

Possible economic effects of Russia's war of aggression and resulting sanctions¹

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Abstract

Russia's invasion of Ukraine has had disastrous impacts on the people and economy of Ukraine and has wide-ranging international economic and political consequences. In reaction to Russia's invasion, many countries have imposed a progressive series of economic sanctions on Russia. International trade with Russia and the associated financial flows are some of the key channels targeted by these sanctions. The sanctions are aiming at hurting Russia economically while making sure the policy measures inflict as limited damage on the sanctioning countries and the rest of the world as possible.

This paper presents results of work aiming at better understanding the trade dependencies and economic impacts of the war using the OECD's computable general equilibrium (CGE) model METRO.

Three sets of "what if" simulations with METRO are used to assess the economic impact of reduced trade relations between Russia and a select group of countries. Given the importance of oil and oil products in Russian exports and the importance of Russia in global exports of oil, the first analysis examines the economic impact of a scenario where G7 and Europe cut oil imports from Russia by 100% under different assumptions as to how extra demand for non-Russian oil can be met from most existing alternative sources.

The second set of simulations examines the economic impact of a stylised scenario of reduced bilateral trade with Russia in all sectors. In this scenario, trade volumes in all sectors between Russia and G7, Europe, and Australia are reduced by 40%. The scenarios are designed to gauge the exposures of sectors and regions to a reduction in bilateral trade with Russia and to compare the economic impact of the different types of trade reductions.

In the third set of simulations, the model is used to analyse the impact of a scenario where OECD economies would contemporaneously increase trade links among each other. Would this lessen the effect of reduced trade links with Russia?

The paper also offers a discussion of the appropriateness of using a CGE model for this kind of analysis and elaborates on interpretation of the different results from a CGE analysis, including the importance of key underlying assumptions and the different key performance indicators that can be looked at.

Keywords: computable general equilibrium, trade sanctions, oil

1. Introduction

Russia's invasion of Ukraine, which began on 24 February 2022, is having disastrous impacts on the people and economy of Ukraine and has wide-ranging international economic and political consequences. The full extent of these impacts will depend on how the war and the international reactions to it evolve and is therefore highly uncertain.

¹ This paper draws significantly on CGE analysis-related parts of (Arriola, et al., 2023)

In reaction to Russia's invasion, many countries have imposed a progressive series of economic sanctions on Russia. International trade of Russia and the associated financial flows are some of the key channels targeted by these sanctions. The sanctions are clearly aiming at hurting Russia economically while making sure that the economic pressure on Russia inflicts as limited damage on the sanctioning countries and the rest of the world as possible although due to their very nature sanctions pursue non-economic objectives with economic means which makes a comparison of their costs and benefits far from straightforward.²

Accounting for 2.1% and 1.3% of world's merchandise exports and imports in the pre-COVID year 2019, Russia is not a major player in world trade overall but it has a relatively export-oriented economy.³ Globally, it has also been an important supplier of some agricultural products (e.g. wheat and meslin), inputs into agriculture (e.g. mineral fertilisers) and industrial raw materials (e.g. pig iron, iron, nickel, wood) as well as fuels (oil and oil products, natural gas and coal) (Table 1).

Russia's merchandise imports on the other hand were mainly concentrated in more technologically advanced manufacturing (e.g. electronics, motor vehicles, pharmaceuticals) as well as in food and textile products and some industrial raw materials (e.g. inputs into aluminium and steel production) (Table 2).

In 2019, Russia's exports of services accounted for 13% of its total exports (with transport and ICT accounting for, respectively, 33% and 17% of services exports). The value of Russia's imports of services was more than double that of exports and they were concentrated in travel (37%), ICT (18%) and transport services (16%), while imports of financial and insurance services accounted for 3%.⁴ For the last two decades, Russia has been re-orienting its trade away from Europe and Central Asia towards East Asia Pacific (Figure 1).

Table 1. Top 30 global imports from Russia

² Recently, de Souza et al. (2022_[10]) investigated the tradeoff for the sanctioning countries between reducing Russia's war capability and the potential harm to their own economies. They argue that the tradeoff is non-trivial: the sanctions reduce both Russian exports and the sanctioning country's imports, as goods cannot be fully substituted for non-sanctioned goods, so both sides incur economic losses. The optimal sanctions depend on the sanctioning country's willingness to pay for sanctions, i.e. the amount of own economic loss it is willing to incur per unit of Russian loss. More broadly this tradeoff applies also to non-economic effects where costly sanctions may be endured to diminish the aggressor's military capacity or force its retreat, etc.

³ As per the World Bank's Global Development Indicators, the share of the Russia's GDP in world GDP in 2019 was 1.9% (in current USD) which was below its export share and above its import share. Its trade balance in the same year was at 7.6% of GDP.

⁴ These shares, not presented in tabular form here, were calculated using services trade data for Russia provided by the Harvard Atlas of Economic Complexity.

Russia's share in world imports in 2019, %

HS code	Product description (abbreviated)	Russia's share in world imports
2524	Asbestos	77%
7201	Pig iron and spiegeleisen in pigs, blocks or other	41%
2612	Uranium or thorium ores and concentrates	37%
2617	Ores and concentrates; n.e.s. in heading no. 26	35%
2619	Slag, dross; (other than granulated slag), scalin	35%
8401	Nuclear reactors; fuel elements (cartridges), noi	34%
1204	Oil seeds; linseed, whether or not broken	27%
7207	Iron or non-alloy steel; semi-finished products th	27%
7203	Ferrous products obtained by direct reduction o	24%
7502	Nickel; unwrought	22%
507	Ivory, tortoise-shell, whalebone and whalebone l	18%
2803	Carbon; carbon blacks and other forms of carbo	18%
7206	Iron and non-alloy steel in ingots or other primar	18%
2844	Radioactive chemical elements and radioactive	17%
2814	Ammonia; anhydrous or in aqueous solution	17%
7501	Nickel mattes; nickel oxide sinters and other in	17%
3104	Fertilizers; mineral or chemical, potassic	16%
7110	Platinum; unwrought or in semi-manufactured fo	16%
3105	Fertilizers; mineral or chemical, containing 2 or	16%
2701	Coal; briquettes, ovoids and similar solid fuels r	15%
1512	Sun-flower seed, safflower or cotton-seed oil an	15%
1001	Wheat and meslin	15%
8108	Titanium; articles thereof, including waste and s	15%
4407	Wood sawn or chipped lengthwise, sliced, peel	14%
3102	Fertilizers; mineral or chemical, nitrogenous	14%
303	Fish; frozen, excluding fish fillets and other fish	14%
7601	Aluminium; unwrought	13%
2503	Sulphur of all kinds; other than sublimed, precip	12%
4801	Newsprint, in rolls or sheets	12%
8112	Beryllium, chromium, germanium, vanadium, ga	12%

Source: UN Comtrade 2019.

