoing public debate on trade dependencies. Global production of products has become increasingly concentrated, and it tends to be increasingly clustered around some countries and regions. This not only due to natural and organic economic factors, such as natural endowments, comparative advantage, economies of scale, or GVC fragmentation, but also most likely policies.

Having said that, the evidence presented shows also that large, if not dominant, portions of global and national trade are relatively well diversified overall, and that international product markets are

characterised by a fair amount of competition and limited control over supply or price formation of specific importers or exporters.

Some of the most striking findings include the fact that countries — including OECD countries — typically source their imports from — and ship their exports to — fewer partners than is in principle globally possible. This reflects a combination of natural factors, such as the role of geography and trade costs, but also national preferences and policies. There is thus untapped potential in using international markets in order to diversify.

In fact, our findings suggest that a significant number of OECD countries have been able to take advantage of diversification possibilities offered by international markets, as testified, for example, by declining average rates of import concentrations and bilateral import dependencies across the OECD membership. Similar reductions have not occurred in the major non-OECD economies most of which saw their dependencies increase.

Which trading partners are the main counterparts in the highly concentrated trade linkages has been raised as one of the key issues in the trade dependency debate. Here, too, some of our findings support a cautious approach to concentrated trade relations, while others are more reassuring.

Dependency on China has increased significantly across all OECD regions since the late 1990s. The country is now the single most important counterpart in trade dependencies of OECD as a whole (14% of OECD dependencies in ‘strategic’ products) and of several OECD countries individually. Trade dependencies of OECD economies on China also need to be put in the context of China’s dependencies on OECD. Here our results suggest that the OECD as group — and several OECD countries on their own — are a much more important counterparts in dependencies of China (e.g. OECD as a group account for 70% of China’s import dependencies in ‘strategic’ products). Moreover, China’s sectoral dependencies involving OECD countries include several industries in which several OECD countries also depend on China, which underscores the mutual character of trade dependencies.

4. Measuring trade dependencies using the OECD TiVA data and ICIO techniques

This section analyses trade dependencies in the global economy using the OECD TiVA data and input-output methods. In contrast to the examination of gross trade flows presented in Chapter 3, this analysis considers not only direct, but also indirect trade links. On the other hand, it is carried out at a coarser level of industry aggregation.

To gauge the importance of a country or industry within the broader economic system, the input-output literature employs a technique known as 'hypothetical extraction'. In this method, all trade flows involving a specific set of countries (or country-sector pairs) are either set to zero or reduced by a specific proportion. The ensuing changes in value added provide a measure of exposure to the hypothetical shock.

In the core scenario, the interdependencies between OECD and MNOE economies are assessed by reducing all trade flows between the two groups of countries by 10%. The data used are derived from the OECD ICIO tables with increased granularity, comprising 75 sectors and 75 countries plus a rest of the world region. The list of countries covered by the analysis is in line with that of Chapter 3.

4.1. Introduction

To complement descriptive statistical analysis of direct trade dependencies using detailed gross trade data and to shed more light on their wider economic implications, Chapters 4 and 5 explore trade dependencies through scenario analysis using respectively, the OECD ICIO tables and the ‘hypothetical extraction’ methodology, and the OECD global CGE global trade model METRO. Scenarios considered in both analyses are largely the same and their specification reflects the terms of reference of the project as well as the requirements and constraints of the two methodologies.

This chapter analyses trade dependencies using TiVA data and input-output methods. Compared to an analysis of gross trade flows like that of Chapter 3, the input-output approach takes a broader

supply chain perspective. The aim is to capture not only those trade dependencies that are due to direct import-export relationships, but also those that may result from indirect trade links. An indirect trade link arises, for example, when a product exported from one country to another embeds a component produced in a third country. This methodology also does away with the issue of re-exports which is an improvement over the analysis in Chapter 3.

In the input-output literature, a sector's (or country's) importance for the global economic system is generally assessed in terms of 'backward' and 'forward linkages'. Backward linkages refer to the fact that, in any given country and industry, production processes make use of intermediate inputs sourced from other countries and industries. Respectively, forward linkages capture the importance of countries and industries as outlets for each other's outputs. As noted, backward and forward linkages are either direct (e.g. foreign value added embodied in imported intermediate is used for production, and then final consumption, in the first importing country) or indirectly (e.g. foreign value added used in production is imported and exported multiple times).

A popular method for the analysis for input-output linkages and one that is used for analysis in this chapter is a technique called 'hypothetical extraction' (Miller and Blair, 2022[38]). The hypothetical extraction method evaluates the economic significance of certain economic connections by calculating what would happen if those connections were removed or reduced while preserving the rest of the global trade and economic activity structure. In this setup, a negative trade shock adversely affects the economy of a country by restricting its access to imported inputs and to its export markets. At a basic level, the hypothetical extraction method yields a measure of the loss of value added experienced as a result of the shock by each country and industry of the global economic system. A summary indicator of dependency at the country level can then be obtained by aggregating the industry-level results into a hypothetical change in GDP.

The principal hypothetical extraction scenario analysed here reduces all trade flows between each of the OECD countries and each of the MNOEs by 10%. All the bilateral exports and imports of goods and services (both for trade in intermediate and final products) between the individual OECD countries and individual MNOEs are reduced by 10%. All the other trade flows remain directly unaffected (but can be affected indirectly, for example, through interruption of indirect links involving OECD-MNOE trade if such links exist). Below, this principal scenario will be referred to as the 'OECD-MNOE trade shock', or simply as the 'trade shock' when there is no risk of confusion. One of the advantages of the hypothetical extraction methodology used here is that the results of the principal scenario can be further decomposed to tease out the contributions to the overall effects of specific sectors and economies where trade is being reduced. In this way, other potential sub-scenarios, which are subsets of principal scenarios (e.g. a reduction of trade between OECD countries and just China or Russia) can also be readily analysed.[40]The components — or 'sub-scenarios' — we highlight here correspond to those analysed using the OECD CGE METRO model in Chapter 5.

The data used in this analysis come from an unpublished version of the OECD TiVA database with increased industry resolution (75 industries, as opposed to 46 in the official release). These data with increase granularity are thoroughly consistent with (i.e. they aggregate up to) the published ones. The geographical coverage consists of 75 countries and a rest of the World region. All calculations are carried out on the basis of data for 2019, the most recent non-pandemic year for which data are available. It is therefore important to keep in mind that many important developments that took place afterwards – most notably, in connection with Russia's invasion of Ukraine – are not captured by our analysis.

As always, the results should be interpreted keeping in mind the characteristics of the methodology. Notably, the hypothetical extraction approach contains an implicit assumption that the intermediate inputs that were initially used but are not longer available need not be replaced. More generally, input-output analysis does not account for any of the substitution effects that would normally be expected as producers and consumers react to the reduced availability of the products affected by the trade

[40] The decomposition of elements of the principal scenario to sub-scenarios yields almost identical results to those that are obtained by separately considering each of the sub-scenarios as individual hypothetical extractions. For more on this, see Annex 8.2.1.

shock. Accordingly, the GDP declines reported in this chapter do not represent predictions as to what would be the economic impact of a disruption in OECD-MNOE trade — except perhaps in the very short term, i.e. before the expected markets adjustments would start occurring. This is an important consideration because these economic adjustments are sometimes unexpectedly quick and large, as we have seen during the COVID-19 pandemic as well as with the economic impacts of Russia's invasion of Ukraine (e.g. in terms of substitution away from and towards supplies of Russian oil and natural gas). The analysis of the same scenarios using the OECD trade model METRO in Chapter 5 accounts for such adjustments and generally presents smaller impacts.

4.2. The effects of reducing bilateral trade between OECD countries and MNOES

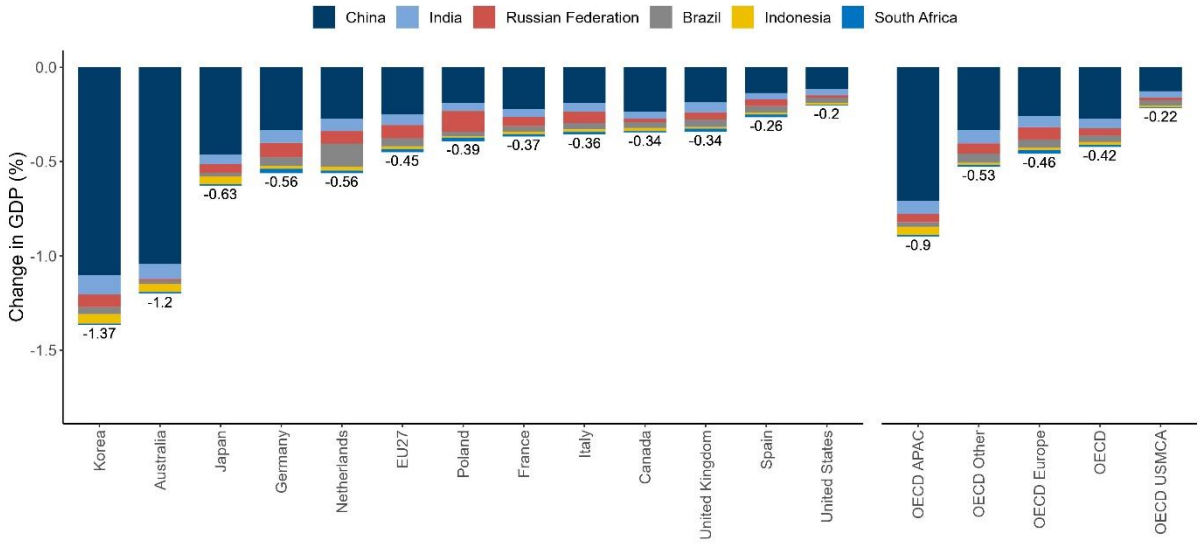
4.2.1. Impacts on country GDP

Figure 4.1 illustrates the impact of a 10% reduction in all OECD-MNOE trade on the GDP of OECD countries. In each case, the total effect is decomposed to highlight the shares that can be attributed to a breakdown of trade between OECD countries and a specific MNOE country and these can be interpreted as representing the effects of sub-scenarios involving specific MNOEs. In the principal scenario, taken together, OECD countries see their overall GDP decrease by 0.42%. That figure, however, masks a significant amount of inter-country variation. The Asia Pacific region is affected the most heavily, with Korea and Australia experiencing GDP losses of 1.37% and 1.20%, respectively. At the other end of the spectrum, North America is relatively unaffected, whereas Europe lies somewhere in between. Among European countries, it is Germany (-0.56%) and the Netherlands (-0.56%) that are more exposed to the shock.

In general, the main driver of these GDP reductions is the decrease in trade with China. This is hardly surprising, given that China accounts for almost two-thirds of the MNOE's overall trade with the OECD. The link with China is particularly strong for the countries of the Asia Pacific, where its reduction accounts for about four-fifths of the overall impact of the OECD-MNOE trade shock. In the case of Europe, exposure to a disruption of trade with China is not as pronounced, but still significant. A 10% reduction in trade between the OECD countries and China is calculated to reduce GDP in the EU27 by about 0.26%. In addition, several European countries (most obviously Poland) display non-negligible ties to the economy of Russia. In this respect, however, it is important to keep in mind that that the data used in this analysis predate Russia's invasion of Ukraine and the ensuing sanctions.

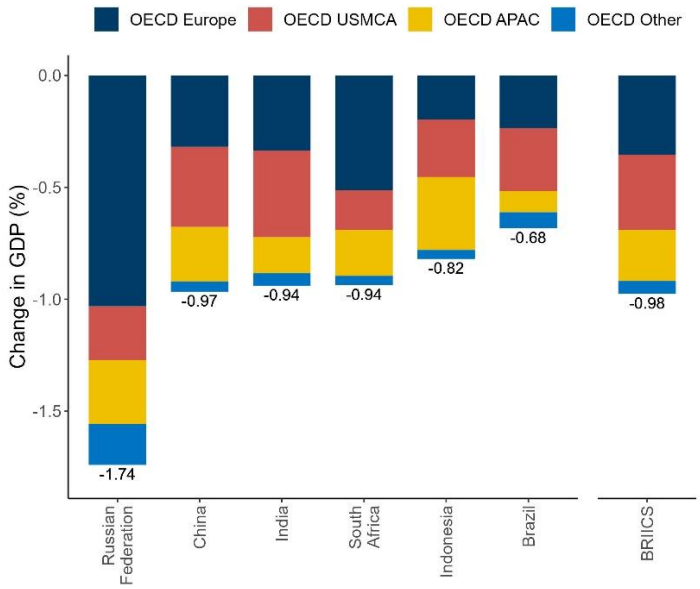
The impact of the trade shock on the GDPs of MNOEs is generally more pronounced than in OECD countries (Figure 4.2). In the simplest terms, this appears to indicate that MNOEs are more economically dependent on trade with the OECD countries that the OECD countries are on trade with MNOEs. This is a consequence of the fact that trade with the OECD accounts for larger shares of the economies in MNOEs than trade with MNOEs does in OECD countries (Figure 4.3). Within the MNOE group, however, different countries have stronger trade linkages with different geographical areas. South Africa and Russia seem most dependent on Europe, whilst China, India and Brazil have comparatively stronger links with North America. For Indonesia, the key partners are those of the Asia Pacific. Among all MNOEs, Russia is the country most affected by the trade shock, which reflects its high reliance on trade with OECD countries in Europe (prior to its aggression of Ukraine).

Figure 4.1. Impact on the GDP of selected OECD economies of a 10% reduction in OECD-MNOE trade



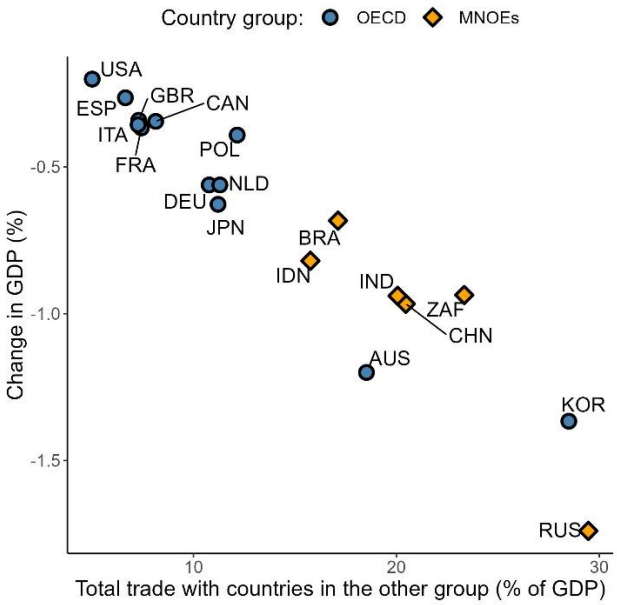
Note: The aggregates OECD APAC, OECD Europe, OECD USMCA and OECD Other respectively refer to OECD countries that are part of the Asia-Pacific region, that are part of Europe, that are party to United States-Mexico-Canada Agreement, and to the remaining OECD countries.
Source: OECD calculations based on OECD ICIO data.

Figure 4.2. Impact on the GDPs of MNOEs of a 10% reduction in trade with the OECD



Note: The aggregates OECD APAC, OECD Europe, OECD USMCA and OECD Other respectively refer to OECD countries that are part of the Asia-Pacific region, that are part of Europe, that are party to United States-Mexico-Canada Agreement, and to the remaining OECD countries.
Source: OECD calculations based on OECD ICIO data.

Figure 4.3. GDP impact of the extraction scenario versus total trade with the other group



Source: OECD calculations based on OECD ICIO data.

4.2.2. Decomposition of country GDP impacts by traded sector

The effect of the OECD-MNOE trade shock on the GDP of a given country can be further decomposed to assess what weight is carried by products of different nature (primary, manufacturing or services) and destined to different uses (intermediate or final). The results (Figure 4.4) suggest markedly different patterns of trade dependence across countries. For a big exporter of agricultural and mining products, like Australia for example, the impact of the shock can be attributed to a very significant extent (60%) to the disruption of trade (mainly exports) of primary products. Similarly, the impact on Russia reflects the fact that its economy is dominated by trade (again, mostly exports) in energy minerals and related products. Brazil, Indonesia and South Africa are also relatively sensitive to disruptions of trade in primary products.

By contrast, in a number of other countries the main channel through which the trade shock affects GDP is represented by manufactured products. The most notable cases are probably those of Korea and China, where a 10% reduction in manufacturing trade between OECD and MNOEs leads to a 1% and a 0.76% drop in GDP, respectively. Even so, manufacturing accounts for a dominant share of the overall GDP impact of the OECD-MNOE trade shock in Italy (67%), Germany (65%) and Japan (62%) as well.

Finally, in several OECD countries it is trade in services that represents the main source of dependency on MNOEs. In the Netherlands and in the United Kingdom, for example, a 10% drop in the flow of services between the OECD and MNOEs is calculated to reduce GDP by 0.33% and 0.20% respectively. Besides, although dwarfed by the impact through trade in manufactured products, the services trade channel is still a very significant source of vulnerability in Korea as well. On the MNOEs side, disruptions of trade in services seem potentially serious for India.

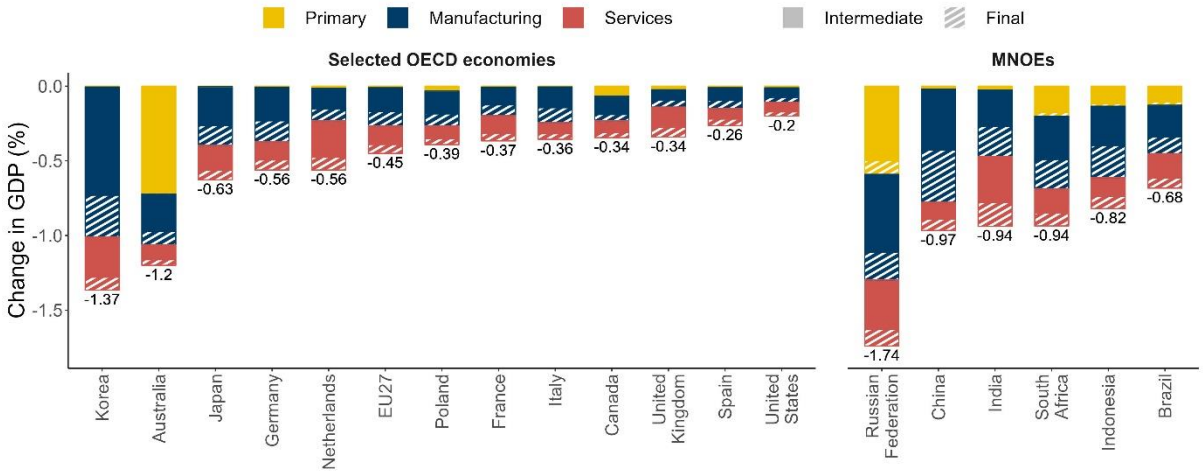
When a distinction is made between different destinations of traded products, China stands out in terms of the share of the impact accounted by the final demand channel (44%). The corresponding figure for the OECD as whole is 30%. This means that more than for other countries, for China the

dependence on trade with the OECD countries is mainly related to trade in final products[41] and not inputs into production (either those that China itself uses for production or those that it provides to other global producers). Within the OECD, the weight of the final product component tends to be lower for the countries of the Asia Pacific region (25%) and higher in Europe (35% for the EU27), but it is quite low for the Netherlands (29%).

When these results are looked at together, a pattern emerges: the components of the OECD-MNOE trade shock that hurt a given country the most are often those that — directly or indirectly — cut off a significant part of its economy from an important export market. The most illustrative example is perhaps provided by Australia. In this case, net export of primary products to MNOEs account for as much as 8% of the country's overall GDP. Indeed, when trade in primary goods between the OECD and MNOEs is reduced by 10%, the GDP of Australia experiences a sizable 0.72% drop. Similarly, Korea is found to be highly dependent on trade in manufacturing products, a sector in which it enjoys a net export position vis a vis MNOEs amounting to more than 5% of its overall GDP. While not always as clear cut, the pattern applies to several other cases that have been identified as important channels of trade dependence (e.g. net exports of services to MNOEs are responsible for almost 2% of the Netherlands' GDP, net exports of final manufactured products to the OECD add up to 3.3% of China's GDP, etc.). In a majority of cases, then, the trade dependencies uncovered appear to arise through forward rather than backward linkages[42].