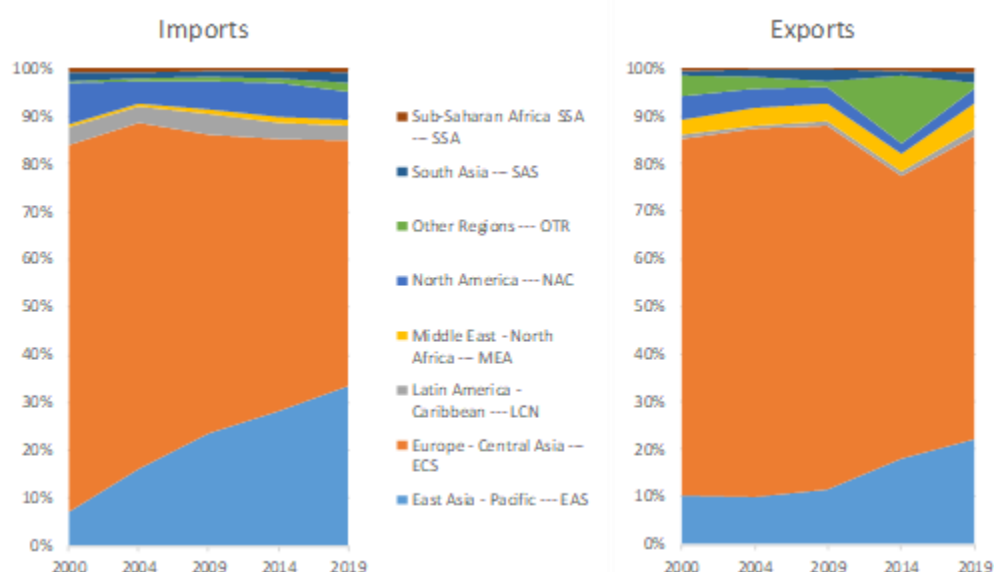
Table 1. Russia's top 30 imports from all countries

Share in Russia's imports in 2019, %

HS Code	Product description (abbreviated)	Share in Russia's imports
8517	Telephone sets, including telephones for cellula	7%
8471	Automatic data processing machines and units	4%
9999	Commodities not specified according to kind	3%
8708	Motor vehicles; parts and accessories, of headi	2%
3004	Medicaments; (not goods of heading no. 3002, i	1%
2818	Aluminium oxide (including artificial corundum);	1%
9503	Tricycles, scooters, pedal cars and similar whe	1%
6403	Footwear; with outer soles of rubber, plastics, le	1%
406	Cheese and curd	1%
803	Bananas, including plantains; fresh or dried	1%
8516	Electric water, space, soil heaters; electro-ther	1%
8528	Television receivers (including video monitors an	1%
8704	Vehicles; for the transport of goods	1%
8529	Transmission apparatus; parts suitable for use :	1%
8473	Machinery; parts and accessories (other than c	1%
8542	Electronic integrated circuits and microassemb	1%
8481	Taps, cocks, valves and similar appliances for p	1%
805	Citrus fruit; fresh or dried	1%
8504	Electric transformers, static converters (eg recti	1%
6204	Suits, ensembles, jackets, dresses, skirts, divi	1%
1201	Soya beans; whether or not broken	1%
202	Meat of bovine animals; frozen	1%
6402	Footwear; with outer soles and uppers of rubber	1%
7208	Iron or non-alloy steel; flat-rolled products of a w	1%
6404	Footwear; with outer soles of rubber, plastics, le	1%
4011	New pneumatic tyres, of rubber	1%
8443	Printing machinery; used for printing by means	1%
8703	Motor cars and other motor vehicles; principally	1%
6110	Jerseys, pullovers, cardigans, waistcoats and s	1%
8518	Microphones and their stands; loudspeakers, m	1%

Source: UN Comtrade.

Figure 1. Geographical orientation of Russia's merchandise imports and exports, 2000-2019



Note: the large increase of the share allocated to “Other regions” is due to the fact that in 2014 and 2015—the two years following Russia’s invasion of the Crimea in 2014 - large shares of Russia’s exports (13.4% and 15.4%) were reported as destined to a ‘unspecified’ country category.

Source: UN Comtrade.

In response to Russia’s invasion of Ukraine⁵, several countries have imposed economic sanctions on Russia. Some of these sanctions restrict international operations of specific Russian financial institutions, enterprises and individuals, while other ban imports from, and exports of goods and services to Russia. The timeline of announcements of the different sanctions as documented and categorised by (Bown, 2022^[5]) reveals that the accumulated count of financial and individual sanctions imposed by specific countries grew quicker and was bigger than the stock of export, import and travel sanctions in the period from February to the beginning of November 2022. Moreover, the stock of sanctions imposed on exports to Russia outsized those on imports from Russia (Figure 2, Panel A). The United Kingdom and United States have announced the most sanctions, followed by the European Union and individual EU countries, Japan, Canada, Switzerland and Australia (Figure 2, Panel B).

While the figure presents only cumulated counts of announced sanctions, and thus may not correctly characterise their relative economic importance, their general structure is not inconsistent with some of the motives behind these sanctions reported in policy announcements and the press. Individual and financial sanctions for example might have been the instrument of choice from the beginning because they may be easier to introduce and enforce while also allowing better targeting of the revenues of Russian government and its political and business allies while sparing the general public.

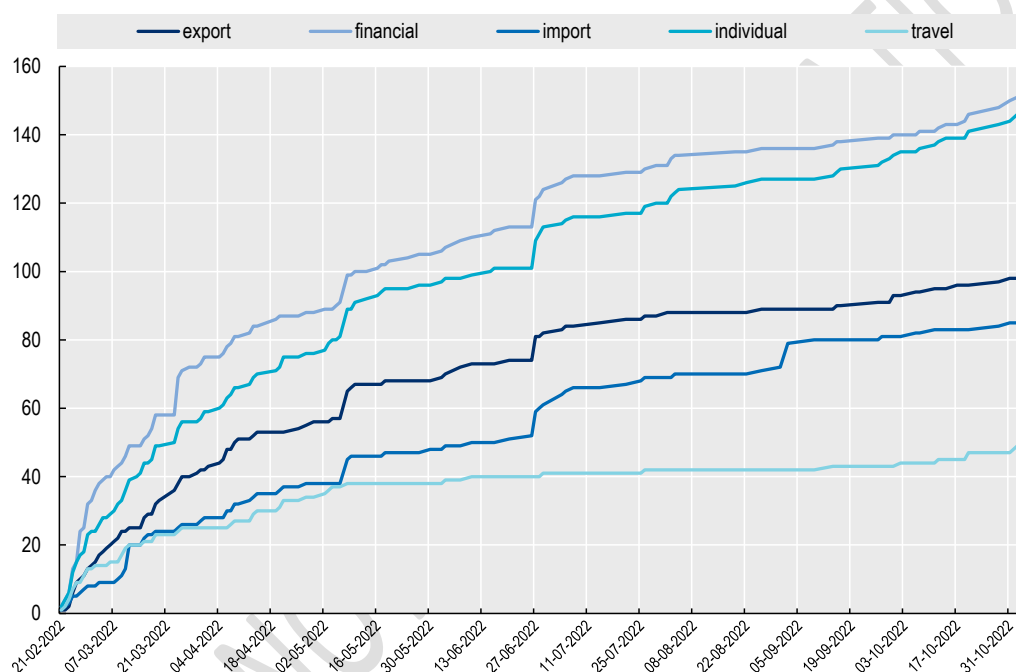
In addition, the apparently faster growth of export sanctions as compared to import measures might in turn be explained by both the essential nature of some of the top Russia’s exports (agricultural products, energy and raw materials) as well as the fact that Russia is a small export market for most countries while being almost completely dependent on imports of more

⁵ Note that the first sanctions were imposed in the period immediately preceding the full-scale invasion of Ukraine’s territory on 24 February, in response Russia’s unilateral recognition of the independence and sovereignty of the so-called Luhansk People’s Republic (LNR) and Donetsk People’s Republic (DNR) regions of Ukraine and ordering of Russian troops sent to the separatist territories on 21 February 2022 (Bown, 2022^[5])

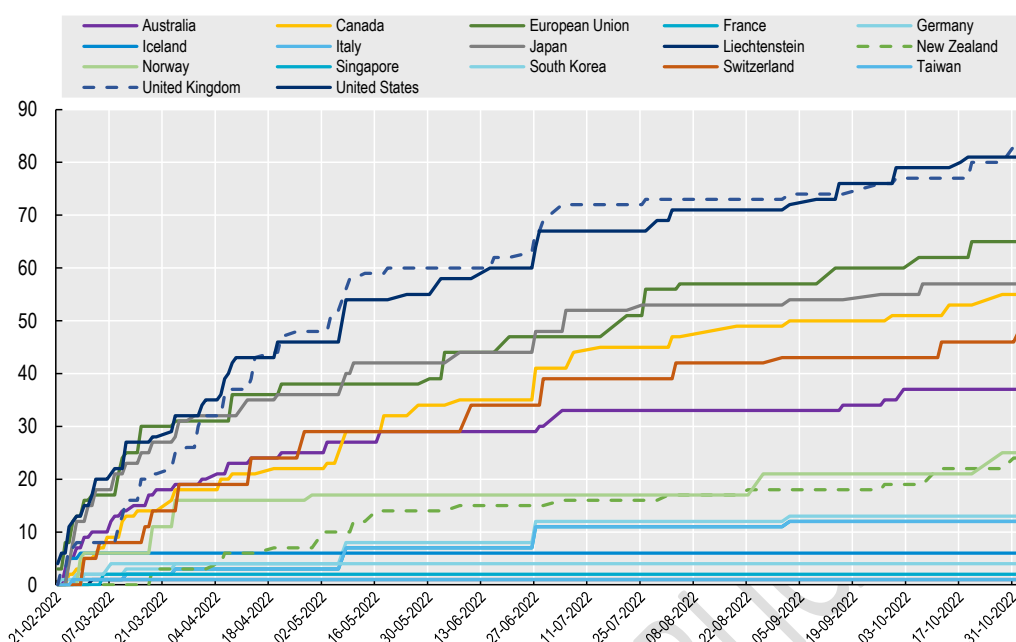
sophisticated manufacturing products (electronics, motor vehicles and parts, machinery and equipment, chemicals, and business services (OECD, 2022_[6]). This might make export sanctions less costly for the imposing countries and, at the same time, impose a high economic cost on Russia. Especially the longer term impacts on the Russian economy can be expected to be substantial if the flow of more technologically sophisticated intermediate inputs is throttled. Recall also that the simulations of reduced trade with Russia presented in our earlier update (OECD, 2022_[6]) showed that, added together, restrictions on exports to Russia of G7, European and Australian goods and services have an almost 50% larger impact on Russia than restrictions of these countries on imports from Russia, and they have also less negative effects on countries imposing the restrictions.

Figure 2. Incidence of economic sanctions imposed on Russia in 2022

Panel A. Cumulative count of sanctions imposed by individual countries on Russia, by sanction type*



Panel B. Cumulative count of sanctions imposed by individual countries on Russia, by imposing country*



*Note: The counts refer to announcements of sanctions imposed on Russia by specific countries other than Ukraine, as documented and classified into measure type by (Bown, 2022^[5]). Note that if a sanction package contained financial sanctions and important sanctions it has been counted as one financial sanction and one import sanction. The European Union is counted as one ‘country’ in the case of measures imposed by the European Union but additional measures imposed by individual EU countries (e.g. in the context of the G7 responses) are counted separately.
Source: OECD calculations using (Bown, 2022^[5]).

2. Assessing the trade implications of the war and associated sanctions using the OECD CGE model METRO

Assessing the trade implications of the war and associated sanctions is complex, not least because some of the measures are targeted to specific products, for example bans on exports of certain products from the EU to Russia, or are working through restrictions on finance, and, more recently, impacting transport costs through restricting access to ship cargo insurance. Some of the sanctions might also be circumvented, for example via transshipments. Added to this is the difficulty of assessing the trade impact of the war on the Ukrainian economy, including its exports and imports. While it is certainly not a complete assessment, this report uses the OECD METRO model to gauge the impacts of sanctions.

The OECD METRO model (OECD, 2020^[1]), like other global CGE models, is well suited to analyse economy-wide implications of trade measures with complex links and interactions between sectors and economies. CGE models can measure the direct and indirect effects on output, income and prices (which are not captured in ICIO analysis) with greater detail at the sector level than macro models. Accordingly, the analyses presented in this subsection adds to the literature of CGE analysis looking into the past and current economic sanctions on Russia (Kutlina-Dimitrova (2015^[2]), Chepeliev, Hertel and van der Mensbrugghe (2022^[3]), Mahlstein et al. (2022^[4]), WTO (2022^[5]), Nilsson, Antimiani and Schmitz (2022^[6])).

The METRO model is comparative static and in this exercise it is set up so as to account for adjustments that occur in medium term where production factors are mobile across sectors

but the overall endowment of labour and capital remain fixed and fully employed (normally understood to be five to ten years). In the oil dependency scenarios, substitution between trade partners and domestic versus imported products is further constrained by reducing substitution elasticities across all products and partners to account for, among other things, infrastructure requirements that might be required for such large changes in the level and direction of trade.⁶ In addition, under the ‘short-term scenario’, the ability of G7 plus countries and China to quickly change their suppliers of oil and oil products is limited.