Figure 4.4. GDP impact decomposition by traded product

Country level GDP impacts decomposed by the type of constrained trade by sector and use



Source: OECD calculations based on OECD ICIO data.

[41] Recall that final products are destined for final consumption while intermediate products are inputs into production. The latter are combined with other inputs, transformed using labour and capital, and they are consumed only at later stages, embodied in products destined for final consumption.

[42] This is a natural consequence of the methodological approach adopted here. As mentioned in the introduction, built into the hypothetical extraction method is the assumption that production can continue without replacing the intermediate inputs lost to the trade shock. Accordingly, the approach tends to place greater emphasis on forward rather than backward dependencies.

4.2.3. Impacts across sectors

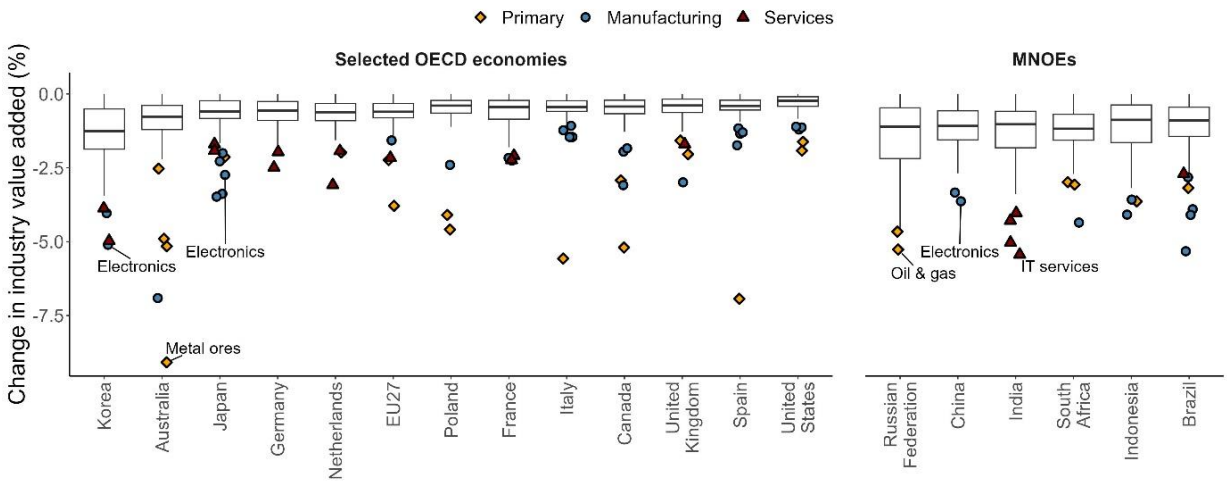
In any given country, not all sectors of the economy are exposed to the considered trade shock to the same degree. Figure 4.5 presents a summary view of how much value added is exposed to trade disruptions in each country at the industry level. Country by country, the boxplots display the distribution of the relative loss of value added associated with the shock over the 75 sectors that comprise the ICIO. The markers represent outliers, industries that experience unusually large impacts.

The range of variation across industries can be fairly wide. In other words, certain sectors of a country's economy are typically significantly more exposed than others. The list of the most impacted industries varies from one country to another, but it is fairly common to find the highest levels of exposure in the primary sector and, more specifically, in industries belonging to the mining and quarrying cluster. This is because the trade shock constrains several important flows of mineral resources between OECD and MNOEs. Australia, for example, sells more than four-fifths of its entire output of metal ores directly to China and until recently many European countries relied heavily on the Russian Federation for their energy inputs. In addition, it is not uncommon for primary products to be indirectly re-exported as intermediate inputs embodied in other products.

In several cases, the sectors identified as the most heavily dependent on OECD-MNOE trade, represent only small shares of their country's economy. Italy's metal ore industry, for instance, is severely affected by the shock but makes a negligibly small contribution to the country's GDP. A similar conclusion holds for Spain as well.

On the other hand, the list of outliers also includes industries of great significance from both a domestic and a global point of view. Most notably, it includes the electronics sector in Korea (where it is responsible for 7% of the country's GDP), China (2.5%) and Japan (1.5%). In the same vein, a reduction of trade with OECD countries would also do significant damage to India's large IT services sector (3.4% of GDP).

Figure 4.5. Distribution of value added losses across industries

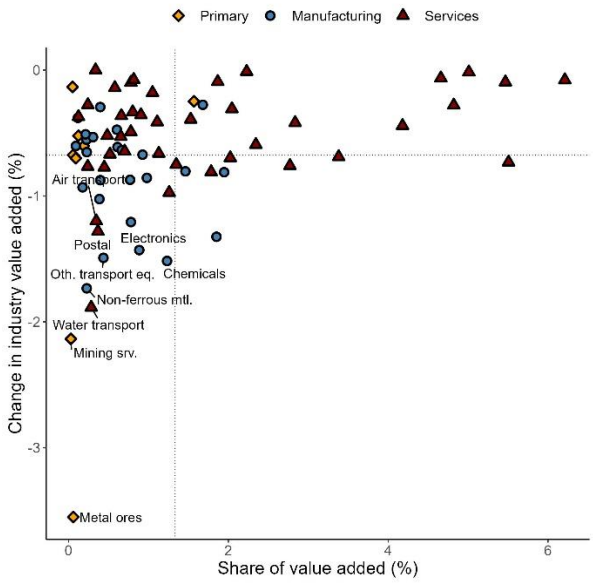


Note: The boxplot for any given country summarises the distribution of the percent change in value added in the 75 industries that make up that country's economy. The lower and upper lines delimiting the box identify the first quartile (bottom 25% of observations) and third quartile (top 25%), respectively. The horizontal bar in the box represents the median. The vertical lines stretching out from the box represent the minimum and maximum values disregarding outliers. Outliers are represented as dots in the picture. The shape and colour of the marker characterize the type of sector. Outliers of particular interest are also identified by labels.
Source: OECD calculations based on OECD ICIO data.

4.2.4. Impacts in the European Union and the Netherlands

This section considers the impact of the OECD-MNOE shock on the economy of the European Union (EU27) as a whole. For each industry of the input-output system, Figure 4.6 plots the value added loss associated with the trade shock against its share of the EU's GDP. Exposure to trade with MNOEs appears comparatively high in important manufacturing sectors like machinery, chemicals and electronics, which experience value added declines between 1% and 2%. At the same time, large service sectors, such as construction, healthcare, education and social services, are linked predominantly to domestic users and appear to be fairly isolated from the trade shock. Conversely, services industries with a close connection to trade (e.g. transport and wholesaling) tend to experience above-average declines in value added and this is important for economies such as that of the Netherlands where transport and logistical services are important contributors to GDP. The chart in Annex 8.2.1 further breaks down the impacts displayed in Figure 4.6 to highlight the contribution of MNOEs. Not surprisingly, China usually represents the dominant component, but India, Russia and Brazil collectively account for significant shares of the impact in several industries (e.g. Water transport, Chemicals, Machinery, Air transport, Iron and steel).

Figure 4.6. Value added losses versus share of GDP in the EU27

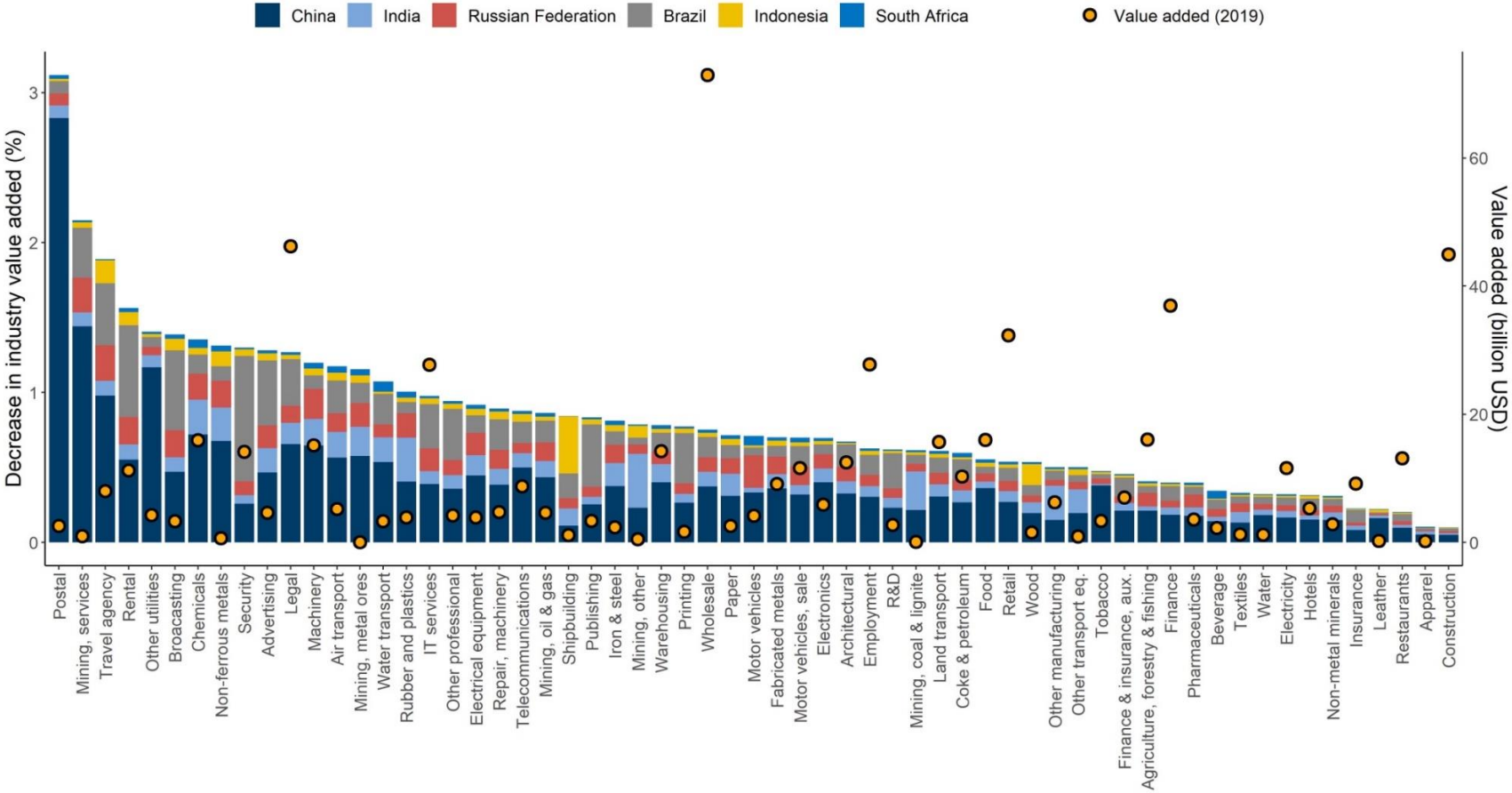


Note: The dotted lines represent mean values.
Source: OECD calculations based on OECD ICIO data.

Zooming in on the results for the Netherlands, Figure 4.7 displays the impacts of the trade shock at the industry level along with a decomposition to gauge the significance of the linkages with individual MNOE countries. Although the largest dependencies are observed in sectors that are comparatively small in the context of the Dutch economy (postal and courier services, mining services), several sizable sectors also show non-negligible losses of value added (legal and IT services, but also chemicals, machinery and security services). In many cases it is the linkages with China that represent the main source of exposure to MNOEs (e.g. postal and courier services, other utilities), but several Dutch industries also appear to have close links with Brazil (security services and rental services) and some with Indonesia (shipbuilding, wood).

Interestingly, exposures are relatively high not only across the manufacturing industries, but also for several types of services which account also for significant shares of GDP (e.g. legal services, IT services and, to a lesser extent, wholesale trade). These services, which are affected by the trade shock, account also for relatively significant shares of the Netherlands' GDP (e.g. legal services, IT services, wholesale trade and shipping and transport services).

Figure 4.7. Industry-level impacts for the Netherlands stemming from the OECD-MNOE trade disruption (selected industries)



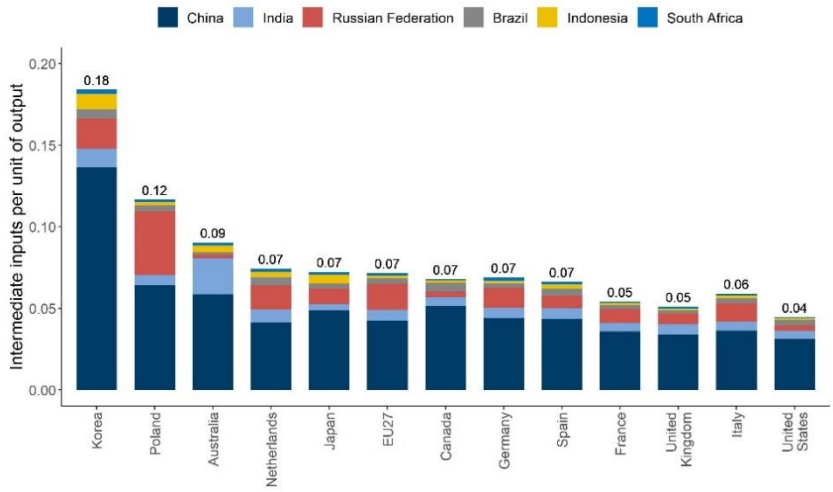
Note: The changes in value added that result from the shock are all negative. They are presented here in absolute value for ease of display.
Source: OECD calculations based on OECD ICIO data.

4.2.5. Focus on backward linkages

By and large, the results of the hypothetical extraction analysis reflect the reciprocal significance of OECD countries and MNOEs as each other's export markets. In other words, our results so far have emphasised how the two groups of countries are tied by a network of important forward linkages. On the other hand, not much could be said on the backward dependency aspects of those relationships. To a large extent, this stems from characteristics of the adopted methodological approach. As noted in the introduction, the hypothetical extraction method contains the implicit assumption that the intermediate inputs made unavailable by the trade shock need not be replaced. Such a framework, in which it is possible for production to continue unaffected in spite of an input becoming unavailable, does not to give due justice to the importance of backward dependencies. Accordingly, this section complements the hypothetical extraction results with an analysis of backward linkages.

Figure 4.8 represents the use of intermediate inputs sourced by selected OECD economies from MNOEs per unit of output. For example, for each USD worth of output it produces, the Korean economy requires USD 0.18 worth of inputs produced in MNOEs. Referred to in some of the recent literature on trade dependencies as 'foreign input reliance' indicator (e.g. Baldwin and Freeman (2022[26]), this measure refers not only to the inputs from MNOEs that are used directly in Korea's production processes, but also to those that are used indirectly in the production of the inputs to those production processes. Equivalently, the dependence measures in Figure 4.8. refer to total backward linkages (that is the reliance on foreign intermediate inputs of the whole economy. Backward linkages to MNOEs are particularly high for Korea and, to a lesser degree, Poland. In all cases, the main contribution to dependency on MNOEs comes from trade with China. For several European countries (most clearly for Poland), Russia also appears to be an important source of inputs. Once again, however, the data are quite likely outdated in this respect. Finally, Australia displays non-negligible backward linkages to India.

Figure 4.8. Sourcing of intermediate inputs from MNOEs by OECD countries



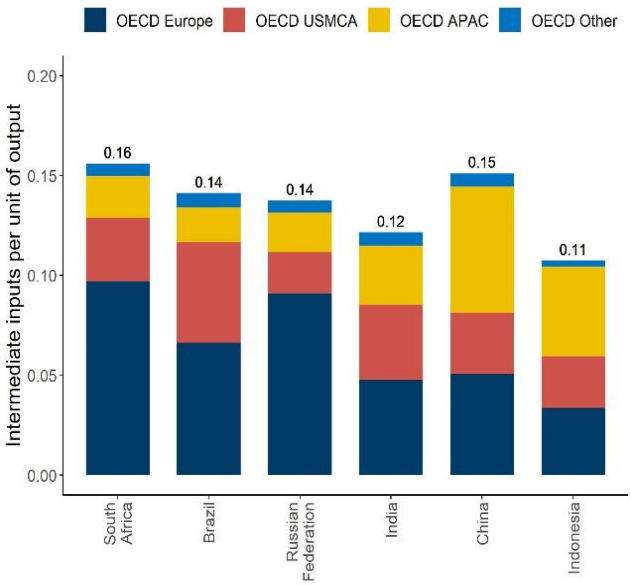
Source: OECD calculations based on OECD ICIO data.

Compared with the results in Figure 4.8**,** the MNOEs backward linkages to OECD countries (Figure 4.9) tend to be relatively high. Europe is a significant source of intermediate inputs for all MNOEs, but more so for South Africa and, subject to the usual caveats, Russia. China, on the other hand, is comparatively more dependent on OECD economies of Asia Pacific.

Taking a closer look at the economy of the EU27 as a whole (Figure 4.10), we see important dependencies on China and, albeit to a lesser extent, on Russia. Dependencies on China are most prominent in the manufacturing industries such as electronics, shipbuilding and electrical equipment. The dependencies on Russia, on the other hand, are all connected to natural resources. They are found in extraction activities themselves (oil and gas, metal ores, mining services), in the energy sector and related processing activities (coke and petroleum), as well as in energy intensive industries (iron and steel, non-ferrous metals). When

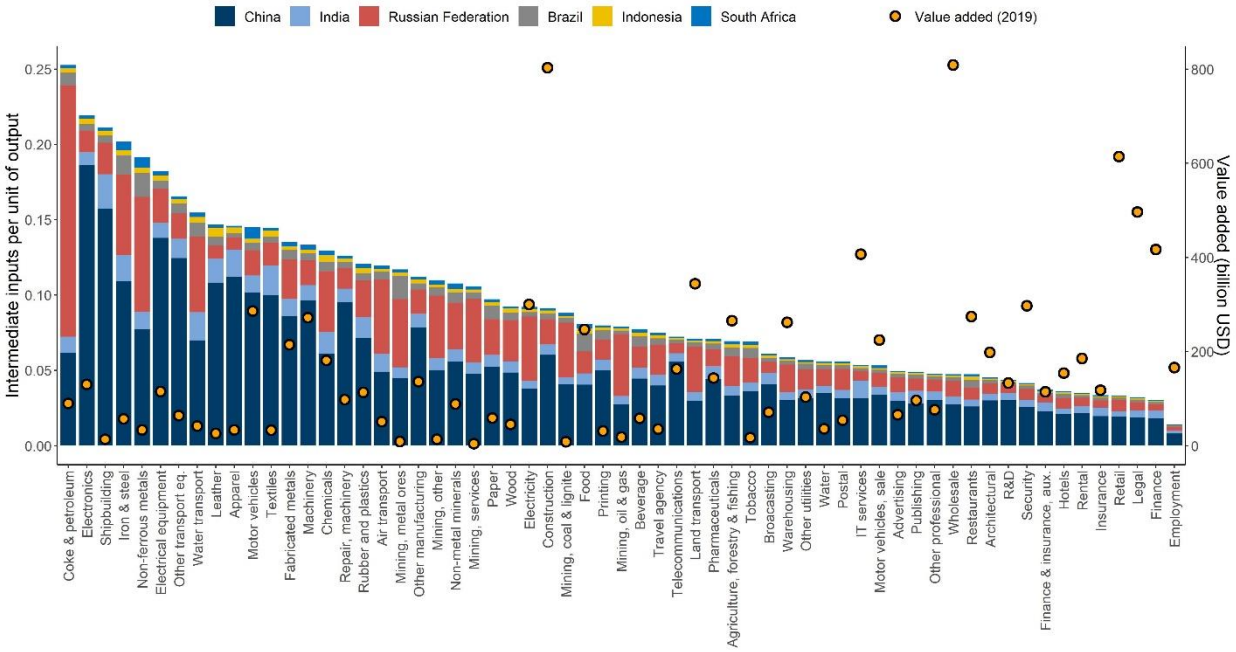
the Netherlands is considered individually, its backward linkage exposures look fairly similar to those for the EU27 as a whole (Figure 4.11).

Figure 4.9. Sourcing of intermediate inputs from the OECD by MNOEs



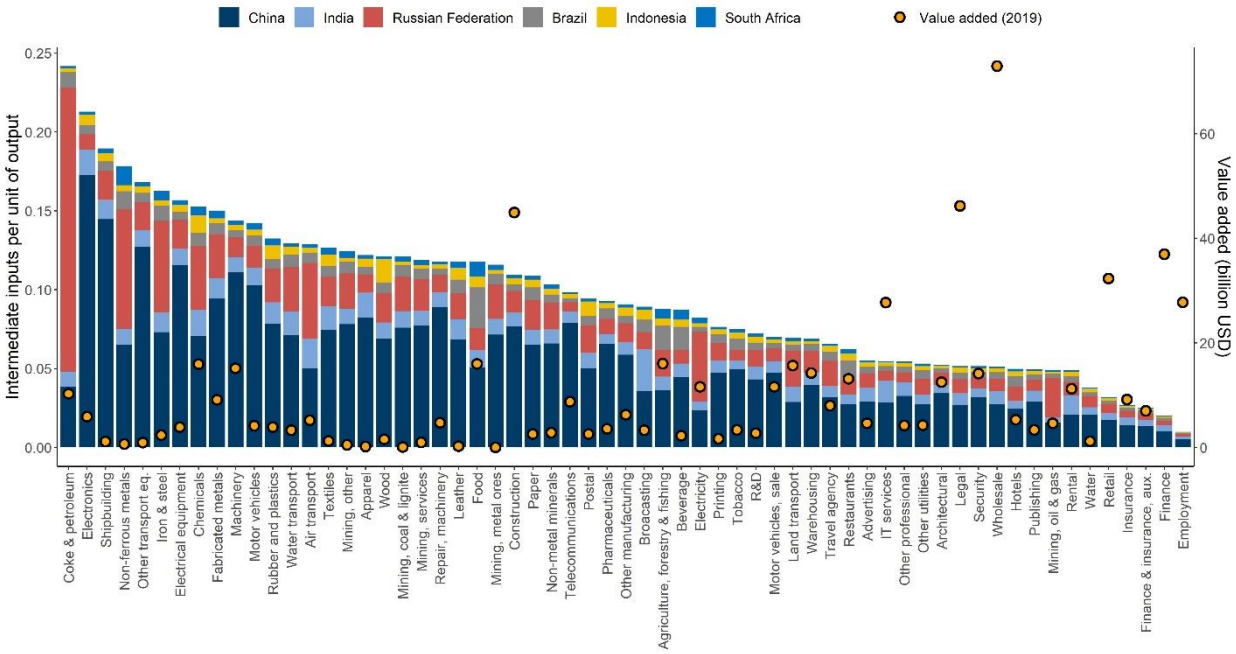
Note: The aggregates OECD APAC, OECD Europe, OECD USMCA and OECD Other respectively refer to OECD countries that are part of the Asia-Pacific region, that are part of Europe, that are party to United States-Mexico-Canada Agreement, and to the remaining OECD countries.
Source: OECD calculations based on OECD ICIO data.

Figure 4.10. Industry-level total (direct and indirect) backward linkages with MNOEs in EU27's selected industries



Source: OECD calculations based on OECD ICIO data.

Figure 4.11. Industry-level total (direct and indirect) backward linkages with MNOEs for selected Dutch industries



Source: OECD calculations based on OECD ICIO data.

4.3. Conclusions from the ICIO analysis

This chapter has analysed the vulnerability of a selection of large economies to a potential disruption of trade between OECD and MNOE countries through the lens of input-output analysis, using the OECD TIVA data and the hypothetical extraction method to assess the potential implications of 10% reduction in all OECD-MNOE trade flows.

At a broad level, trade disruptions of this kind are found to hurt the GDP of MNOEs more than that of OECD countries. This is simply because the trade flows being suppressed represent a larger share of the economy in the former than in the latter. Among the OECD countries, the most exposed are those of the Asia Pacific region: their economies display very high levels of integration with China, which is by far the largest of MNOEs by any metric of trade. Australia's primary sector and Korea's manufacturing appear particularly vulnerable. Still, a disruption of OECD-MNOE trade would also have severe repercussions in China's manufacturing sector, whose production is to a very significant degree destined to final consumers in the OECD. Unsurprisingly, the electronics industries of Korea, China and Japan are found to be particularly dependent on OECD-MNOE trade.

While not as high as that of the Asia Pacific, Europe's degree of dependency on trade with MNOEs is still far from negligible and significantly more pronounced than for North America. Keeping in mind that the results of the hypothetical extraction should be interpreted with caution[43], we find that a 10% reduction in trade between the OECD and MNOEs is associated with an almost half percentage point drop in the GDP of the EU27. Within Europe, it is Germany and the Netherlands that exhibit the most significant

[43] As noted in the introduction of this chapter, the methodology does not account for any of the adjustments that would take place in the economic system following a trade shock of this kind. Accordingly, the results represent an assessment of the broader economic significance of the trade links suppressed, but not an attempt to predict the consequences of the shock – especially not beyond the very short run. Ultimately, the calculated GDP losses should be interpreted as measures of the size of the exposure to disruptions, but the actual losses would be higher or lower depending on substitutability of inputs or in consumer markets.

dependencies. In the former, they arise predominantly through trade in manufactured products, in the latter through trade in services. Especially in the case of the Netherlands, exposure is not limited to China and significant linkages with the other MNOEs (e.g. Brazil) are also observed.

Due to assumptions of the employed methodology, the trade dependencies that emerged from this analysis stem mainly from forward linkages. In other words, the results of hypothetical extraction tend to highlight cases in which the OECD-MNOE shock separates producers in one group of countries from important (direct or indirect) export markets in the other group. This certainly underestimates the overall significance of trade dependencies. Nevertheless, these relatively conservative estimates show already that reliance on imported raw materials and other imported intermediates is not the only — or may even not be the main — aspect to consider. This puts into context the ongoing policy debate which seems to be predominantly concerned with import dependencies. It is in this context the final part of the chapter has extended the analysis to the backward linkages between OECD and MNOEs. Once again, the results show evidence of the high degree of economic integration between the two groups of countries (and especially between OECD countries and China) and illustrates some of the economic costs that may be involved in the currently debated strategies of 'de-risking' supply chains.

5. Modelling trade dependencies using the OECD CGE model METRO

The Inter-Country Input-Output (ICIO) approach pursued in the previous chapter keeps prices fixed and does not allow for any adjustment, through trade or in domestic product and factor markets, to cushion the impacts of trade disruptions. The ICIO approach can thus be considered as portraying short-term impacts when typical economic adjustments have not yet occurred.

The global computable general equilibrium (CGE) model approach used in this chapter relaxes these rigidities to gauge the impacts in the medium term, when adjustments can take place. Allowing for adjustments in the sourcing of inputs, the re-balancing of product markets as well markets for different kinds of labour and capital, enable a more comprehensive picture of possible economic impacts to be drawn.

This analysis uses the OECD global CGE trade model METRO to assess the impacts on selected economies of the same 10% trade reduction scenario between the OECD and MNOE countries.

5.1. Introduction

As discussed in Chapter 2, trade dependencies are usually defined as trade links that are potentially more prone to disruptions (the notion of risk), for which substitution towards other suppliers or to other equivalent products is difficult (the notion of substitution/diversification), and which are economically important from the country's point of view (the notion of economic importance). The OECD global economy CGE trade model METRO, which is used to shed further light on trade dependencies in this chapter, allows better integrating the latter two dimensions in one quantitative framework while also providing a consistent framework for a systematic analysis of possible risks and their consequences.[44]

The main characteristics of the METRO model are summarised in Annex 8.3. The main characteristics of supply chain integration identified in the literature on GVC integration and as measured in the OECD's ICIO tables and TiVA methodology used in Chapter 4 are accounted for in the model and its associated database. For example, the model can be used to calculate the foreign content of gross exports (i.e. a measure of 'backward' GVC participation) or domestic value added content in other countries gross exports ('forward" GVC participation) in the baseline and in analytical scenarios. Therefore, similar to the hypothetical extraction methodology used in Chapter 4, the model allows the incorporation of a supply

[44] An on-going OECD work uses the same model and a similar database aggregation to study the question of how different shocks propagate across the global economy (see Arriola, Kowalski and van Tongeren (forthcoming[31]) in a highly interlinked global economy).

chain perspective on trade dependencies and tracking where value is generated and where and how it is used.

In addition, through explicitly modelling economic behaviour of producers and consumers located in different countries, as well as international trade links connecting them, the model allows for a more realistic assessment of adjustments to potential disruptions. The size of the simulated impacts on value added and GDP is typically smaller than those coming from the ICIO analysis since the CGE model allows for adjustments (substitution) in both sourcing and sales in response to a given trade disruption.

For example, in response to a disruption in the supply of a specific intermediate product sourced from a foreign location, producers in a certain economic sector may, first, try to replace the foreign inputs with inputs from domestic sources, try sourcing a similar input from alternative foreign sources, or attempt to substitute it with other inputs used in production, for example, with larger amounts of labour or capital. In the model, the ease of these substitutions is determined by an interplay of data reflecting the actual economic production structures of trading sectors and countries (e.g. shares of alternative sources of intermediates or shares of different factors of production in the value added of the sector) and parameters (e.g. elasticities of substitution and other parameters used in the model). If these alternative ways of producing are economically viable (e.g. because the elasticity of substitution between the different source countries is high and alternative sources can be found) the sector's producers may not have to significantly reduce its output or revenue which would suggest that the sector is in fact not 'trade dependent'. Similar substitutions are modelled for final products. Note also that in this model the adjustments to disruptions go beyond the actors immediately involved in the disrupted trade links. In particular, in reaction to trade disruptions a part of trade is expected to be diverted to third partners and possibly benefit them economically. Lastly, trade shocks will also have indirect effects in the rest of domestic economy which are connected through domestic factor markets and adjustments related to incomes and expenditures. The interlinkages embedded in the model allows for the identification of trade dependences that affect multiple sectors and therefore might have an economy wide impact.

The model is set up so as to account for adjustments that occur in medium term where prices adjust in line with the underlying elasticities so as to equilibrate demand and supply for products, and production factors are perfectly mobile across sectors to equilibrate the associated demand for and supply of production factors, but the overall endowment of labour and capital remain fixed and do not move across national economies. Normally, such a set-up is understood to correspond to adjustments that typically take up between five and ten years.

Another attractive feature of the modelling approach at hand is that it integrates all the economic activities and linkages between them in one consistent macroeconomic accounting framework. This allows assessing the economic significance of trade linkages not only at the level of a sector or product but also at a level of a country. This may be helpful in distinguishing between macroeconomically insignificant (but possibly otherwise significant) and macroeconomically significant trade dependencies.

Like with all models, there are also some limitations to keep in mind and some of them are particularly relevant for the study of trade dependencies.

First, while the model has a relatively high degree of sector disaggregation for this class of models, it is at the level of broad sector rather than the more specific product level that was considered in Chapter 3. The level of aggregation is also somewhat higher than that used in the ICIO analysis in Chapter 4. Consequently, while adjustments are explicitly modelled this is performed at the relatively high level of aggregation. Therefore, while the approach should capture well average effects in broad sectors, it may overlook the dependencies that exist for more specific products. This may be problematic if in reality there is a lot of heterogeneity within the broader sector. For example, different raw materials which may be critical inputs into production in different industrial sectors are aggregated together, which may result in a possible overestimation of a possibility of substitution for alternatives. However, if signs of dependency are detected in the analysis conducted at the broad sector level, this suggest that at least some of the more specific activities or products that are covered by this category, may be trade dependent. The analysis should therefore not be seen as exhaustive but as a first filter for identifying those broad economic sectors which can be studied in detail using methodologies allowing for more product detail.

Another limitation is that technology is assumed not to change in response to price signals and intermediate inputs are used in fixed shares in the production of a product. In contrast to the aggregation problem, this may in turn result in an overestimation of the economic significance of reliance on certain intermediate

inputs. Finally, in this type of models, economic trade links which are insignificant in the baseline cannot be created or easily expanded (unless they concern products characterised by some trading activity and very high elasticities).

5.2. The effects of reducing bilateral trade between OECD countries and MNOEs

The main scenario considered in the CGE analysis[45] is the same as the one applied in Chapter 4, specifically a 10% reduction (in real terms) of bilateral trade across all sectors between the individual member countries of the OECD and each country in the MNOE group.[46] Similar to the results from the ICIO analysis, in the CGE modelling exercise, countries in the two groups lose from the 10% reduction of trade between the two groups, although, as expected, the impacts obtained from the CGE analysis tend to be smaller since firms are able to respond to disruptions by finding alternative sources for inputs and markets for output to try to mitigate any negative effects.

5.2.1. Real GDP changes

At the macro level, few countries benefit from reduced trade between OECD and MNOEs (Figure 5.1 Panel A). Aside from the United States, which experiences an increase in real GDP, all countries in the OECD and MNOE groups experience a fall in real GDP. Korea and Australia are the most negatively impacted among OECD countries losing close to a 10th of a per cent of GDP. Both countries have relatively strong forward and backward supply chain and final products linkages with MNOEs, particularly China as well as Indonesia and India. The Netherlands is the most negatively affected among EU countries, and this is driven by relatively larger declines in the value added output in the services sectors. Value added in services sectors decline -0.1%. While small relative to the increase in value added in Dutch primary and manufacturing industries. Services sectors account for over 80% of the value added. The US experiences a very small increase in real GDP because the negative effects of reducing inputs from MNOEs are outweighed by market gains domestically and abroad especially in markets of OECD partners who also cut supplies from MNOEs and where the US is in a strong position to compete. Canada, and Mexico fare better than most OECD countries because of integrated international supply chains and strong trade linkages within North America, in particular with the US. These linkages are further strengthened when each OECD country located in North America and other regions reduces trade with MNOEs.

In general, OECD countries with stronger trade linkages with MNOEs rather than the OECD fare worse when OECD regions reduce imports and exports with MNOEs (Figure 5.2 Panel A). This is the case for Australia and Korea and is in line with the results of input-output analysis presented in Chapter 4. Stronger linkages within the OECD help mitigate the negative effects of trade reduction with MNOEs (Figure 5.2 Panel B).

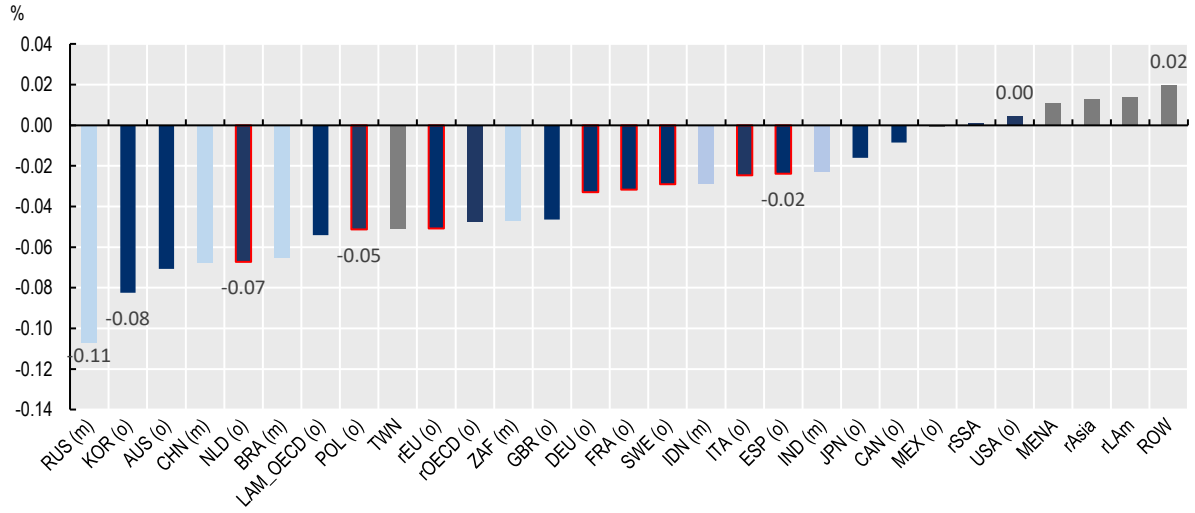
Australia and Korea have stronger trade linkages with MNOEs compared to other OECD countries and are therefore the most negatively affected by reduced trade with the group. Many sectors in Korea and Australia rely heavily on MNOEs as export markets, particularly China. Australia exports 77% of mining products and over a third of its metals to China. Similarly, half of Korean electronics and 45% of chemicals are exported to China. The model results suggest that when Australia and Korea reduce trade with MNOEs, they fail to find enough alternative markets for their exports to make up for the losses even when other OECD countries reduce imports from MNOEs and thus have the potential to source more from OECD partners. Real exports decline around 3% for both of these countries which is roughly ten times larger than for most other OECD countries.

[45] See Annex section 8.3.2 for a detailed descriptions of the METRO model scenarios.

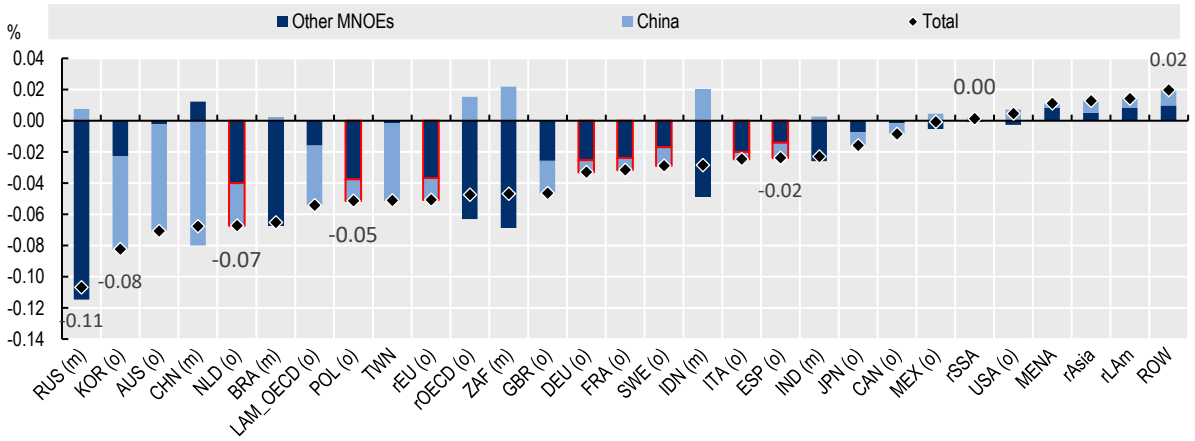
[46] Note, however, that the country and sector aggregation while as similar as possible, differs slightly between these approaches and therefore not all results may be directly comparable.