Like with all models, there are some limitations to keep in mind. CGE models may not capture the full cost of the transition away from trade with Russia of certain products (e.g., the cost required for building new pipelines needed to access non- Russian oil). The static nature of the analysis implies fixed capital stocks. Moreover, there is no foreign direct investment in the model. Changes to the amount of capital in an economy either through domestic capital accumulation or changes in foreign direct investment, due to for example foreign companies refusing to do business in Russia, are not captured in the analysis. This could underestimate the medium-term impact of scenarios looking at the highly capital intensive energy sector. Additionally, while the model has a relatively high degree of sector disaggregation, it is not at the detail that can well capture trade dependencies or measures targeting specific products at the HS 6 level or higher. While typically specified at an industry level and therefore incapable of capturing the product or firm-level detail that can be accounted for using detailed trade or firm-level data, they build on economic theory and incorporate adjustment mechanisms which can be considered under different assumptions about how the economy functions, including elasticities which determine the magnitudes of such adjustments. Lastly, results can be sensitive to elasticities.

Three sets of “what if” simulations with METRO are used to assess the economic impact of reduced trade relations between Russia and a select group of countries. Given the importance of oil and oil products in Russian exports and the importance of Russia in global exports of oil, an oil embargo was one of economic sanctions considered first after Russia’s invasion of Ukraine. Accordingly, the first analysis examines the economic impact of a scenario where G7 and Europe⁷ cut oil imports from Russia by 100%. The second set of simulations examines the economic impact of a stylised scenario of reduced bilateral trade with Russia in all sectors. In this scenario, trade volumes in all sectors between Russia and G7, Europe, and Australia are reduced by 40%. In the third set of simulations, the model is used to analyse the impact of a scenario where OECD economies would contemporaneously increase trade links among each other. Would this lessen the effect of reduced trade links with Russia?

Box 1. METRO Database and Model Configuration

For both sets of simulations, the model database with reference year 2017 is configured to allow for representation of major energy producers and importers as well as energy linkages in domestic industries and between economies. Non-energy sectors relevant in the current

⁶ Elasticities are sourced from the GTAP database. In the short run analysis presented in the document, import elasticities on all products were reduced by 30% under the assumptions that substitution between exporters, particularly oil and oil products, are more difficult in the short run. Reducing elasticities to further emphasise the short-term nature of the analysis is common approach applied by recent studies on the Russia-Ukraine crisis including WTO (2022^[5]) and Chepeliev, Hertel and van der Mensbrugghe (2022^[3]). As a sensitivity check, the simulation on the ‘medium term’ oil ban scenario was run using the default GTAP elasticities. While the macro effects are generally slightly smaller with the larger substitution elasticities, the direction and relative magnitude of the results remain largely the same.

⁷ In the METRO Model analysis, reference to “G7” include the following countries which are separate regions in the model database: Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States. Reference to “Europe” covers the model regions Norway, Ukraine, and Rest of Europe. For the analysis in this document, rest of Europe is an aggregation of regions that include all EU27 regions except France, Germany, and Italy, as well as Albania, Serbia, GTAP regions rest of EFTA, and rest of Europe.

context (e.g., wheat, minerals, metals, and motor vehicles) were also considered when determining the database aggregation.

The resulting analysis database contains 25 countries and 29 sectors. Countries include Australia, China, Japan, India, Canada, United States, Mexico, Argentina, Brazil, United Kingdom, Norway, France, Germany, Italy, rest of Europe, Russia, Ukraine, rest of CIS, Saudi Arabia, Türkiye, Iran, Rest of Arab Gulf States, rest of MENA, Egypt, and Rest of the World. Sectors include Wheat, Cereal grains, Oil seeds, other Crops, other Agriculture, Oil, Gas, Coal, Other Extraction, Food and beverages, Other manufacturing, Petroleum and coal products, Chemicals and pharmaceuticals, Mineral products, Ferrous metals, Metal and metal products, Electronics, Machinery and equipment, Motor vehicles and parts, Gas manufacture and distribution, Trade, Transport nec, Water transport, Air transport, Communication, Financial and insurance services, Business services, Public Administration and defence, and Other services.

The database is also configured to reflect the post-2017 situation of lack of imports of gas, oil and oil products from the Islamic Republic of Iran into G7 countries and Europe. No particular assumptions about a post-COVID-19 economic recovery path are made.

In the configuration of the model used for the simulations — referred to as the model ‘closure’— 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 as a share of final demand is fixed while the government balance is allowed to adjust. The trade balance is assumed flexible. Investment demand is also flexible, while the household savings rate is fixed.

3. Results

3.1 Reduced oil dependency on Russia⁸

The first hypothetical scenario examined is one of reduced dependency on Russian oil. For this analysis, G7 and Europe are assumed to impose a ban on imports of Russian oil and oil products.⁹ In this medium-term scenario, it is assumed the extra demand for non-Russian oil can be met from most existing alternative sources.

In addition to the medium-term scenario, rigidities which may arise when adjusting to the Russian oil import ban are assessed under alternative short-term assumptions about which regions can step in to fill the supply and demand gap created by the reduction in Russian oil imports of select economies (See Table 3). In the short-term scenario, it is assumed the extra demand for non-Russian oil cannot be met from most existing alternative sources (including Canada, Mexico, the United States, Norway, Saudi Arabia, Rest of Gulf countries, and others, accounting together for about 80% of world oil and oil products exports). In addition, in this scenario, China’s imports of Russian oil and oil products are capped at current levels so that China does not step in to absorb the excess supply of Russian oil and, at the same time, the increased demand for non-Russian oil by the OECD countries is not offset by a corresponding decline in Chinese demand for non-Russian oil. In this case, the adjustments are mainly

⁸ This section was produced in collaboration with David Haugh and Donal Smith of OECD’s Economics Department. The section also benefited from extensive comments from Joel Couse, Special Advisor – Energy Markets and Security of the International Energy Agency, Laurence Boone, formerly Chief Economist and Deputy Secretary General of the OECD, Marion Jansen, Director of the Trade and Agriculture Directorate, and Tomasz Kozluk, Economic Counsellor to the Chief Economist of the OECD.

⁹ Technically, this is implemented in the model through an introduction of a near prohibitive tariff while also making an assumption that the extra tariff revenue is not spent but set aside in the form of government savings (so it does not directly influence the aggregate demand).

through higher prices of imported oil from non-Russian sources and through lower prices of the now less demanded Russian oil.