Figure 5.1. Most countries loose from the OECD-MNOE trade reduction scenario in the medium-term

Panel A. Real GDP change when OECD countries reduce imports and exports from MNOEs (total effect)



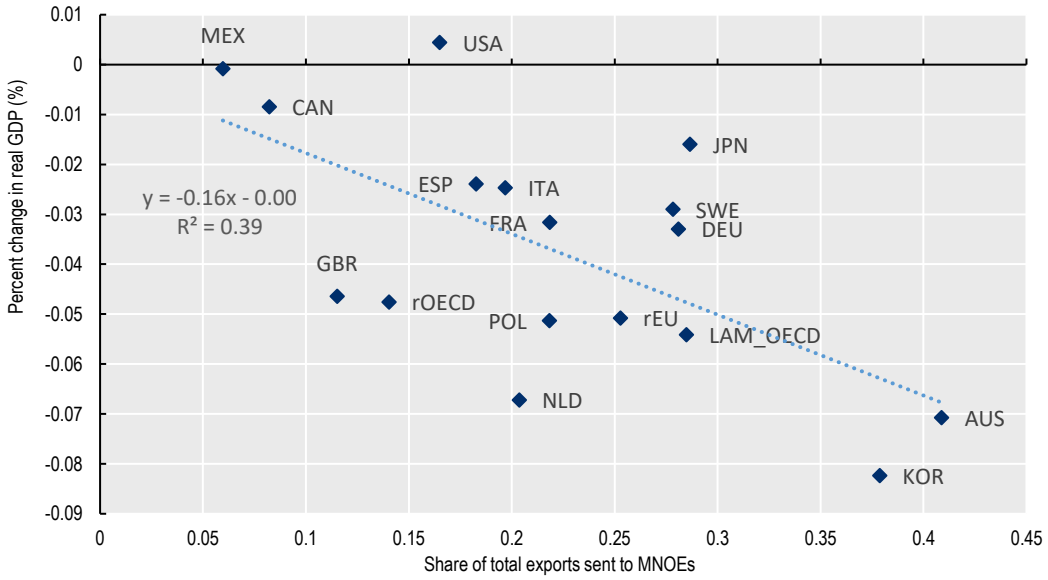
Panel B. Decomposed the part of the total effect attributable to trade with China



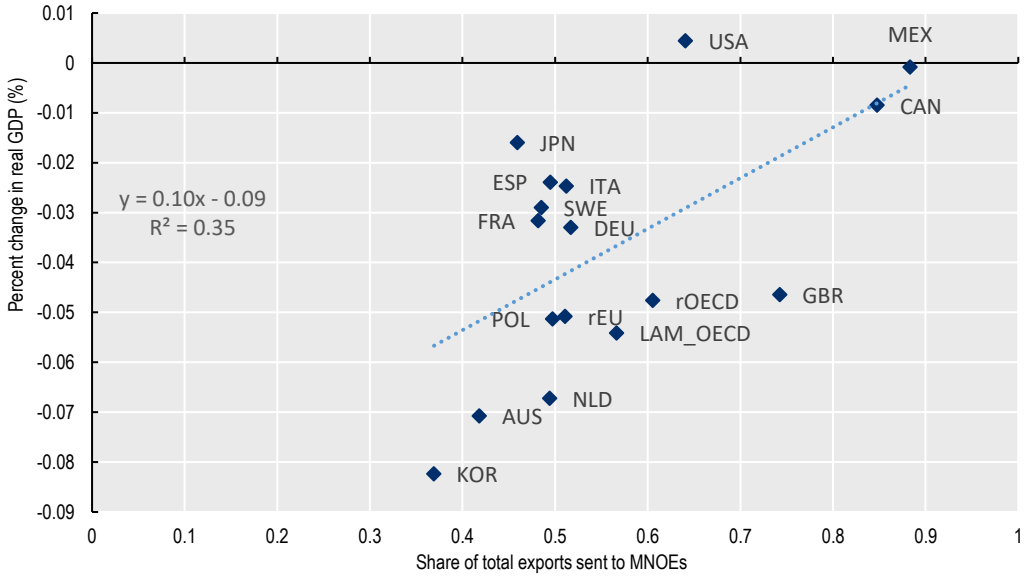
Note: In Panel A, dark blue bars are OECD regions (o), Dark blue bars outlined in red are EU27 regions, light blue bars are the MNOE countries (m), and grey bars are other regions. In Panel B, bars that are outlined in red are EU27 regions. The shading of the bars signifies the changes attributed to either reduced trade with China (light blue) or other MNOEs (dark blue).
Source: OECD METRO Model.

Figure 5.2. Real GDP changes and dependence of OECD countries on MNOEs vs OECD export markets

Panel A. Changes in real GDP juxtaposed with MNOE export market shares



Panel B. Changes in real GDP juxtaposed with OECD export market shares



Note: Similar relationship, though not as strong, when using import shares. Except for EU27. More imports from EU27 means real GDP decline is less negative (though R2 is 0.03). Panels A and B exclude intra-EU trade in the share computation [including intra EU trade similar but small results and R2].
Source: OECD METRO Model.

While real GDP of EU countries also decline, the impacts tend to be smaller than for OECD countries in Latin America and Asia and Pacific. This is because MNOEs account for a relatively smaller shares of trade among EU27 Members. Moreover, when trade links are reduced, particularly on the import side, there is an increase in export demand among alternative trade partners. Intra-EU trade fills in the gap, albeit incompletely as total real exports and imports still decline somewhat in the EU region as a whole (Figure 5.3).

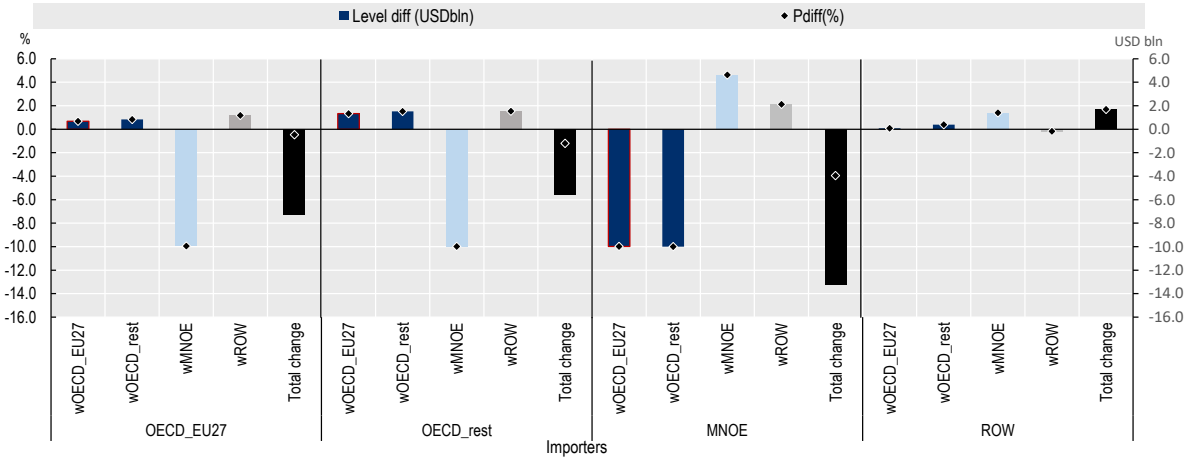
The real GDP of the Netherlands decreases the most among all the EU countries included in the model (-0.07%) — driven mainly by output declines in a number of services sector where relatively large shares of labour is employed. The fall in output in the services sectors translates to deeper factor and subsequent household income declines than in other EU regions (Figure 5.4). Household income in the Netherlands falls -0.46% but only -0.32% in the EU26 region on average.

The North American region is least affected by the reduced trade scenario. The economy of the United States records a small gain and the economies of Mexico and Canada record some of the least negative impacts among the OECD countries. Despite relatively stronger trade links with MNOEs compared to other OECD regions, the US economy does not decline because it benefits both from import substitution and from re-rerouting of trade flows triggered by the considered scenario. The is illustrated by increases of output in United States' manufacturing sectors where MNOEs initially make up a large share of its imports. The increases in output are driven by both increased domestic and export demand. OECD partners reducing their imports from MNOEs results in an increased demand for US exports of *electronics*, *textiles and wearing apparel*, and steel (*ferrous metals*). The net effect is an improvement in the US trade balance which underpins the small but positive real GDP change. Moreover, the increase in import demand in the US from non-MNOE partners is met predominantly by Mexico and Canada as illustrated by the fact that they are the only two OECD countries with an increase in real exports in the scenario.

MNOEs are also negative affected when they reduce trade with OECD countries (Figure 5.1). Real GDP in Russia, China, and Brazil decline the most among MNOE countries as they are the regions who rely more heavily on OECD export markets and import supply compared to the other countries in the MNOE group. Around three quarters or more of imports into MNOE countries of *pharmaceuticals*, *motor vehicles*, *communications*, and *financial and insurance services* come from OECD countries. And for many of these sectors, OECD is the main source (accounts for 80% of imports) for the three most impacted MNOE countries. On the export side, the OECD market is an important destination overall for China and Russia in the baseline database (2017), but in certain sectors the OECD region is a key export market particularly for Indonesian *textiles and wearing apparel*, Russian *petroleum and coal* as well as *metals* sector, and *business* and *communication* services exports from India and *other manufacturing* and *financial services* from China to name a few. Reductions in import and export to and from important trading partners has a negative impact on MNOE economies.

Figure 5.3. Change in bilateral trade (imports by source)

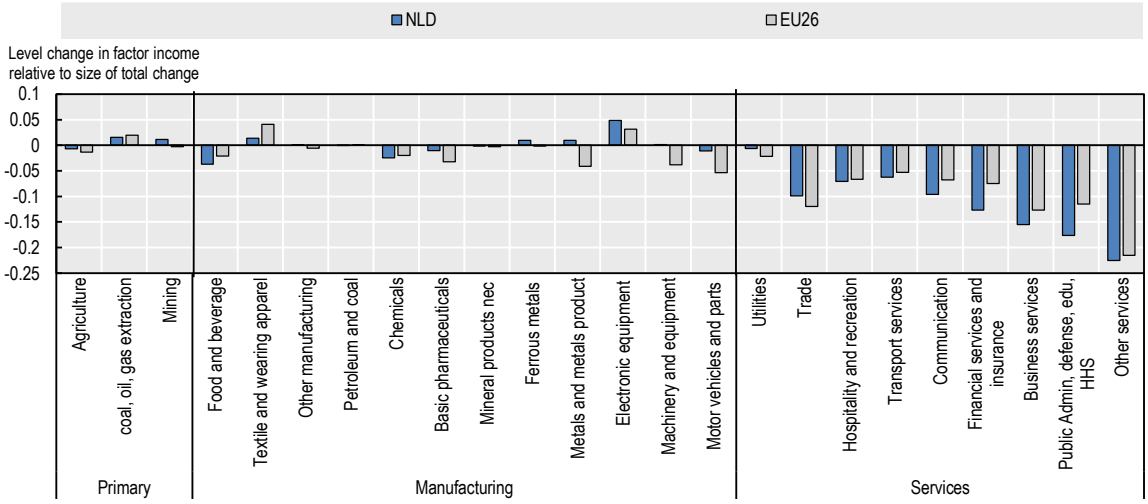
Real change in imports after OECD reduces trade with MNOEs across all sectors



Note: "W" prefix indicates partner regions, which are the exporter regions in this figure.
Source: OECD METRO model.

Figure 5.4. Size of factor income decline in the Netherlands, by sector

Netherlands compared to rest of EU



Source: OECD Metro Model.

5.2.2. Impact on sectoral output in the OECD

The real GDP changes discussed above mask considerable differences in sectoral output changes which are due to both the nature of the considered trade shock as well as the underlying trade specialisation patterns. With few exceptions, production declines in most sectors in the OECD as a whole are driven mainly by reductions in export demand which range from -0.004% in the *other manufacturing* sector to 4% for the *mining* sector (Figure 5.5 Panel A). Production in the *textile and wearing apparel*, *electronics equipment*, *other manufacturing* and *mineral* sectors is helped by both an increase in domestic demand and an increase in intra-OECD trade when OECD trade with MNOEs is reduced.

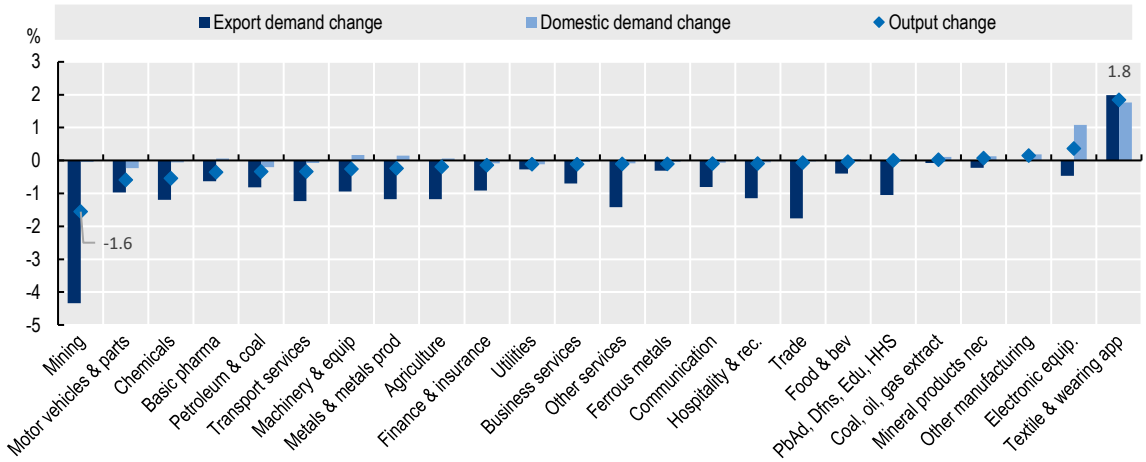
The *mining*, *motor vehicles*, and *chemicals* sectors are hit the hardest (Annex Table 8.2) and the declines are driven largely by the reduction in export demand. The fall in *mining* sector output is predominantly accounted for by the changes in mining production in Australia, where about half of its exports are destined for China. The decline in total production in the OECD region of *motor vehicles and parts* are more widespread. Main OECD producers of this sector (United States, Mexico, Japan, the United Kingdom, Germany, France, and rest of EU) see production declines of about 1% or less. Similarly, in the *chemicals* sector, production declines across most OECD regions with the sharpest declines observed in Korea (-3%), Germany (-1%), and Japan (-1%).

Total output declines in the EU are smaller than the total decline in the OECD as a whole. In the EU, the fall in output by sectors range from -0.02% in the *ferrous metals* sector to -0.76% in the *motor vehicles and parts* sector. Small increases in output are seen in the *government* sector (public administration, defense, education, and health and human services), *agriculture*, *other manufacturing*, *coal, oil and gas extraction*, *electronic equipment* and *textile and wearing apparel*. Production increases range from 0.02% (*government sector*) to 2.0% (*textile and wearing apparel*) (Figure 5.5 Panel B). Much of the output changes are driven by the changes in export demand but adjustments in the domestic factor and product markets as well as income effects are likely driving the changes in the *government* sector and less traded services.

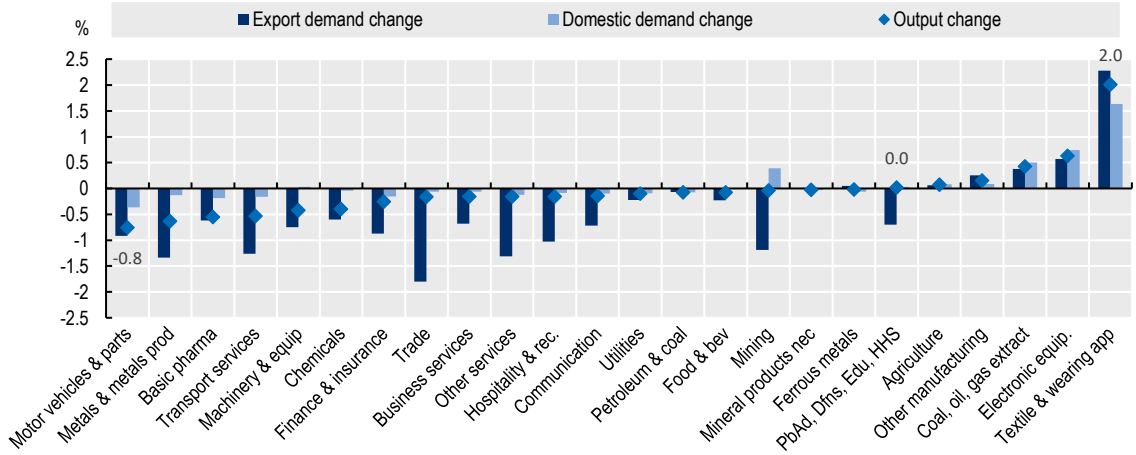
The *motor vehicles and parts*, *metals* and *metal products*, and *basic pharmaceuticals*, are the sectors with the strongest declines in output. France, Germany, and Sweden see the largest decline in motor vehicle production in relative terms (-1.1%, -1.0%, and -0.8% respectively). The rest of EU, accounts for almost all the decline in *metals* and *metal products* within the EU27 region. Sweden records the largest decline in *basic pharmaceutical* production in relative terms (-2%), but most of the decline in the EU27 region is accounted for by the rest of EU, Germany, France, and Italy.

Figure 5.5. Change in output, export and domestic demand

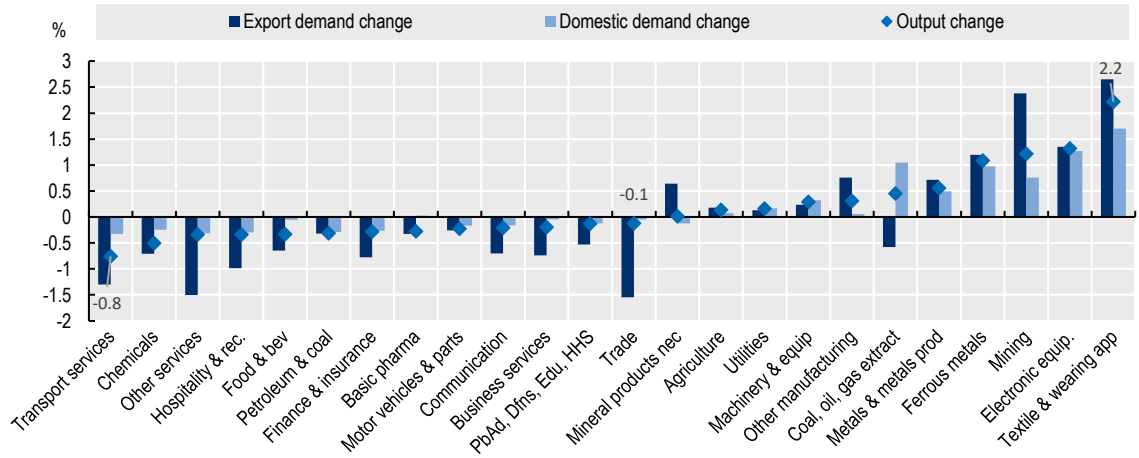
Panel A. OECD (total)



Panel B. EU27 (total)



Panel C. The Netherlands



Note: OECD and EU27 panels show the change in total output for the region.
Source: OECD METRO model.

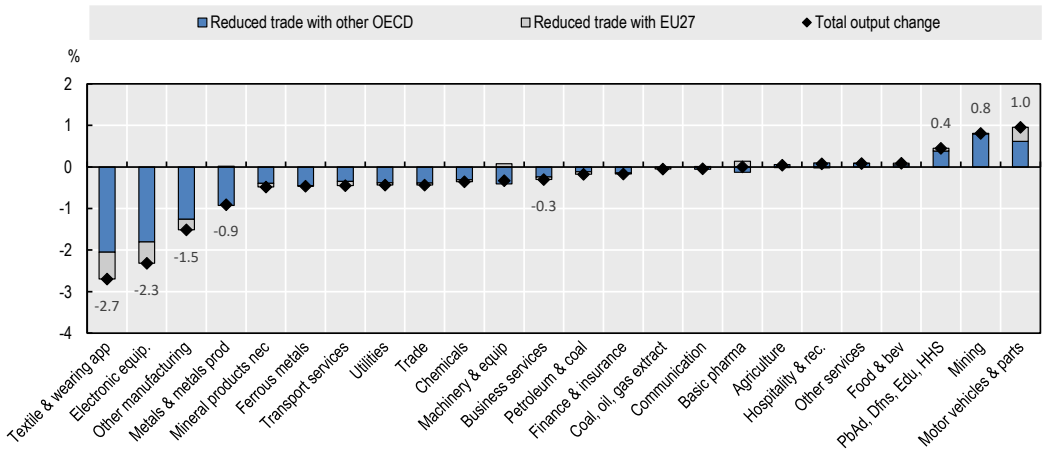
Total output in the Netherlands declines 0.13%, but due to strong increases in output of certain industries the average output change across the different sectors is slightly positive (0.15%). *Transport services*, *chemicals*, and *other services* see the strongest declines which range from -0.8% (*transport services*) to -0.1% (*trade*) (Figure 5.5 Panel C**)**. Production declines in all but one services sectors, *utilities*, with output in the *transport services* falling the most as reductions in world trade reduces the demand for shipping and transport services. Sectors with strong production increases see an increase in both export and domestic demand with generally a stronger demand in exports — the exception being *electronic equipment* and *coal, oil and gas* where in the latter domestic demand plays a larger role.

5.2.3 Impact on sectoral output in China and other MNOEs

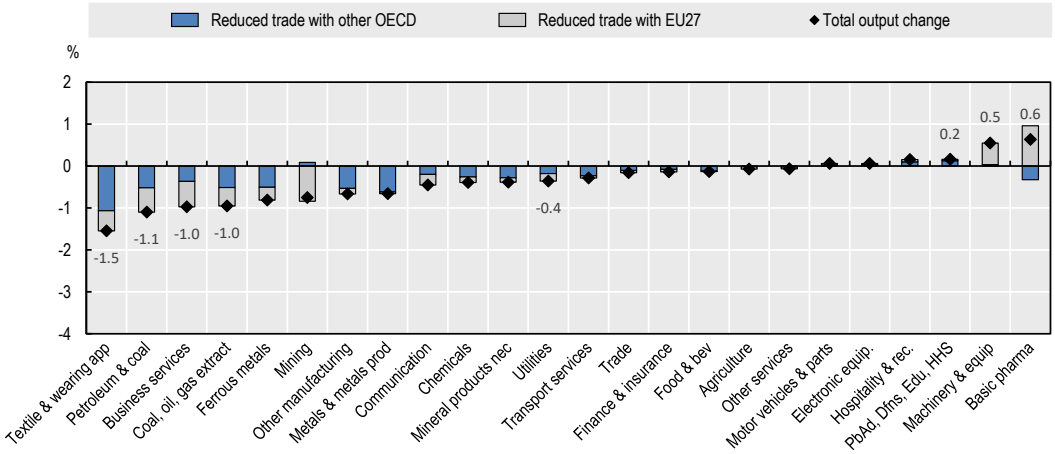
Reduced trade between OECD and MNOEs also has a negative impact across most sectors in China as well as in the other MNOE regions which highlights the fact that dependencies go in both directions. Manufacturing sectors in China particularly *textiles and wearing apparel*, *electronic equipment* and *other manufacturing* are affected the most declining between 1.5% and 2.7% in the simulation (Figure 5.6 Panel A). These sectors also seem to be the most dependent on the EU27 compared to other sectors as reduction of trade between MNOEs and EU27 adds about half a percentage point to the decline.

Figure 5.6. Output in most sectors in China and other MNOEs decline as a result of reduced trade with OECD countries

Panel A. China



Panel B. Other MNOEs (total)



Note: Decomposes the impact of sectoral output in China when MNOEs reduce trade with EU27 Members versus other OECD countries. Other MNOE Panel (B) presents the change in total output across countries in that region.
Source: OECD METRO Model.

Total output changes in the other MNOE region show a similar pattern. Output in many sectors decline, but the mix of most impacted sectors differ from those in China reflecting the heterogeneity in the industrial structure of the MNOE region as a whole. In addition to *textile and wearing apparels,* primary sectors such as *petroleum and oil* as well as *coal, oil and gas extraction* also experience a decline in production in the MNOE region aggregate that does not include China (Figure 5.6 Panel B)*. Business services* is among the top three of the most affected sectors for the other MNOE group, where India accounts for most of the decline (Annex Table 8.2). Dependence with the EU27 is also notably stronger among the other MNOE region than with China.

5.2.4 Industry exposure to OECD trade reduction with China

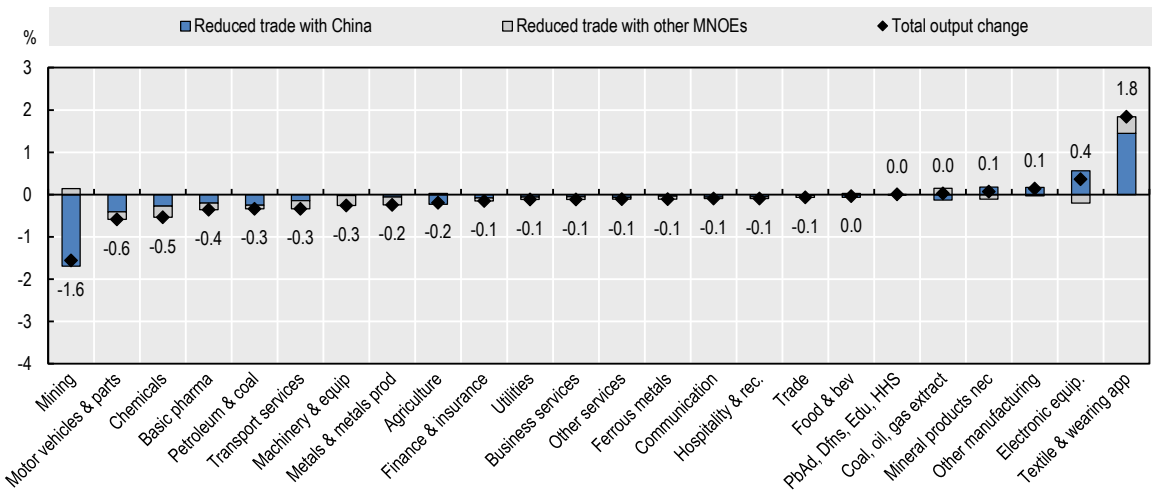
Supply chain disruptions during COVID-19 exposed the potential vulnerability of global value chains to bottlenecks and supply failures related to an industry's dependency on a limited number of suppliers. China's dominance and importance in global supply chains makes a convincing case for examining an industry's exposure to reduced trade with China and how a supply disruption could affect its output. Using an additional set pf trade scenarios where each of the OECD countries is assumed to reduce by 10% trade only with China (or any other individual member of the MNOE grouping), it is possible to identify which sectors in which regions are more exposed to trade with China (or, equivalently, any other individual member of the MNOE grouping).

The exposure of sectoral output to Chinese trade differs across regions and sectors (Figure (5.7). For the OECD region as a whole, reduced trade with China drives the output changes in many sectors particularly those with the largest changes — *mining*, *motor vehicles*, *electronics equipment*, and *textiles and wearing apparel*. Similarly, for the European Union and the Netherlands, many sectors are also exposed to trade with China, including *motor vehicles*, *electronics equipment*, and *textiles and wearing apparel* but also the *food and beverage sector*. However, for some industries other MNOEs are also relevant – for example the *mining* sector, where Brazil is an important trading partner of the EU. In the Netherlands, other MNOEs are important in sectors like *petroleum and coal* and *utilities* (which includes electricity and the distribution of manufactured gas through pipelines) where Russia is an important supplier and the *chemicals* sectors where the share of total imports from Indonesia, India and Russia account for account for as much as the imports from China at base levels (the starting point of the simulation).

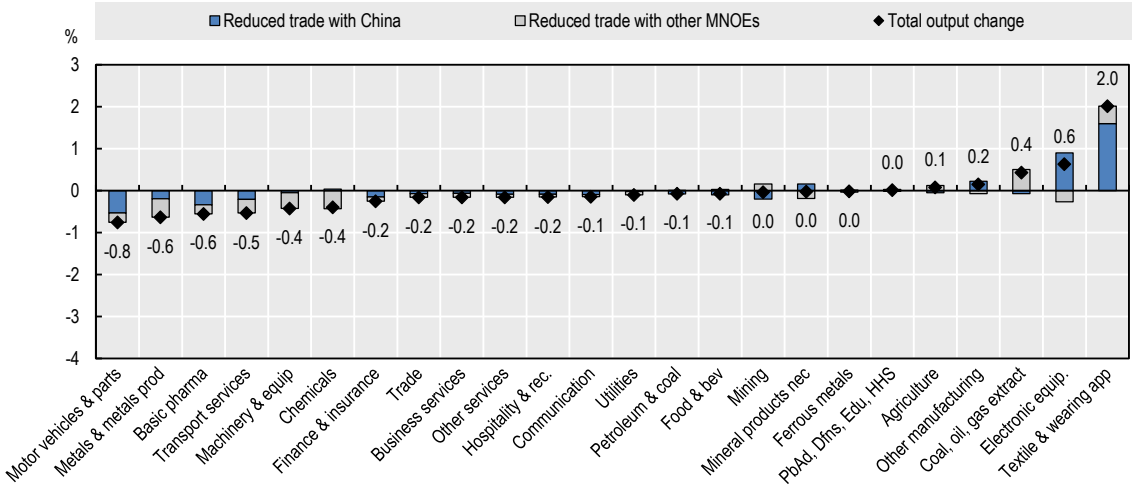
For certain key sectors such as m*otor vehicles and electronics equip*, exposure to China drives some, if not most, of the output changes. Supply failures or other market shocks in these sectors could have economy-wide implications should trade with China be reduced.

Figure 5.7. Sectoral output's exposure to reduced trade with China varies across regions

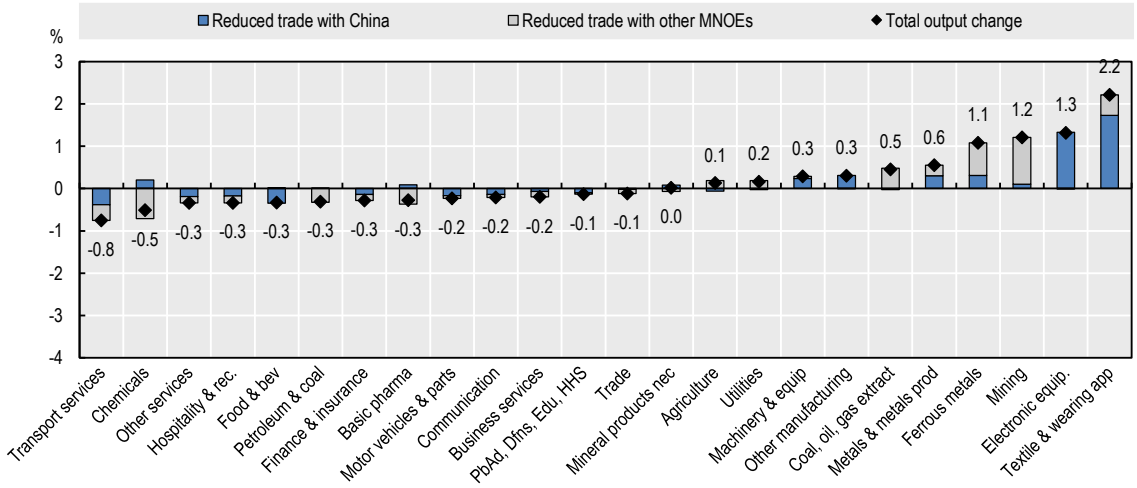
Panel A. OECD region



Panel B. EU27



Panel C. The Netherlands



Source: OECD METRO Model.

5.2.3. Exposure to OECD trade reduction with China of 'strategic' sectors

This section identifies the sectors that are most exposed to reductions in trade of key commodities between the OECD and China. By running different scenarios that reduce trade between the two regions in only one specific 'strategic' sector at a time, it is possible to decompose the effects of each sector scenario on an industry's production.

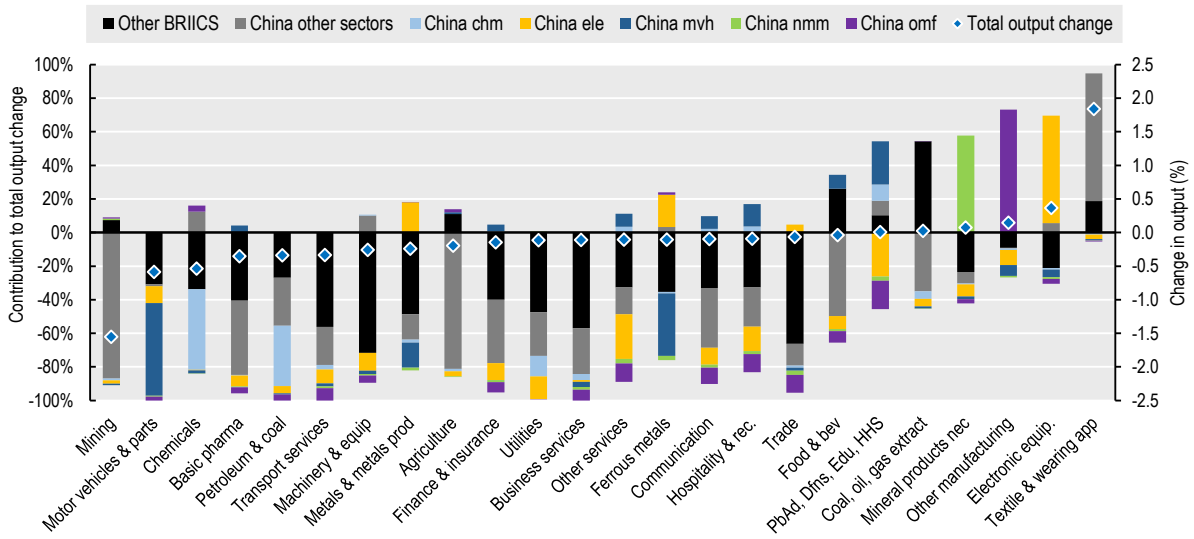
This analysis focuses on 'strategic' sectors which are defined similarly to strategic products in the detailed trade data analysis in Chapter 3.[47] The analysis focuses on sectors such as *chemicals*, *electronic equipment*, *motor vehicles*, *mineral products*, *other manufacturing* and attempts to ascertain how changes

[47] The definition of strategic sectors in the analysis of Chapter 5 is based on strategic manufacturing sector (ISIC Rev 4 definition) identified in the World Economic Outlook, April 2023: A Rocky Recovery (imf.org) (IMF, 2023[18]). The ISIC Rev 4 codes are then mapped to GTAP sectors using an HS 6-digit codes correspondence as an intermediary step (and the HS codes used here are the same as the ones used for defining strategic products in Chapter 3). Non-energy GTAP sectors where at least 25% of corresponding HS6 codes were mapped to a strategic ISIC rev 4 code were selected for this exercise. Other manufacturing was also included despite not meeting this threshold.

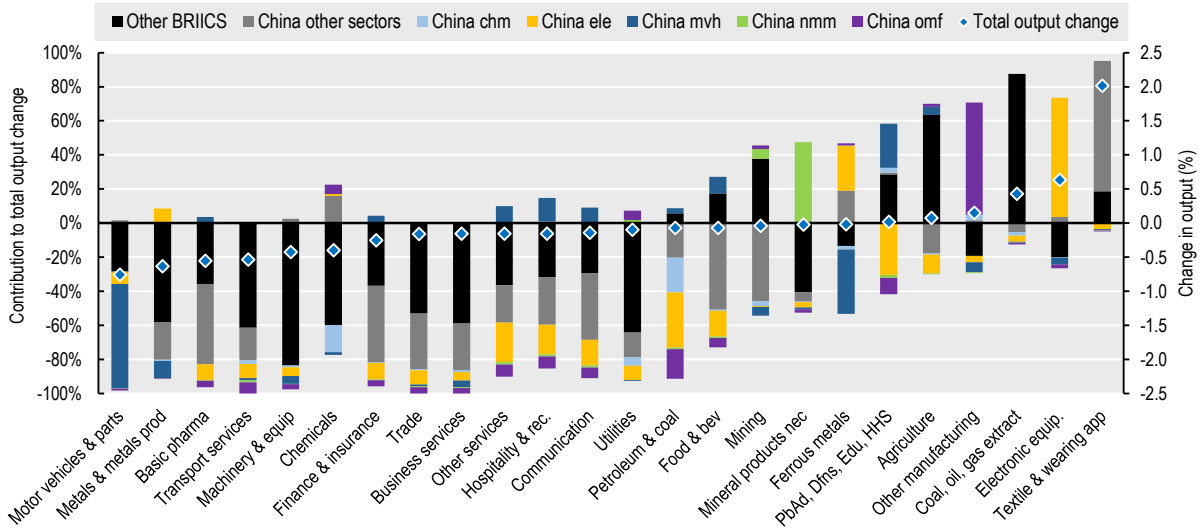
in the trade of one of these strategic sectors might affect the production of others. Using these scenarios in conjunction with the main scenario of trade reduction of all sectors between OECD and MNOEs as well as OECD and China we can identify how much of the production change can be attributed to changes in trade of a strategic sector with China versus other sectors or other MNOE partners. Moreover, by scaling the proportion of change attributed to each simulation to 100 for all sectors, it is possible to compare the relative exposure of each industry to a given strategic sector. This decomposition is presented if Figure 5.8 for the OECD (Panel A), as well as for the EU27 and the Netherlands (Panels B and C respectively).

Figure 5.8. Output change and exposure to OECD strategic sector trade with China

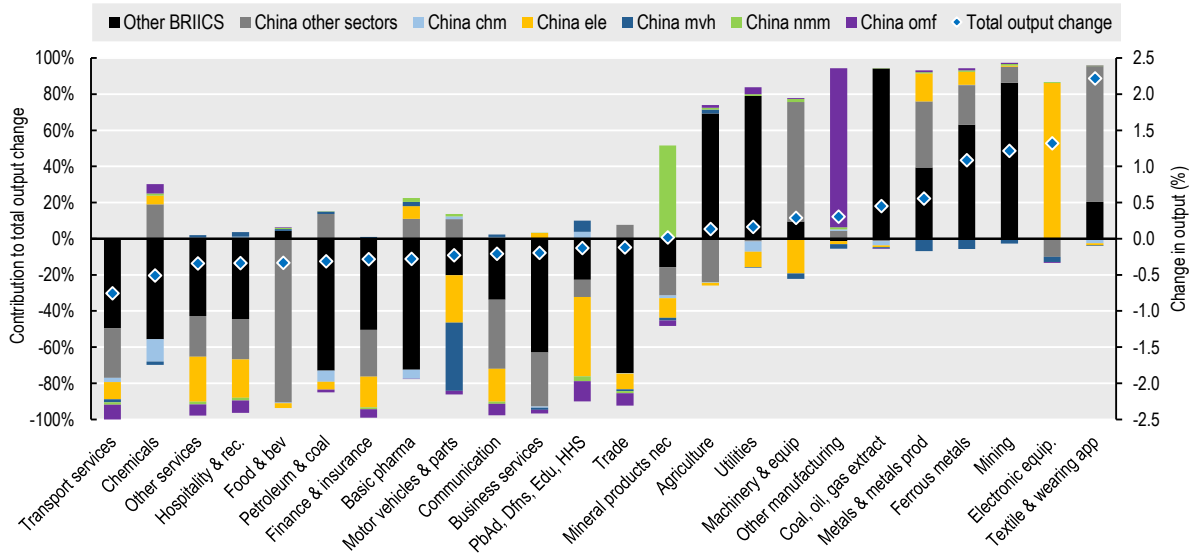
Panel A. OECD



Panel B. EU27



Panel C. The Netherlands



Source: OECD METRO Model.

Not surprisingly the direct effect of reducing trade of a strategic sector accounts for the largest share of change in that sector, be it positive or negative (within the OECD as well as the EU27 region). OECD reducing trade with China of mineral products, other manufacturing, and electronics equipment increase production in each sector respectively due to increase in both domestic and export demand (as in *mineral products* and *other manufacturing*) or increases domestic consumption (*electronics sectors*). Reducing *chemicals* and *motor vehicles* trade with China has negative effects on those sectors due to both reduced domestic and export demand.

Among the five different strategic sectors, OECD reducing *electronic*s, *motor vehicles*, *and other manufacturing* trade with China has a more widespread affect across other industries compared to more upstream sectors such as *chemicals* and *minerals* which have more specialised uses – e.g. chemicals are used in the petroleum and coal sector, but not necessarily in hospitality, or at least not to the same extent. This is true within the OECD as a whole as well as the EU27.

For the Netherlands, the direct effect of reducing trade with China of a strategic sector accounts for the largest share of the change in output of that industry as was found to be the case of for the OECD as a whole and for EU27 (Figure 5.8 Panel C). OECD reducing trade in the *electronics equipment* and the *other manufacturing* industry with other MNOEs accounts for almost all the increase in production of those sectors. The exception is for the *chemicals* sector, where Indonesia, Russia, and India are also important sources of imports in addition to China. While the production of *motor vehicles and parts* sector in the Netherlands is predominantly affected by the reduction of the sector with China, it is also negative impacted by the reduction trade with China of *electronics equipment*. In fact, the reduction in *electronics equipment* trade with China (yellow bars in the chart) has negative impact across most sectors, except the industry itself, where less trade with China increases Dutch production in this sector. Reductions in trade of *other manufacturing* with China (purple bars) affects a larger set of industries compared to the minerals or chemicals sectors.