Table 0. Oil dependency scenarios and their alternative adjustment assumptions

Scenario Name	Countries which are restricted in filling the gap in oil supply by exporting more to G7 and Europe
Medium term	none
Short term	Canada, Mexico, the United States, Norway, Iran, Saudi Arabia, Rest of Gulf countries, rest of Europe, rest of CIS, rest of MENA, Rest of the World <u>and China maintains its imports from Russia at the base level</u>

Note: In all scenarios, G7 and Europe reduce oil imports from Russia 99.9%. Countries banning Russian oil imports include: Canada, France, Germany, Italy, Japan, United Kingdom, United States, Rest of Europe, Norway, and Ukraine. Rest of Europe is an aggregation of regions that include all EU27 regions except France, Germany, and Italy, as well as Albania, Serbia, GTAP regions rest of EFTA, and rest of Europe.
Source: Authors' compilation

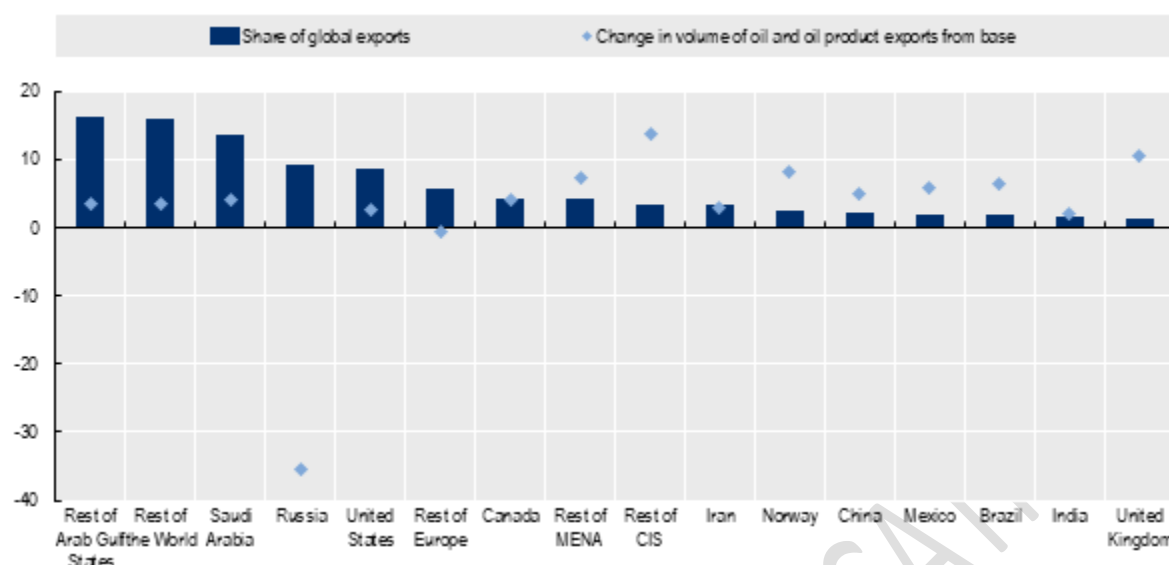
What would be the costs of drastically reducing dependency on Russian oil in the medium-run when supply increases and international trade of oil adjusts?

In the medium-term scenario, higher prices induce greater non-Russian oil production by all the other current exporters along existing oil supply chains to satisfy the extra demand for non-Russian oil in the G7 and Europe. The increase in supply is in line with the model's standard supply and substitution elasticities and reflects market shares and costs. The countries supplying more oil include the traditional large oil producers outside the G7 countries and Europe, such as Saudi Arabia and the Rest of Gulf countries, as well as smaller producers (Figure 3). However, even if OPEC Gulf States decided not to ramp up production, simulations which are not presented in this document indicate that increased sourcing of oil from G7 and within Europe, including Norway as well as from Mexico, would greatly contribute to minimizing the costs of the reduction in Russian oil dependency.

These increases in production and exports from other oil producing countries in the medium-term scenario limit the costs of sanctions imposed on Russia for the rest of the world. The rebalancing is particularly important for countries like Germany and Italy, where the production increase and adjustment from the consuming country reduces the medium-term cost markedly (e.g. from 2.9% of household income loss in the short-term to 0.8% in the medium-term for Germany and from 2.1% to 0.5% for Italy).

Figure 0. Other producers would have price incentives to increase export volumes in the medium-term in the case of drastically reduced imports from Russia by the G7 and EU

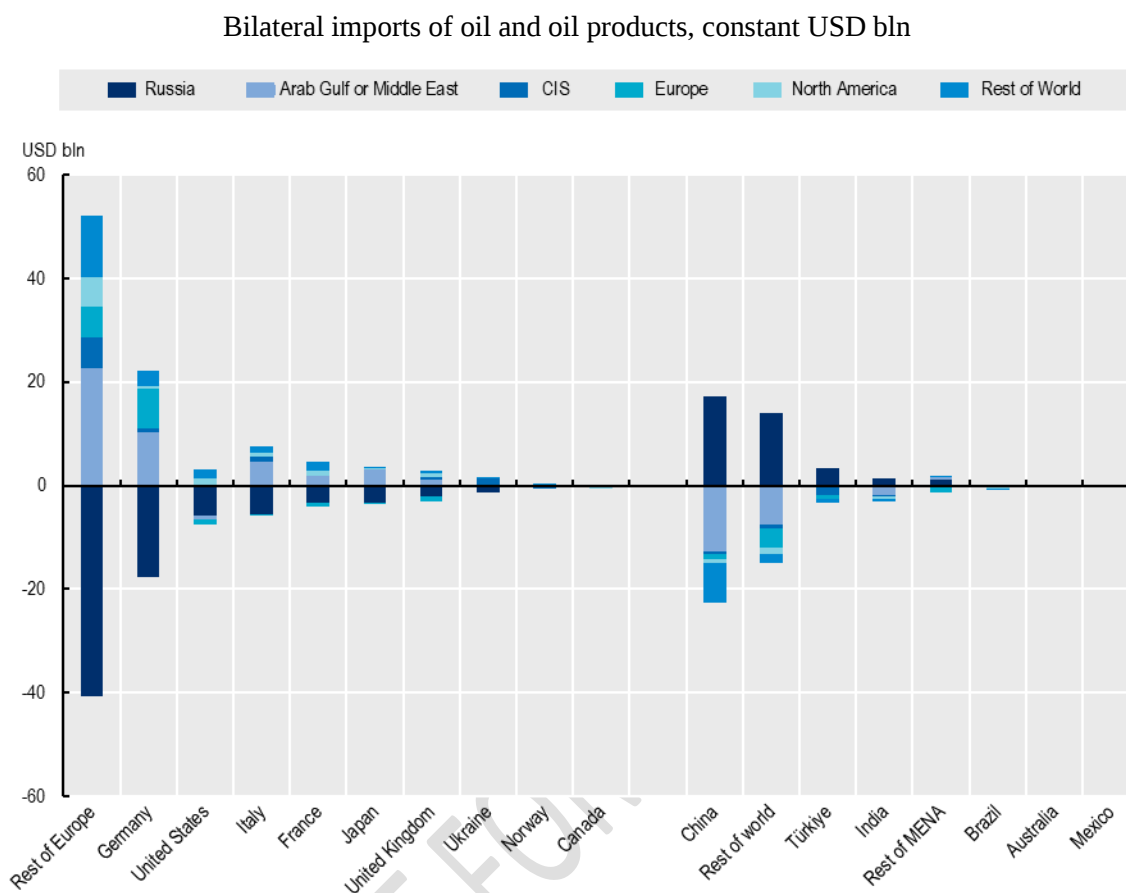
Oil and oil products export shares in the baseline and changes of export volumes, %



Source: OECD METRO model medium-term simulation. Showing only countries accounting for over 1% of world export supply.