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itself, where less trade with China increases Dutch production in this sector. Reductions in trade of *other manufacturing* with China (purple bars) affects a larger set of industries compared to the minerals or chemicals sectors.

Table 5.1. Sectors indirectly affected by the reduction in trade between OECD and CHN

By strategic sectors, The EU27

Sectors where trade is reduced between OECD and China				
Chemicals	Electronic equip.	Motor vehicles & parts	Mineral products nec	Other manufacturing
Mining (-) Other manufacturing (+) Petroleum & coal (-) Mineral products nec (-) Ferrous metals (-) PbAd, Dfns, Edu, HHS (+)	Agriculture (-) Mining (-) Food & bev (-) Other manufacturing (-) Petroleum & coal (-) Basic pharma (-) Mineral products nec (-) Ferrous metals (+) Metals & metals prod (+) Motor vehicles & parts (-) Utilities (-) Trade (-) Hospitality & rec. (-) Transport services (-) Communication (-) Finance & insurance (-) PbAd, Dfns, Edu, HHS (-) Other services (-)	Agriculture (+) Mining (-) Food & bev (+) Other manufacturing (-) Mineral products nec (-) Ferrous metals (-) Metals & metals prod (-) Electronic equip. (-) Hospitality & rec. (+) Communication (+) PbAd, Dfns, Edu, HHS (+) Other services (+)	Mining (-) PbAd, Dfns, Edu, HHS (+)	Mining (+) Food & bev (-) Petroleum & coal (-) Chemicals (+) Mineral products nec (-) Ferrous metals (+) Utilities (+) Hospitality & rec. (-) Transport services (-) Communication (-) PbAd, Dfns, Edu, HHS (-) Other services (-)

By strategic sectors, The Netherlands

Sectors where trade is reduced between OECD and China:				
Chemicals	Electronic equip.	Motor vehicles & parts	Mineral products nec	Other manufacturing
Petroleum & coal (-) Basic pharma (-) Mineral products nec (-) Utilities (-)	Chemicals (+) Basic pharma (+) Mineral products nec (-) Ferrous metals (+) Metals & metals prod (+) Machinery & equip (-) Motor vehicles & parts (-) Utilities (-) Trade (-) Hospitality & rec. (-) Transport services (-) Communication (-) Finance & insurance (-) PbAd, Dfns, Edu, HHS (-) Other services (-)	Mineral products nec (-) Metals & metals prod (-) PbAd, Dfns, Edu, HHS (+)	(none)	Chemicals (+) Mineral products nec (-) Trade (-) Hospitality & rec. (-) Transport services (-) PbAd, Dfns, Edu, HHS (-)

Note: Each column lists the sectors where share of the output change coming from the reduce trade of sector listed in bold is larger than 7% of the size of total change. The cutoff, 7%, is the average share across all indirect output changes in the EU27 and Netherlands respectively. Indirect changes are those resulting for a shock of another sector. Direct changes are not listed in the table. (-) production declines. (+) production increases.
Source: OECD METRO Model.

Table 5.1 uses the underlying data behind Figure 5.8 Panels B and C and identifies industries where the proportion of change in each strategic sector is greater than the average across sectors in the EU27 and Netherlands respectively. Since the direct effect (reducing trade of the industry itself) often accounts for the largest share of the output change in the industry, the table includes only indirect effects.

Several observations can be made. The indirect sectoral exposure to the five different strategic sectors is not as prevalent in the Netherlands as it is in the EU as a whole (Table 5.1). More Dutch industries are exposed to reduced trade of *electronics equipment* than the other four strategic sectors (positively or negatively). Most of the sectors not affected by trade reductions in *electronics equipment* from China are in more upstream industries (*agriculture*, *mineral and oil extraction*, *food and beverages* and *textiles and wearing apparel* to name a few). Dutch sectors exposed to trade with China in products of the other manufacturing are almost all negatively affected. Production declines concerns several services sectors (*trade*, *hospital*, *transport services*, and *government services*).

5.3 Conclusions from the CGE analysis

This chapter uses the OECD CGE trade model METRO to assess the impact of reducing trade between the countries in the OECD and several major non-OECD economies (MNOE). Similar to ICIO analysis of the previous chapter, a 10% reduction in all trade flows between countries in the two groupings is applied. The CGE approach complements the ICIO analysis by extending the analytical time frame in order to analyse the economic impact over the medium term allowing time for product and factor markets to adjust, and substitution of intermediate inputs and output markets to have occurred. As such the magnitude of the impact in the CGE analysis is not as strong. Nonetheless, the two approaches generally draw the same conclusion that OECD and MNOE countries do not benefit from the scenario, and they give broadly similar rankings of the most and least affected countries.

At a macro level, the range of the impacts on real GDP vary across regions with few countries benefiting from the reduced trade scenario. OECD countries with stronger trade linkages with MNOEs, particularly those in the Asia and Pacific region, are affected the most negatively among OECD countries. OECD countries in North America are significantly less affected due to less direct exposure to MNOEs and to market gains domestically and abroad especially as OECD partners replace supplies from MNOEs. EU countries are moderately affected by the trade reduction, with Germany and the Netherlands relatively more exposed than other EU Members. The MNOE countries tend to be affected even more negatively and Russia and China are among the most adversely affected countries across all regions due to their dependence on OECD markets and inputs.

The trade exposure of sectors within each region also varies due to the nature of the trade relationship between regions as well as each country's trade specialisation. With a few exceptions, production declines in most sectors in the OECD as a whole are driven mainly by reductions in export demand with *mining*, *motor vehicles*, and *chemicals* sectors as the hardest hit sectors. Production in some sectors in the OECD region increase, namely the *textile and wearing apparel*, *electronics equipment*, *other manufacturing* and *mineral* sectors, helped by both by import substitution as well as an increase in intra-OECD trade when OECD trade with MNOEs is reduced. However, these sectoral output gains should be seen in the context of economy-wide effects which are negative for most OECD countries.

Reduced trade between the two groupings also has a negative impact across most sectors in China and in the other MNOE countries highlighting the fact that trade dependencies go in both directions. Manufacturing sectors in China particularly those which see an increase in intra-OECD trade (*textiles and wearing apparel*, *electronic equipment* and *other manufacturing*) are hit the hardest. Output declines are also detected in many sectors of the other MNOEs, but the rankings of sectoral affects differ reflecting the heterogeneity in the industrial structures within this country group.

Moreover, reductions in trade with China in key sectors can have spillover effects in other sectors of the economy and the exposures to different key sectors are not equal. For example, reducing trade with China in *electronics*, *motor vehicles*, and *other manufacturing* products has a more widespread effect across other industries compared to trade in products of more upstream sectors such as *chemicals* and *minerals* which have more specialised uses. This is true within the OECD as a whole as well as the EU27. For some sectors in some regions there is more exposure to trade with other MNOEs. For example, in the Dutch chemicals sector, Indonesia, Russia, and India are also important sources of imports in addition to China.

The CGE results illustrate the mutual nature of trade. Reducing trade flows between the countries in the OECD and MNOE groupings exhibits economic costs even in the medium term. Some of the negative effects of decreased access to intermediate inputs and markets are mitigate by increase intra-OECD trade but not enough to eliminate a decline in overall or sectoral output.

6. Conclusions and implications

The results of this analysis illustrate some of the concerns that lie beneath the debate in on trade dependencies in the context of increasingly uncertain global economic and geopolitical environments. As documented in this report, global production of products has become increasingly concentrated, and it tends to be increasingly clustered around some countries and regions, notably China and Asia. This is not only due to natural or organic economic factors, such as natural endowments, comparative advantage, economies of scale, or GVC fragmentation, but also policies. Whichever is the principal source of growing concentration, shocks related to climate change, changes in economic policy or geopolitical conflicts, arguably have a higher potential to disrupt commercial links and cause economic or societal damage now than they had in the past. There is also more potential for trade to be used as a tool of economic coercion.

Having said that, the evidence presented also shows that large, if not dominant, portions of global and national trade are relatively well diversified overall, and that international product markets are characterised by a fair amount of competition and limited control over supply or price formation of specific importers or exporters. It is difficult to distinguish those concentrated trade links that could cause problems from advantageous trade linkages. Concerns that policy responses which aim to minimise trade risks and improve supply chain resilience may not be well designed and may unnecessarily undermine the benefits of international trade are therefore legitimate.

Countries typically source their imports from—and ship their exports to—fewer partners than is in principle globally possible. This reflects a combination of natural factors, such as the role of geography and trade costs, but also national preferences and policies. There is thus untapped potential in using international markets to diversify. In fact, our findings suggest that a significant number of OECD countries have been able to take advantage of diversification possibilities offered by international markets, as testified, for example, by declining average rates of import concentrations and bilateral import dependencies. In this sense, trade dependency does not seem to be a generalised phenomenon, but it is rather constrained to some specific countries and products.

Which trading partners are the main counterparts in the highly concentrated trade linkages has indeed been raised as one of the key issues in the trade dependency debate. This is a legitimate approach because geographic, economic and geopolitical risks are often related to the country affiliation or location of trading partners. Here, too, some of our findings support a cautious approach to concentrated trade relations, while others are more reassuring.

Dependency on China has increased significantly across all OECD regions since the late 1990s and the country is now the single most important counterpart in trade dependencies of OECD as a whole and of several OECD countries individually. There is thus interest in a better understanding of the reasons for the emergence of China as a source of dependencies. In particular, the contributions of natural and policy-related factors, including policies which may have involved market distortions or targeted non-economic objectives, need to be better understood.

Trade dependencies of OECD economies on China also need to be put in the context of China's dependencies on OECD. OECD as group — and several OECD countries on their own — are a much more important counterparts in dependencies of China. Moreover, China's sectoral dependencies involving OECD countries include several industries in which several OECD countries also depend on China, which signals the mutual character of some trade dependencies.

The current debate on 'de-risking' international trade needs to consider carefully for the possible costs and benefits of different policy choices. The different methodologies used to produce evidence unanimously demonstrate a relatively high degree of trade interdependency between the OECD and MNOE countries (and especially between OECD countries and China) as well as potentially high economic costs of significant trade fragmentation. OECD countries in Asia and Pacific come across as bearing the highest cost of fragmentation, followed by Europe (where Germany and the Netherlands are affected more than on average), while OECD countries in North America record lower impacts. MNOEs, including China, tend to be affected relatively more than the OECD.

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8. Annexes

8.1. Annex to Chapter 3. Trade data analysis

8.1.1. Measuring trade concentration as an approach to identifying trade dependency

The idea behind identifying trade dependencies on the basis of high bilateral trade shares is that it is likely to be more difficult to find alternative partners in cases of disruptions of relatively large trade flows (i.e. those which account for high shares of exports or imports of a given product). In addition, when alternatives cannot be found, these disruptions may be relatively more economically harmful than disruptions to flows which are small. At the same time, individual bilateral trade flows should be interpreted in the overall market context and it is likely that the higher the overall concentration of trade across all partners the more difficult it may be to substitute toward alternative partners.

While using the combined share and concentration criteria is intuitive, there are no strong theoretical indications as to what specific measures and thresholds should be used to appropriately separate trade dependencies from normal trade flows. This chapter follows several recent studies which make use of the Herfindahl-Hirschman Index to measure concentration (HHI thereafter).

HHI is calculated as the sum of squared market shares and lies between 1/*n*, when all of the *n* suppliers have equal shares, and one, in a monopoly. For example, a value of 0.2 for the HHI would be obtained[48], if there were only five suppliers and each of them supplied an equal share of 20%, while a value of 0.1 would be obtained if there were ten suppliers with equal shares of 10%. There are no objective thresholds for values of HHI which clearly delineate low and high concentration, but some indicative thresholds have been used in applied work. The US Department of Justice and US Federal Reserve, for example, consider markets with a HHI between 0.15 and 0.25 to be moderately concentrated and markets with HHI equal to or more than 0.25 to be highly concentrated[49], although, as is discussed further in this chapter, interpretation of the values of this index is necessarily somewhat arbitrary and should ideally be accompanied by a more detailed contextual analysis.

To paint a comprehensive picture of trade concentration and trade dependency, the chapter analyses the values of HHI for different levels of trade, including global and national concentrations of exports and imports. It also demonstrates how the information on global and national concentrations can be combined to determine cases of 'excessive' national concentration. Finally, the main part of the analysis assesses the global distributions of bilateral trade flows in terms of the trade shares and concentration ratios they are associated with. On this basis, the analysis subsequently defines the candidates for bilateral product-level dependencies as bilateral trade flows accounting for 10% or more of the value of overall national imports or exports of a specific product and for which the overall national imports or exports are relatively highly concentrated across the trading partners (HHI of 0.2 or higher, see Section 3.5). The analysis then zooms in on the possible cases of dependencies and identifies partners which account for large portions of these dependencies to characterise the geographical structure of bilateral trade dependencies and its evolution in time.

There are several qualifications associated with this approach which should be mentioned at the outset. The ability to diversify suppliers may depend on several factors which may be not well captured by trade shares and trade concentration measures. These factors may be related to the different economic sources of concentration as well as natural and technological characteristics of products and markets. For example, while comparative advantage and specialisation are expected to result in concentration, these concepts in themselves do not imply difficulty of substitution (i.e. the notion of comparative advantage and specialisation is consistent with competitive markets and flexible market entry). The ability to substitute is also determined by the time frame considered and product-specific technology and innovation outlooks (i.e. over the long term the possibility of substitution by technological innovations is greater than in the

[48] This is an example as in reality many different constellations of unequal market shares can yield a given HHI value.

[49] See https://www.justice.gov/atr/herfindahl-hirschman-index.

short and medium term). This is why some quantitative studies of trade dependencies are sometimes accompanied by consultations with engineers and industry experts (European Commission, 2021[39]).

The level of aggregation at which the analysis is conducted is also a potential constraint. Most products are highly differentiated by a myriad of characteristics which determine uniqueness and substitutability. This heterogeneity may not be well captured even by the relatively disaggregated trade data used in this chapter. For example, uses of lithium extracted from salt-flat brines through a process of evaporation and chemical recovery (e.g. for batteries) are different from those for lithium extracted from lithium-bearing ores, such as spodumene, through a process that involves crushing, roasting and acid leaching. To the extent that different types of lithium are classified in the same statistical trade classification even small amounts of one type of lithium can be difficult to substitute for others. This is the case not only for different grades and specifications of other raw materials but also commodities (e.g. different types of cereals used for food production and for industrial uses), as well manufacturing products (e.g. different electronic chips used in different electronic products).

There are also limitations to the fact that this analysis uses gross trade data and therefore does not account for where the value added embodied in the imports actually originates, or for the extent to which imports are actually retained or used for exports or further processing in other countries. In a world of long and complex international supply chains, the weakest link can sometimes determine the vulnerability of the whole chain. The methodology also abstracts from how much is actually produced and consumed in the importing countries and whether trade links concern intra or extra-firm trade flows. This approach can therefore miss some dependencies while overstating others. The other approaches used in subsequent chapters of this study—the OECD's Inter-Country Input-output and Trade in Value Added (TiVA) data (Chapter 4) and the CGE analysis (Chapter 5)—are used to correct some of these shortcomings and arrive at a more comprehensive assessment.

Defining bilateral trade dependencies

Recall that, for each product imported (exported) by a country, the HHI measures the concentration of imports (exports) across all the partners by summing up the squared values of all bilateral trade shares. At one extreme, when the product is imported from (exported to) only one country the value of bilateral share is the same as the value of HHI. At another extreme, when there is a large number of partners, each of them with a small share close to zero, the value of HHI is also converging to zero. In between these extremes, there may be cases with relatively high bilateral trade shares which are associated with relatively low HHI values (i.e. if there are many other partners with relatively low shares). Similarly, some insignificant bilateral trade shares may contribute little to high readings of HHI driven by high shares of other partners.

It can be therefore argued that both the bilateral share and HHI as a measure of overall concentration contain relevant information and should be considered as joint criteria for 'dependency' on a specific partner. A high bilateral trade share with a given partner may be not problematic in terms of the ability to substitute away if there are many other partners (which would be consistent with a low or moderate HHI). A low bilateral share, in turn, even in the presence of overall high concentration, indicates that the specific partner does not contribute much to this concentration and that therefore this particular link is not problematic.

In this context, bilateral dependencies have been defined in this Chapter as bilateral trade flows at HS6 level of product classification that meet the following joint conditions:

1. The gross imports (exports) of the given product (at the HS6 level) are overall highly concentrated (**concentration criterion, country-level imports (exports) HHI>=0.2**).
2. The import from (export to) a specific partner accounts for a relatively high share of the country overall imports (exports) of the product (**bilateral share criterion, bilateral share>=0.1**).

The choice of specific thresholds that were used to operationalise the above criteria (bolded out above) remains somewhat arbitrary, but it had been supported by an analysis of the global distribution of trade along the different values of HHI and bilateral trade shares. Bilateral imports which jointly meet the two criteria account for 1% of all active bilateral links and for 46% of the value of world trade. It can be therefore concluded that they constitute a relatively conservative filter for identifying potential dependencies. These conservatively identified candidates for dependencies can be explored further in more details, including by looking at the implicated products, trading partners and firms.

8.1.2. Definition of 'strategic' products following the Atlantic Council and the International Monetary Fund approach

A list of strategic products adopted in this chapter follows the study of fragmentation of FDI by (IMF, 2023[18]) which had built on a list of sectors designated as strategic in study by the Atlantic Council (Tran, 2022[40]) and mapped these sectors to 3-digit of the International Standard Industrial Classification of all economic activities (ISICs), resulting in a list of 17 different sectors. The same study by (IMF, 2023[18]) also used data from quarterly earning calls from NL Analytics (paid data source based on Hassan et al., 2019) to identify 3-digit ISIC industry groups in manufacturing and mining mentioned the most in these earning calls (top 3 deciles) along with-reshoring related terms (2017-2022), adding four additional sectors. A list of HS6 codes (as well as GTAP classification sectors) associated with these ISIC industries was created for the purposes of this study. The HS6 code version of the list was used for separating out and the calculations associated with the 'strategic' products.