The medium-term scenario shows also that there is a large rebalancing of bilateral oil trade flows (Figure 4). While the countries reducing Russian oil dependency source more oil from established suppliers in existing trade links, other countries absorb some, but not all, of the excess Russian oil: China, Türkiye and many less developed economies increase their imports, at a price discount for Russian oil that the model estimates at above 30%. India also slightly increases its imports, but the volumes are not substantial.

Figure 4. EU countries would massively reduce imports from Russia while China and others would increase them in the medium-term



Source: OECD METRO model medium-term simulation.

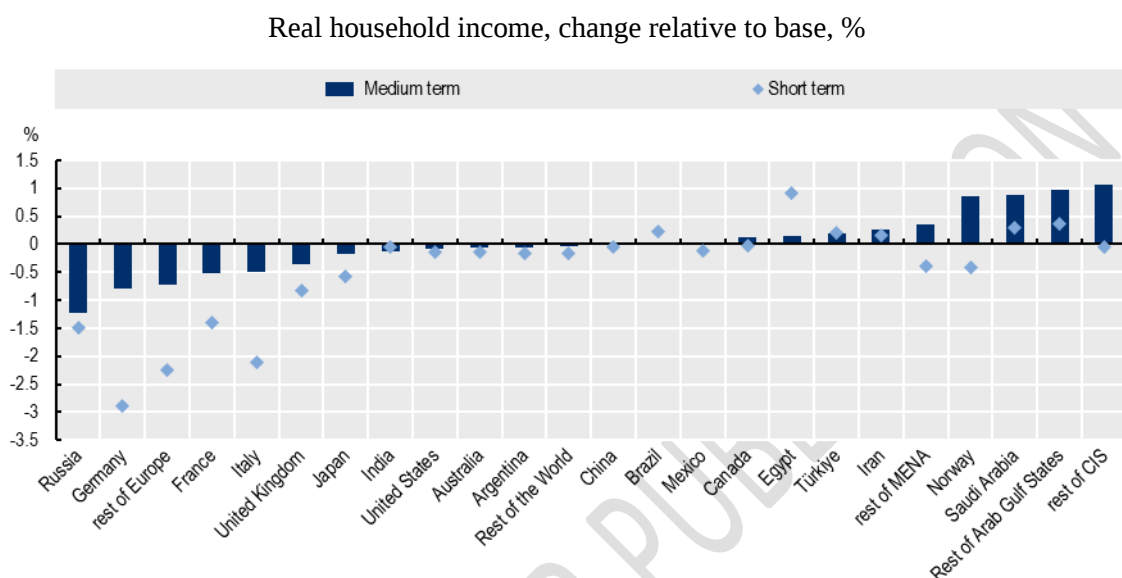
The model produces several metrics that can be used to evaluate the overall economic impact of policy changes. The impact on real GDP, which is a commonly reported performance statistic, measures the income of the economy, accounting for changes in production (in value added terms) generated in different sectors of the economy. Nevertheless, in the context of this study a different measure is considered to be more appropriate. In a natural resource-dependent economies such as Russia where the structure of production can be very different from the structure of consumption, real GDP does not capture well the impact on purchasing power. This is why in this analysis the focus is on 'real household income changes', a measure which is defined as the adjustment in household income¹⁰ that would be required at the base prices after the considered policy to attain the new level of utility (i.e. reflecting the concept of equivalent variation) and thus measures changes in economic welfare.

Overall, the economic cost as measured in the loss of real household income estimated under the medium-term adjustment assumptions due to higher prices in countries restricting oil imports from Russia are moderate but they are also unequally distributed across (and within) countries (Figure 5). In relative terms, Russia is impacted the most negatively in medium-term and, among the other countries, the highest economic costs of restricting oil imports fall on

¹⁰ The household's income accrues from labour, capital, land, and natural resource incomes.

European countries¹¹, with non-EU G7 members less affected. Other oil exporters in the global economy on the other hand benefit through higher oil prices.

Figure 5. Reducing oil dependency by G7 and Europe: Costs are unequally distributed and higher in the short term



Source: OECD METRO model simulations.

Short-run costs for countries reducing Russian oil dependency

Finding alternative sources of oil in the short term may be challenging due to inexistent or insufficient oil transport or production infrastructure (i.e. lack of pipelines or additional oil tankers). Substitution of different kinds of oil products might also be difficult because different products are used for different purposes and refineries are specialised in processing certain grades of crude oil and final products (diesel, petrol, kerosene, heating oil). Mismatches between alternative crude supplies and requirements of existing infrastructure could lead to shortages in final products and in production and transport bottlenecks (e.g. kerosene for aircraft). Altogether, the volume adjustment via rebalancing of bilateral oil trade flows may take time and require additional resources.¹²

In the short-term scenario therefore, adjustments are assumed to mainly occur through higher prices of imported oil that have knock on effects on other prices in the economy and reduce household purchasing power. In reality, the costs in the short term could be large (shortages, high prices and rationing, industry shutdowns) and unequally distributed between and within countries depending on their current energy and industry mix. Under these assumptions and depending strongly on the share of Russia in the country's imports of oil as well as on the concentration of oil imports from other providers, household income losses go up to around 3% (Figure 5). The income loss is three or more times higher than in the medium-term scenario, emphasising the importance of adjustments to global production and directions of international trade of oil which minimise the costs of the embargo.

¹¹ The dependency on Russian oil varies within Europe. Some of the countries that are included in a 'Rest of Europe' for modelling purposes (this is all of Europe except Ukraine, Germany, France, Italy, United Kingdom, and Norway, which are kept as separate economies in the analysis) may face household income losses that significantly exceed the average for this group.

¹² Note, however, that, compared to natural gas, it is easier to switch between alternative sources of imported oil because due to its liquefied natural state, there are in principle more relatively inexpensive transportation options.

How could reactions of China and India affect the outcome in the short term?

Could a large increase in China's imports substantially offset the economic impact on Russia in the face of such an embargo? In the short-run this may be challenging because of the large size of the entailed increases. Such an offset would require China to more than double its pre-war imports of Russian crude of 1.6 million barrels per day (Mbd) to almost 4 Mbd, or 40% of their total oil imports.¹³ Industry sources nevertheless point to very limited spare capacity in oil pipelines connecting China to Russia, and it is unclear where China would procure the oil tankers required for shipping more oil to China and at what cost.

In this context, the short-term scenario assumption that Chinese imports of Russia oil and oil products are capped at current levels is estimated to drive down Russian oil exports by a further 13% relative to its post-embargo oil export revenues for a total loss of USD 67 billion (55% of pre-embargo oil revenues) and adds to Russian household income losses.

What about an increase in Indian imports offsetting the effects on Russia? India is a large consumer of imported oil with net oil imports of 4 Mbd, however, imports of Russian crude have been very minor.¹⁴ Since the war started, Indian imports from Russia have risen to 0.95 Mbd in April and May suggesting, in this case, that adjustment towards the medium-term may be rather quick.¹⁵ However, these amounts still remain modest relative to Europe's pre-war imports from Russia of around 3.4 Mpd and reported logistical hurdles may slow further increases.^{16,17} In addition, imports from Russia were purchased at a reportedly steep discount of USD 30 per barrel reducing the positive revenue effect for Russia.¹⁸ The modelling results confirm that the likely offsetting effect for Russia would be overall modest.

Short-term pain is likely but the medium-term costs are manageable

While the income effects of the oil embargo derived from the CGE analysis can be seen as moderate overall, the bottom line for countries reducing their oil dependency on Russia is that the medium-term costs after markets adjust are smaller than the short-term ones which will be mainly felt when the global oil price temporarily increases. The urgent policy challenge for these countries would be therefore to plug short-term shortfalls and find energy alternatives for the most acutely affected countries and industries. The key to addressing this challenge is close international cooperation, which is already taking place. Preparing for the policy shift in advance by lining up alternative sources as many OECD countries are doing will also help.

Europe unsurprisingly faces the highest medium-term costs, after Russia. The region is more dependent on Russian oil than others and has less diversified alternatives. In Germany, where simulated effects are the largest, household income is reduced by less than 1%, although the short-term cost could be three times as high. The costs to countries of reducing their dependency on Russian oil are less than shocks to incomes in the wake of the COVID-19 pandemic though they may last longer.

Reduced bilateral trade between Russia and select economies

In the next set of scenarios, a wider suite of hypothetical, highly stylised 40% reductions in bilateral trade is modelled in all industries between Russia and G7, Europe, and Australia (also

¹³ See [Oil Market and Russian Supply – Russian supplies to global energy markets – Analysis - IEA](#)

¹⁴ IEA (2021) India Energy Outlook 2021 [India Energy Outlook 2021](#)

¹⁵ Indian imports from Russia averaged 0.1 Mbd in 2021 but this had increased to 0.95 Mbd by May 2022 (IEA (2022), [Oil Market Report June 2022](#))

¹⁶ European Import data from IEA (2022), Oil Market Report June 2022

¹⁷ [India's ONGC struggling to move Russian oil to Asia as sanctions bite.](#)

¹⁸ [Ukraine crisis: Why is India buying Russian oil? - BBC News](#)

referred to as G7 plus regions).¹⁹ It is not the aim of this second scenario to specifically assess applied or announced sanctions on Russia. Many of the announced sanctions are aimed at specific individuals or products at a very detailed level (e.g. dual-use goods), are highly difficult to translate into policy shocks to incorporate into a model without strong assumptions (e.g. the SWIFT ban), and they continue to quickly evolve over time. Instead, the scenarios are designed to gauge the exposures of sectors and regions to a reduction in bilateral trade with Russia and to compare the economic impact of the different types of trade reductions (e.g. limiting exports to Russia versus imports from Russia).

To help decompose and compare the effects, reductions in exports and imports on goods and services trade are simulated separately. The four scenarios considered are:

- Scenario 1: Imports of goods from Russia to G7 plus regions are reduced by 40%
- Scenario 2: Imports of services from Russia to G7 plus regions are reduced by 40%
- Scenario 3: Exports of goods to Russia from G7 plus regions are reduced by 40%
- Scenario 4: Exports of services to Russia from G7 plus regions are reduced by 40%

3.2 Reducing trade across all industries doubles the negative effect on Russia

Compared to the previous simulation of eliminating dependency on Russian oil, reducing bilateral trade by 40% on all industries approximately doubles the negative real income effect on Russia in the medium term (Figure 6). This suggests that sanctions related to energy trade are indeed important, even if they are not the only lever that the G7 plus countries can use.

For regions reducing all bilateral trade with Russia, the cost remains unevenly distributed, but household income losses are consistently lower compared to the reduced oil dependency scenario. This reinforces the point about the relative appeal of the broader trade reductions from the point of view of the sanctioning countries. Outside Russia, most of the economic costs of throttling trade fall on the G7 plus regions, while other countries which maintain their trade relations with Russia are hardly impacted. The exception is Norway which is reducing bilateral Russian trade in these scenarios, but as an energy exporter benefits from higher energy prices (particularly oil and gas extraction).

Russia is a net exporter whose main exports are energy products, but it relies heavily on G7 and other economies for imports of among other things electronics, motor vehicles and parts, machinery and equipment, chemicals, and business services. At least 70% of these imports are sourced from G7, Europe, or Australia. From the Russian perspective, restricting imports of Russian goods and reducing exports of goods and services to Russia have roughly the same impact – reducing household purchasing power by 0.92%, 0.73%, and 0.67% respectively (Figure 6). Added together, restrictions on exports to Russia of G7, European and Australian goods and services have an almost 50% larger impact on Russia than restrictions of these countries on imports from Russia.²⁰ This applies to both consumption products as well

¹⁹ These scenarios are implemented using export taxes and import tariffs in countries applying the sanction calibrated so as to reduce bilateral trade by 40%. As in the previous oil scenarios, it is assumed that the extra government revenue is not spent but set aside in the form of government savings.

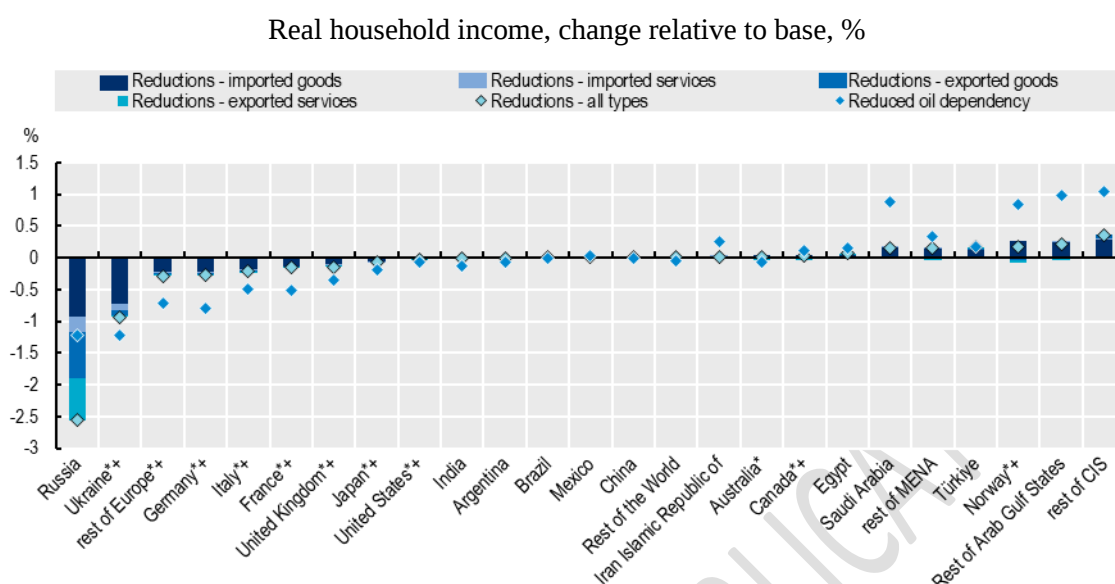
²⁰ It should be noted however that reductions of Russia's exports and imports may have also other effects which are not captured well or fully in the current modelling exercise. For example, there is some evidence that strong energy exports, in combination with expansionary fiscal policy and capital controls have made the Russian currency much stronger. A stronger rouble limits the government income effect of higher oil prices, because the rouble-denominated tax revenues from oil exports do not increase at the same pace as oil export revenues which are paid in foreign currency. The rouble's strength gives Russia additional purchasing power to source imports via new supply chains or routes. Also, import constraints may have more acute effects on Russia in the short run but in the