List of 4-digit ISIC rev. 4 'strategic' industries included in analysis

ISIC rev 4 description	ISIC rev 4 description
Cutting, shaping and finishing of stone	Manufacture of motor vehicles
Manufacture of articles of concrete, cement and plaster	Manufacture of office machinery and equipment (except computers and peripheral eqpmnt.)
Manufacture of basic chemicals	Manufacture of other general-purpose machinery
Manufacture of bearings, gears, gearing and driving elements	Manufacture of other non-metallic mineral products n.e.c.
Manufacture of cement, lime and plaster	Manufacture of other porcelain and ceramic products
Manufacture of clay building materials	Manufacture of other pumps, compressors, taps and valves
Manufacture of coke oven products	Manufacture of ovens, furnaces and furnace burners
Manufacture of consumer electronics	Manufacture of pharmaceuticals, medicinal chemical and botanical products
Manufacture of domestic appliances	Manufacture of plastics and synthetic rubber in primary forms
Manufacture of electronic components and boards	Manufacture of power-driven hand tools
Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	Manufacture of refractory products
Manufacture of fertilizers and nitrogen compounds	Manufacture of watches and clocks
Manufacture of fluid power equipment	Mining of other non-ferrous metal ores
Manufacture of lifting and handling equipment	Mining of uranium and thorium ores
Manufacture of measuring, testing, navigating and control equipment	Support activities for petroleum and natural gas extraction

8.1.3. Discussion of criteria used for measuring bilateral trade dependencies

The choice of specific thresholds that can be used to operationalise the above criteria has been necessarily somewhat arbitrary. In particular, while exposures to specific trade partners—as captured bilateral trade shares—have straightforward interpretation, it is not clear above what specific threshold the shares can be usefully deemed overly high. Similarly, there are no strong international trade theory or empirical research-based indications as to what threshold can be used for the HHI to detect overly concentrated trade.[50]

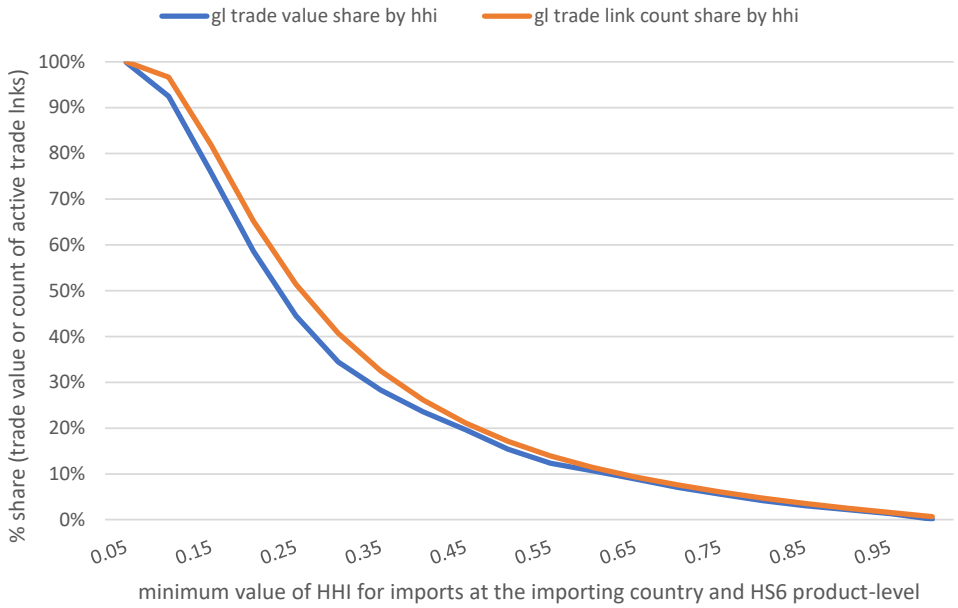
Some appreciation of the significance of values of different concentration thresholds can be gained from the analysis of distribution of global trade along the values of theses concentration measure. For example, Annex Figure 8.1, Panel A shows that that bilateral imports of products for which imports are relatively highly concentrated (import HHI of equal or higher than 0.20) account for more than 51% of the number of all globally active HS6 product-level bilateral trade links, and they account for more than 45% of the value of global imports. This means that, in line with the US Department of Justice and US Federal Reserve quantitative interpretation of the significance of HHI, around half of world imports can be seen as highly concentrated.

Annex Figure 8.1 Panel B on the other hand shows that most of active bilateral trade links account for relatively low shares in countries' imports. For example, only around 12% of active bilateral trade links at the HS6 product level are associated with a bilateral import share of 10% or higher. At the same time, these relatively rare trade links are relatively economically important as they account for 69% of the value of global trade. The relatively high value share of the relatively few bilateral trade relations at the product level is consistent with the relatively high level of concentration of imports at the country level.

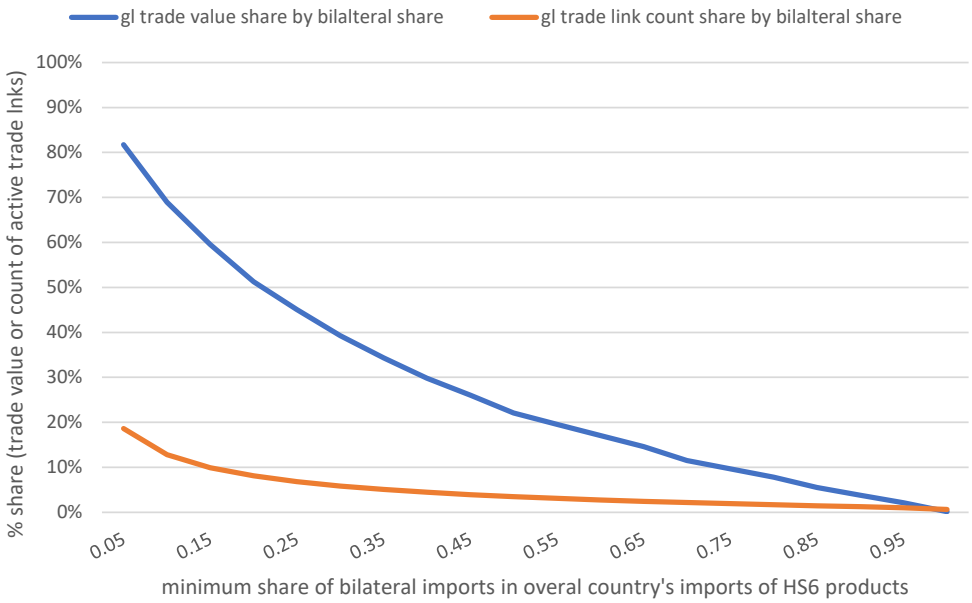
[50] There is the commonly referred to US Department of Justice/ US Federal Reserve interpretation (Section 3.2), but it is not clear how exactly it has been established.

Figure 8.1. Distribution of global imports by the size of bilateral import share and HHI

Panel A. HHI



Panel B. Bilateral trade share



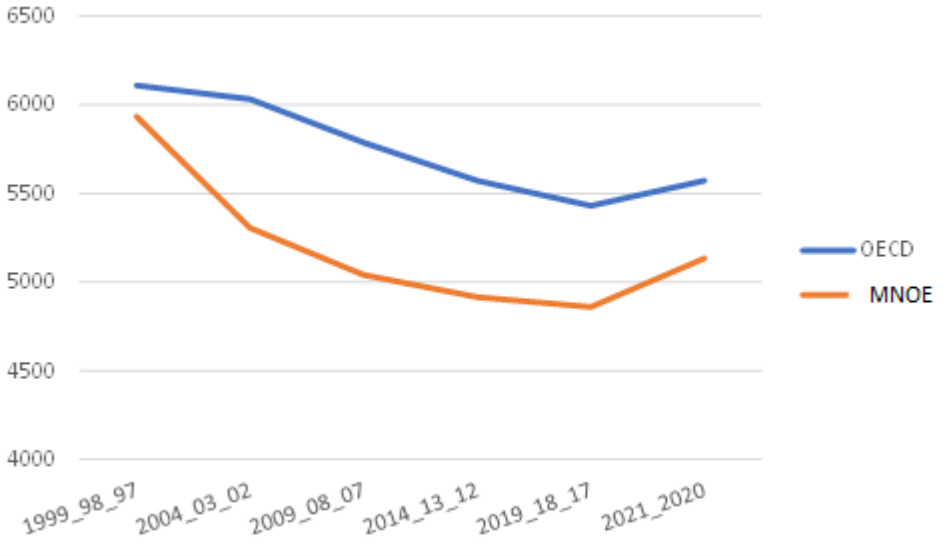
Source: OECD calculations using the BACI data.

8.1.4. Analysis of bilateral export dependencies – accompanying the analysis of bilateral import dependencies in Section 3.4.3

Both across the OECD and MNOEs, the average incidence of export dependencies declined between 1997-99 and 2017-19, and this process was more rapid for the MNOE grouping (Figure 8.2). However, both groupings experienced an increase in export dependencies in the COVID-19 pandemic period (2020-21).

Figure 8.2.Bilateral export dependencies have been falling in the OECD and MNOE grouping

Average number of bilateral export dependencies per country in each of the country grouping



Source: OECD calculations using the BACI data.

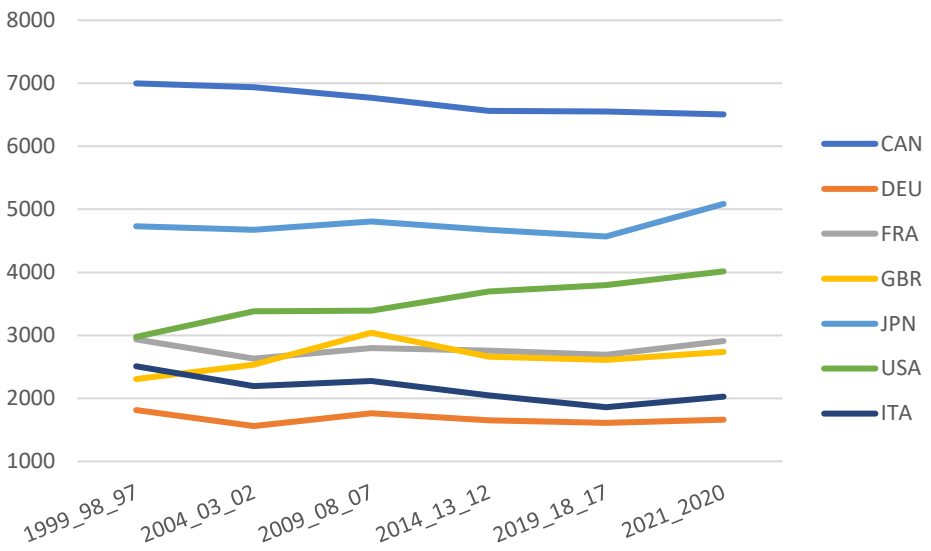
However, there were also large differences across different OECD and MNOE countries and not in all individual countries did the count of export dependencies decline in the main period. Among the G7 countries, Canada — the OECD country with the highest count of dependencies in the grouping — had more than four times more dependencies than Germany —t he country with the lowest count — although the count of Canada's dependencies has been gradually falling in the analysed period (Figure 8.3). The United States and the United Kingdom however saw their export dependencies count increase. We also see that, apart from Canada, dependencies increased for all other G7 countries in the COVID-19 period.

Among the other OECD countries covered in this exercise, most have seen export dependency counts decline in the main period. Poland experienced the most dramatic decline which is interesting in the context of its strong economic growth and export performance in this period. The Netherlands and Spain had been and still are the least dependent in this OECD sub-group. All the countries in this OECD sub-grouping grouping saw increases in dependencies in the COVID-19 period (Figure 8.4).

Among the MNOEs, Russia has had the most bilateral export dependencies since the beginning of the period and their level exceeded the dependency levels of the most dependent OECD countries. All the other MNOES reduced their export dependencies in the main periods, and these reductions were the most impressive for Brazil and China. In India, the declining trend has been reversed in the most recent period. In all MNOEs but China dependencies increased in the COVID-19 period (Figure 8.5).

Figure 8.3. There are different levels and trends in bilateral export dependencies in the G7 grouping

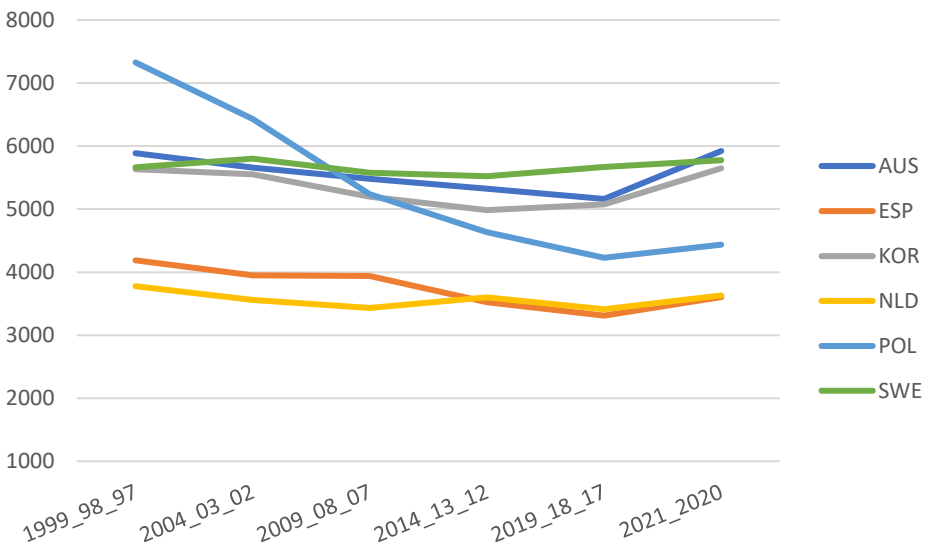
Number of bilateral export dependencies for each G7 country



Source: OECD calculations using the BACI data.

Figure 8.4. As well as in other OECD countries

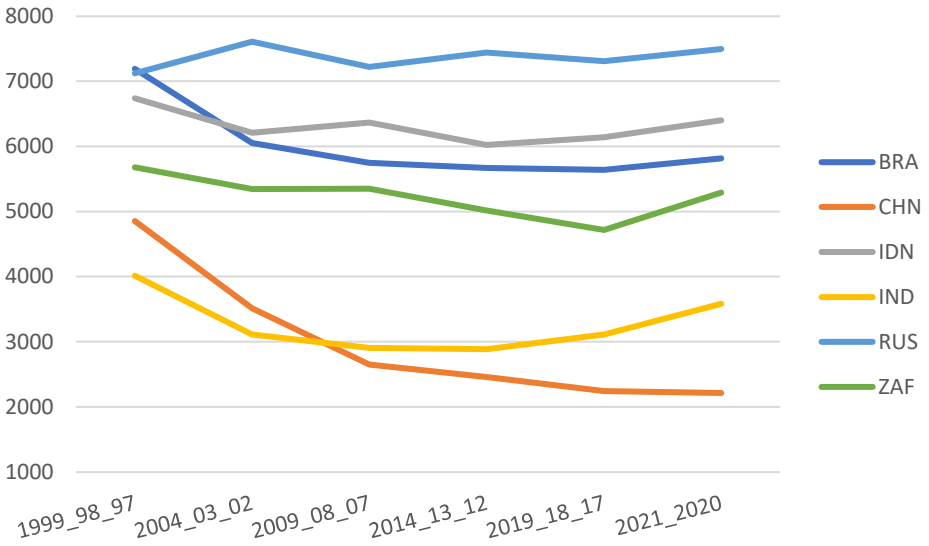
Number of bilateral export dependencies for each OECD country



Source: OECD calculations using the BACI data.

Figure 8.5. Export dependencies have been declining for MNOEs, apart from Russia

Number of bilateral export dependencies for each MNOE country

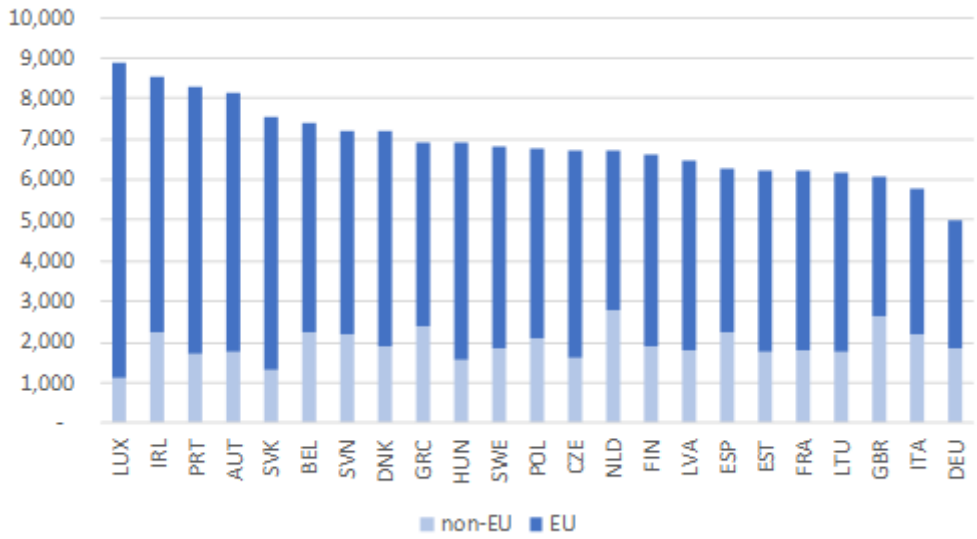


Source: OECD calculations using the BACI data.

8.1.5. Additional figures accompanying Chapter 3

Figure 8.6. Regional dimension of import dependencies across EU Members

Number of import dependencies across all products by region of exporter



Source: OECD calculations using the BACI data.

8.2. Annex to Chapter 4 The ICIO-TIVA Methodology

8.2.1. Scenario decomposition or running standalone hypothetical extraction scenarios?

The principal scenario is a set of the following five 'sub-scenarios': 1. OECD-CHN, 2. EU27-MNOE; 3. EU27-CHN; 4. USMCA[51]-MNOE; and 5. USMCA-CHN. Since the five scenarios are all nested within the principal OECD-MNOE scenario[52], we can construct $\mathbf{\Delta x}$ for scenarios 2-6 by decomposing the value of $\mathbf{\Delta x}$ obtained for scenario 1 as discussed above. The advantage of doing so is practical: since the decomposition is additive, the results from different scenarios can now be stacked on top of each other in a single chart which saves space and makes for easier visual comparisons.

Do the results from this scenario-decomposition approach differ from those we get from running a series of stand-alone scenarios? The short answer is no. The figure below plots the two sets of results against each other for the various scenarios. The differences are hardly detectable for 4 out 6 scenarios.

The only panels in which we do observe some differences are those involving the European aggregate. The differences here, however, are due not to the technique giving different results, but rather on the fact that we are comparing different shocks. The OECD Europe shocks include the UK but omit Romania, Bulgaria, Cyprus,[53] and Malta. The reverse is true of the EU27 shocks.

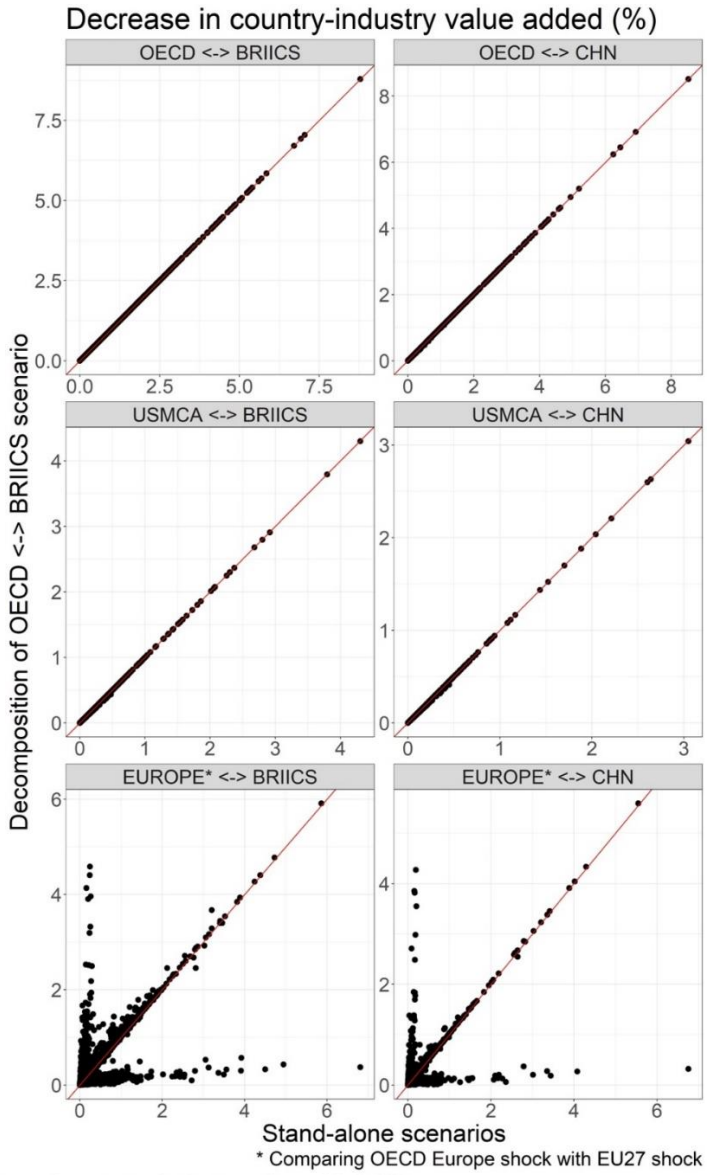
In practice, however, the points that depart from the equality line are those that relate to the UK, Romania, Bulgaria, Cyprus and Malta themselves (figure below). For all other countries, the differences are generally very small. Most notably, the results for the EU27 aggregates are virtually identical.

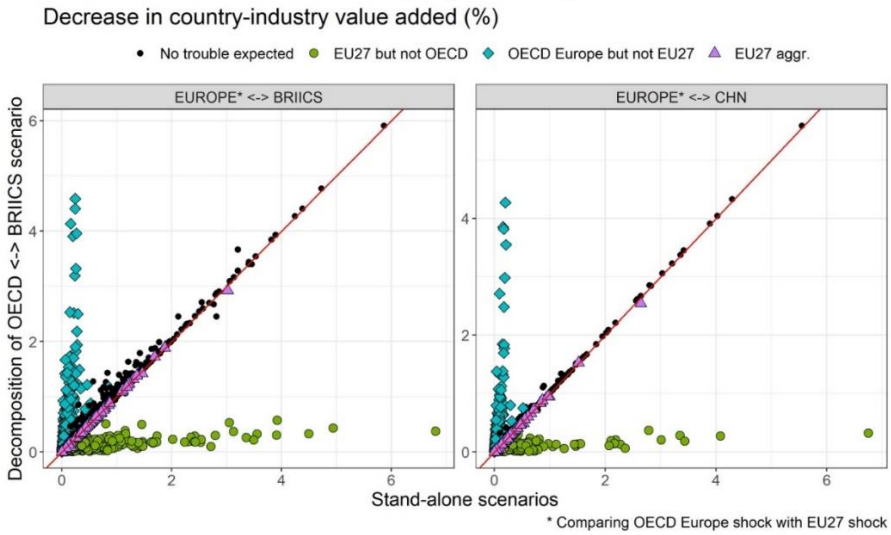
[51] USMCA refers to the signatory countries of the United States-Mexico-Canada Agreement.

[52] This is true only approximately because Romania, Bulgaria, Cyprus and Malta are part of the EU but not of the OECD. In the context of our analysis, however, these are small economies and do not affect our results in any meaningful way.

[53] Note by Türkiye: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Türkiye recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Türkiye shall preserve its position concerning the "Cyprus issue".

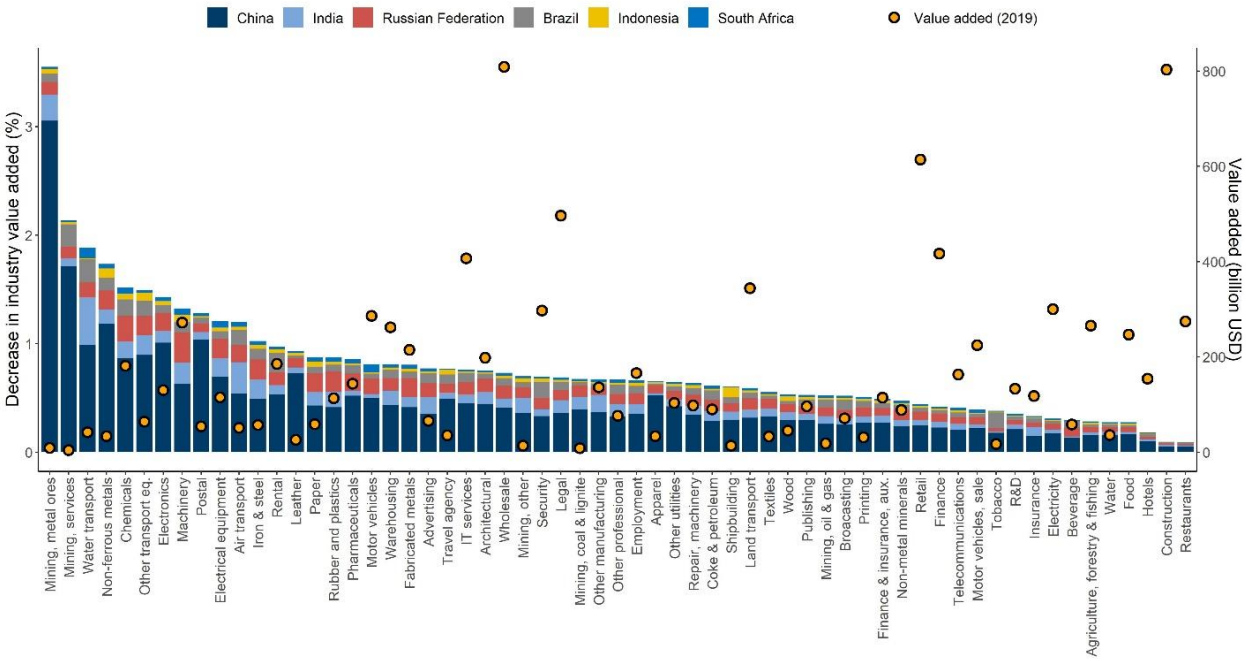
Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Türkiye. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.


Decrease in country-industry value added (%)
OECD <-> BRIICS
OECD <-> CHN
USMCA <-> BRIICS
USMCA <-> CHN
EUROPE* <-> BRIICS
EUROPE* <-> CHN
Decomposition of OECD <-> BRIICS scenario
Stand-alone scenarios
* Comparing OECD Europe shock with EU27 shock


Decrease in country-industry value added (%)
No trouble expected
EU27 but not OECD
OECD Europe but not EU27
EU27 aggr.
EUROPE* <-> BRIICS
EUROPE* <-> CHN
Decomposition of OECD <-> BRIICS scenario
Stand-alone scenarios
* Comparing OECD Europe shock with EU27 shock

8.2.2. Europe

The chart below provides additional breakdown for the EU-level results in Figure 4.6. The chart displays the contribution of each individual MNOE to the value added changes in EU27 sectors resulting from the OECD-MNOE shock.



8.3. Annex to Chapter 5 CGE modelling

8.3.1. The OECD METRO Model

The METRO model (OECD, 2023[41])is a multi-country, multi-sector computable general equilibrium (CGE) model that traces international interdependencies in a theoretically and empirically consistent framework, and incorporates several features of GVC participation such as trade of intermediate and final products and trade in value added (TiVA) concepts.

The model builds on the GLOBE model developed by McDonald and Thierfelder (2013[42]). The novelty and strength of METRO lies in the detailed trade structure and the differentiation of commodities by end use. Specifically, commodities and thus trade flows are distinguished by whether they are destined for intermediate use, for use by households, for government consumption, or as investment commodities.

The underlying framework of METRO consists of a series of individually specified economies interlinked through trade relationships. As is common in CGE models, the price system is linearly homogeneous, with a focus on relative, not absolute, price changes. Each region has its own numeraire, typically the consumer price index, and a nominal exchange rate (an exchange rate index of reference regions serves as model numeraire). Prices between regions change relative to the reference region.

The database of the model relies on the GTAP v11 database pre-release version 2 (Aguiar et al., 2022[43]) in combination with the OECD Inter-Country Input-Output Tables, which are the main source of the OECD Trade in Value Added Indicators and allows the model to distinguish trade for use in intermediate production or final demand. Policy information combines tariff and tax information from GTAP with OECD estimates of non-tariff measures on goods (Cadot et al, (2018[44]); Gourdon et al, (2020[45])), services (Benz and Gonzales, (2019[46]); Benz and Jaax, (2020[47]); Benz and Jaax, (2022[48])), trade facilitation (OECD, 2018[49]) and export restricting measures. The METRO database contains 151 countries and regional aggregates and 65 sectors. For this analysis the database as aggregated to 23 regions and 23 sectors. See Annex Table 8.1 for the description of the regions and sectors.

The model is firmly rooted in microeconomic theory, with firms maximising profits and creating output from primary inputs (i.e. land, natural resources, labour and capital), which are combined using constant elasticity of substitution (CES) technology, and intermediate inputs in fixed shares (Leontief technology). Households are assumed to maximise utility subject to a Stone-Geary utility function, which allows for the inclusion of a subsistence level of consumption. Substitution elasticities are sourced from GTAP, while the income elasticity used in the Stone-Geary utility function is based on USDA estimates (Muhammad et al., 2011[50]) and (Seale, Regmi and Bernstein, 2003[51])). All commodity and activity taxes are expressed as ad valorem tax rates, and taxes are the only income source to the government.

In the configuration of the model used for the simulations, capital and labour stocks are assumed fixed, and factors are mobile between industries, but not between economies. All factors, including capital and labour, are fully employed and returns to land and capital and wage rates are flexible. Tax rates are fixed. Government expenditure is fixed in volume terms at base levels while the government balance is allowed to adjust. The trade balance is assumed flexible. Investment as share of total final demand is remains fixed, but the household savings rate can adjust.

Table 8.1. METRO Model database regions and sectors

Model regions		Model sectors	
OECD countries (non EU27)		agr	Agriculture
CAN	Canada	ext	Coal, oil, gas extraction
USA	United States	oxt	Mining
JPN	Japan	fdbev	Food and beverage
GBR	United Kingdom	txwr	Textile and wearing apparel
AUS	Australia	omf	Other manufacturing
KOR	Korea	p_c	Petroleum and coal
MEX	Mexico	chm	Chemicals
LAM_OECD	OECD Latin America	bph	Basic pharmaceuticals
rOECD	Rest of OECD	nmm	Mineral products nec
EU27 (and OECD)		i_s	Ferrous metals
DEU	Germany	metals	Metals and metals product
FRA	France	ele	Electronic equipment
ITA	Italy	ome	Machinery and equipment
ESP	Spain	mvh	Motor vehicles and parts
NLD	Netherlands	uti	Utilities
POL	Poland	trd	Trade
SWE	Sweden	hosprec	Hospitality and recreation
rEU	Rest of EU	otp	Transport nec
MNOE countries		cmn	Communication
BRA	Brazil	ofins	Financial services and insurance
RUS	Russia	obs	Business services
IDN	Indonesia	gserv	Public admin, defense, edu, hhs
IND	India	oserv	Other services
CHN	China		
ZAF	South Africa		
Other countries and regions			
TWN	Chinese Taipei		
rAsia	Rest of Asia		
MENA	Middle East and North Africa		
rLAm	Rest of Latin America		
rSSA	Rest of Sub-Saharan Africa		
ROW	Rest of World		

Source: Authors' compilation.

8.4.1 Scenarios to assess trade dependencies

To assess trade dependences using the METRO model, a set of stylised scenarios reducing trade between OECD countries and MNOE countries were performed which reduced bilateral trade in all industries between the two groups. The scenarios were implemented using import tariffs and export taxes applied in OECD countries calibrated to reduce trade by 10%. Because of the assumption that government

expenditure is fixed to base levels in volume terms, it assumed that the extra government revenue from the tax increase is not spent but set aside in the form of government savings.

Moreover, to help decompose and isolate the effects reduced trade between specific regions, countries, and sectors, reductions in trade of between different groups and different sectors are simulated separately. The approximately linear nature of the model allows to add and subtract the results of different simulations to decompose and isolate effects.

The main scenario

- Imports and exports of goods and services between the OECD countries and MNOE are reduced 10%

Additional scenarios for decomposition

To decompose effect by certain countries or regions

- Imports and exports of goods and services between OECD countries and China are reduced 10%
- Imports and exports of goods and services between EU27 Members and MNOE are reduced 10%
- Imports and exports of goods and services between EU27 Members and China are reduced 10%

To decompose effect of reduction of exports vs reduction of imports

- Imports of goods and services between OECD countries and China are reduced 10%
- Exports of goods and services between OECD countries and China are reduced 10%
- Imports of goods and services between EU27 Members and China are reduced 10%
- Exports of goods and services between EU27 Members and China are reduced 10%

To decompose effect of certain sectors

- Imports and exports of *electronic equipment* between OECD countries and China are reduced 10%
- Imports and exports of *motor vehicles and parts* between OECD countries and China are reduced 10%
- Imports and exports of *mineral products* between OECD countries and China are reduced 10%
- Imports and exports of *chemicals* between OECD countries and China are reduced 10%
- Imports and exports of o*ther manufacturing* between OECD countries and China are reduced 10%

The selection of individual products selected for decomposition are based the list of ISIC Rev 4 3-digit codes identified by IMF (2023[18]) as strategic which were subsequently mapped HS6 digit codes and then to GTAP sectors. Non-energy GTAP sectors where at least a quarter of the associated HS6 codes are considered strategic in the first mapping were selected for the decomposition simulations. Other manufacturing was also included despite not meeting this threshold.

8.3.2. Select results from the main simulation

Table 8.2. Per cent change in sectoral output when OECD and MNOEs reduce bilateral trade across all sectors by 10%

Sectors	EU27								Rest of OECD									MNOEs						ROW					
	DEU	ESP	FRA	ITA	NLD	POL	rEU	SWE	AUS	JPN	KOR	CAN	MEX	USA	GBR	LAM _OECD	rOECD	BRA	CHN	IDN	IND	RUS	ZAF	MENA	rAsia	rLAm	ROW	rSSA	TWN
Agriculture	0.2	0.2	0.0	0.0	0.1	0.0	0.0	0.1	-1.5	0.2	0.3	-1.0	0.0	-0.4	0.1	-0.2	-0.3	-0.5	0.0	0.0	0.1	0.0	-0.8	-0.1	-0.1	0.0	-0.1	0.0	-0.3
Coal, oil, gas extract	0.5	0.2	0.2	0.4	0.5	0.5	0.4	0.4	-0.3	0.1	0.1	0.1	0.0	0.0	0.2	0.1	0.3	-0.4	0.0	-0.2	0.1	-1.5	-0.2	0.0	-0.2	0.0	-0.1	0.0	-0.2
Mining	1.1	-0.3	0.6	0.3	1.2	0.5	-1.0	0.9	-5.3	0.3	-0.5	0.1	-0.3	0.1	0.6	-4.0	-1.1	-1.0	0.8	-0.2	0.4	-2.4	-0.1	1.1	0.8	1.6	1.2	1.5	0.4
Food & bev	0.0	-0.1	-0.1	-0.1	-0.3	0.0	0.0	-0.1	-0.2	0.2	0.4	-0.1	0.0	0.0	-0.1	0.1	-0.4	-0.4	0.1	-0.4	0.1	0.0	0.0	-0.1	-0.4	0.0	-0.1	-0.1	-0.5
Textile & wearing app	2.1	1.6	2.0	1.7	2.2	2.1	2.5	1.6	6.6	0.1	0.7	3.7	2.5	1.8	2.9	4.1	1.8	-0.4	-2.7	-3.7	-1.6	0.3	0.0	0.2	2.6	0.4	1.3	-0.2	0.9
Other manufacturing	0.1	0.1	0.4	0.1	0.3	0.2	0.1	-0.1	0.8	-0.2	-1.0	0.7	0.7	0.3	0.0	0.1	0.0	-0.7	-1.5	-1.1	-1.2	0.3	0.9	0.0	0.8	0.0	0.2	-0.1	1.0
Petroleum & coal	-0.2	-0.1	0.4	-0.2	-0.3	-0.2	0.0	0.4	0.4	-0.5	-2.2	0.1	-0.1	-0.3	0.0	-0.8	0.5	0.4	-0.2	0.3	-0.8	-2.6	-0.3	0.4	0.2	0.2	1.0	0.2	0.8
Chemicals	-0.5	0.0	-0.3	-0.3	-0.5	-0.7	-0.4	-0.1	0.5	-1.3	-3.3	0.5	0.1	0.0	0.1	-0.6	-0.6	-0.1	-0.4	-0.4	-1.2	0.7	0.7	1.0	1.0	0.3	1.4	0.1	1.9
Basic pharma	-0.6	-0.5	-0.9	-0.9	-0.3	-0.5	-0.4	-2.0	-0.8	0.0	0.9	0.1	-0.5	-0.2	-0.7	0.4	0.6	1.7	0.0	0.7	-1.8	8.6	2.3	-0.2	-0.8	0.0	0.5	-0.5	-0.8
Mineral products nec	0.0	0.1	0.1	0.0	0.0	0.0	-0.1	0.0	0.6	-0.3	-0.3	0.8	0.3	0.3	0.1	0.3	-0.3	-0.7	-0.5	-0.1	-0.5	-0.2	0.1	0.0	-0.1	0.0	0.0	-0.2	-0.4
Ferrous metals	-0.6	0.4	0.3	0.1	1.1	0.0	0.0	0.1	-0.4	-0.8	-0.5	1.5	0.5	0.6	0.2	1.1	0.9	-1.5	-0.5	1.3	-0.3	-1.5	-1.4	0.2	0.5	0.5	1.3	0.3	1.0
Metals & metals prod	-0.2	0.2	0.3	0.0	0.6	0.0	-2.1	0.2	-2.8	-0.2	-0.8	1.0	0.5	0.4	-0.2	-2.7	0.2	-0.8	-0.9	-0.1	0.2	-2.3	-2.4	0.6	1.5	1.1	1.4	1.8	1.3
Electronic equip.	0.1	1.0	0.8	0.7	1.3	0.9	0.9	0.4	2.2	-0.8	-3.8	2.5	1.5	1.6	1.1	2.9	0.9	0.2	-2.3	-2.4	-0.5	1.7	1.7	0.1	3.0	0.4	1.2	-0.2	3.4
Machinery & equip	-0.7	-0.1	0.0	-0.6	0.3	-0.6	-0.3	-0.4	-0.1	-0.8	-1.2	1.0	0.4	0.2	-0.3	0.7	0.3	0.1	-0.3	1.0	0.0	2.0	1.0	-0.4	1.1	0.1	0.9	-0.5	1.2
Motor vehicles & parts	-1.0	-0.1	-1.1	-0.6	-0.2	-0.5	-0.5	-0.8	0.3	-0.8	-0.2	0.1	-0.6	-0.4	-1.4	0.7	-0.1	-0.6	1.0	1.1	-0.1	2.8	-1.6	0.0	0.4	0.7	3.1	-0.3	0.0
Utilities	-0.1	-0.1	0.0	-0.1	0.2	-0.3	-0.1	0.0	-0.3	-0.2	-0.6	0.1	0.1	-0.1	-0.1	-0.6	0.0	-0.3	-0.4	-0.2	-0.2	-0.5	-0.3	0.1	0.1	0.1	0.2	0.1	0.6
Trade	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	0.2	-0.1	0.0	-0.1	-0.1	0.0	-0.1	0.0	-0.2	-0.2	-0.4	-0.2	-0.1	-0.2	0.0	0.0	0.1	0.0	0.0	0.1	-0.3
Hospitality & rec.	0.0	-0.2	-0.1	-0.2	-0.3	-0.3	-0.2	-0.2	0.2	0.1	0.4	-0.2	-0.2	-0.1	-0.1	0.1	-0.3	0.0	0.1	0.1	0.6	0.1	-0.2	0.0	-0.6	-0.1	-0.2	-0.1	-1.2
Transport services	-0.5	-0.4	-0.4	-0.2	-0.8	-0.6	-0.8	-0.4	-0.1	-0.2	-0.6	-0.1	-0.2	-0.1	-0.4	-0.2	-0.6	-0.1	-0.4	-0.4	-0.2	-0.5	-0.5	0.0	-0.3	0.1	0.0	0.1	-0.5
Communication	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1	0.1	0.0	0.3	-0.2	-0.2	-0.1	-0.2	0.0	-0.2	-0.1	0.0	-0.3	-1.6	-0.1	-0.3	0.0	-0.2	0.0	0.0	0.0	-0.1
Finance & insurance	-0.1	-0.2	-0.1	-0.1	-0.3	-0.2	-0.4	-0.2	0.0	0.0	0.2	-0.2	-0.3	-0.1	-0.3	0.0	-0.3	-0.1	-0.2	-0.1	-0.2	0.0	-0.2	-0.1	-0.3	0.0	0.0	0.0	-0.5
Business services	-0.2	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	0.0	-0.1	-0.1	0.0	-0.2	-0.2	-0.2	0.1	-0.3	1.5	-3.2	0.3	-0.2	0.1	0.0	0.1	0.0	-0.1	0.4
PbAd, Dfns, Edu, HHS	0.1	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.1	0.3	0.1	0.8	-0.1	-0.1	-0.1	0.0	0.2	0.0	0.0	0.4	0.2	0.6	-0.1	0.1	-0.1	-0.6	-0.1	-0.2	-0.1	-1.1
Other services	-0.1	-0.2	-0.1	-0.1	-0.3	-0.3	-0.2	-0.1	0.2	0.0	0.4	-0.2	-0.3	-0.1	-0.1	0.0	-0.3	-0.2	0.1	0.1	0.0	-0.3	-0.4	0.0	-0.4	-0.1	-0.1	0.0	-1.0

Source: OECD METRO Model.

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