as imports of intermediate inputs used for production in Russia. Reducing exports to Russia, especially exports of technology-intensive goods, can be expected to have even deeper consequences for Russia in the longer run than suggested by the modelling in this study. Slower capital accumulation and lower productivity following reduced imports of intermediate goods and technology will negatively affect the Russian economy over time. This also highlights another important point: the benefits of trade (and here the harm potentially inflicted with trade sanctions) is at least as much about imports as it is about exports.²¹

medium run those constraints may start to erode if Russia can find new supplies - and the strength of the rouble (as a result of strong energy exports) may accelerate that transition.

²¹ Note also that this has practical implications, as it may be more difficult to design and implement export sanctions, for example because third countries might not honour the sanctions and may act as transit points.

Figure 6. Reducing trade across all goods and services has a large impact on Russia



Note: * Reduces imports from and exports to Russia by 40%. + Reduces Russian oil dependency.

Source: OECD METRO model simulations, medium-term.

Reducing trade across all industries has little impact on world trade but large effects on Russia

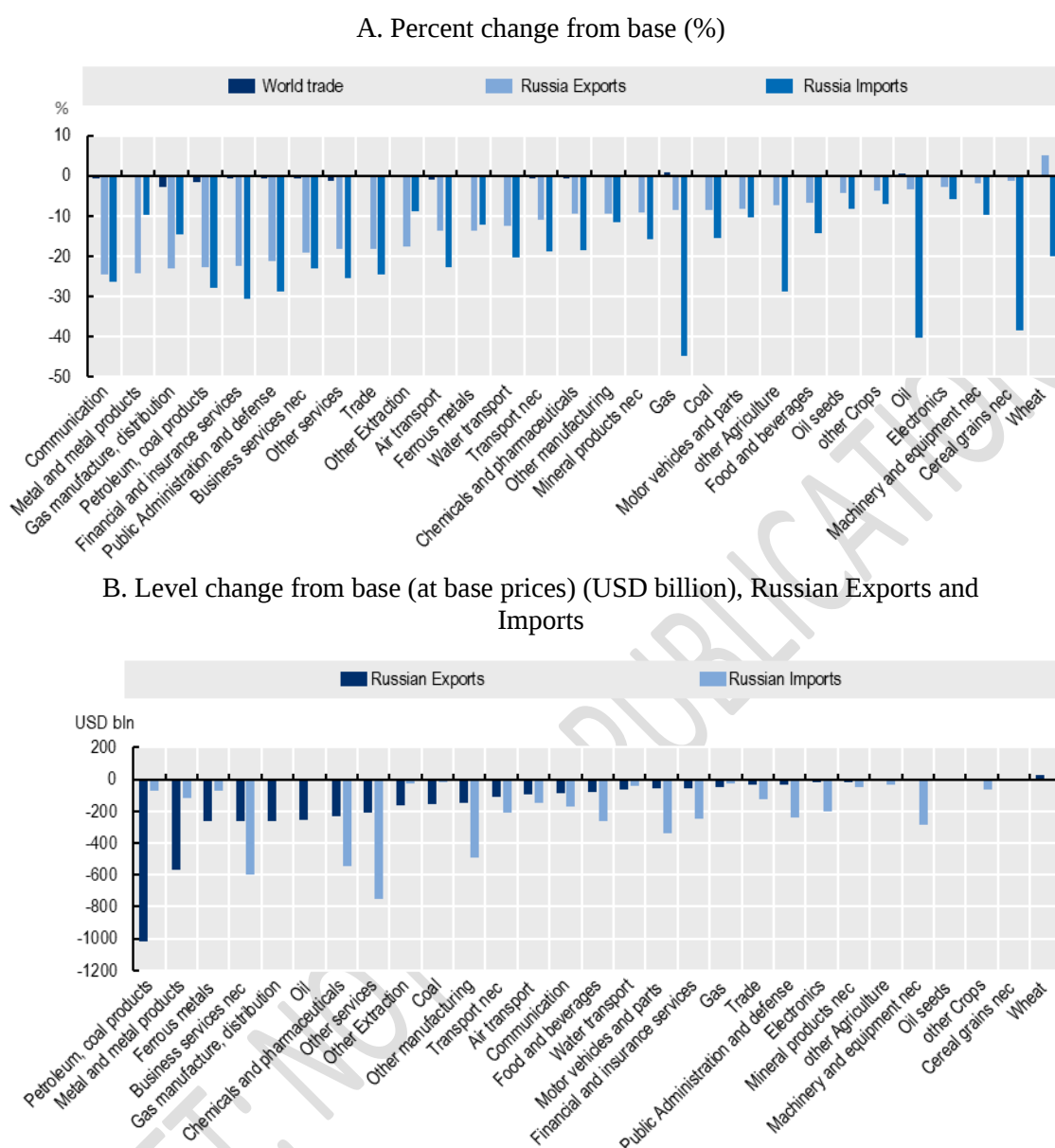
World trade is only slightly negatively affected when G7, Europe, and Australia reduce trade with Russia. Trade across all sectors declines on average 0.5% (Figure 7 Panel A). Unsurprisingly, exports of manufacture and distribution of gas, where Russia accounts for a third of world exports, decline the most (2.8%). Global wheat exports increase by 0.2% which is explained by the fact that Russia—an important player in wheat markets -- allocates additional domestic resources to wheat and produces and exports more wheat. While this effect may not materialise in reality due to weather effects and logistical problems with exporting Russian wheat, it shows that, under certain assumptions, Russia could become an even more important player in wheat markets due to international reactions due to its war against Ukraine.

Russian total exports decline by 12% and total imports decline by 16% when sanctions are imposed (in volume terms). Export losses centre around merchandise trade –Russia’s main exports (Figure 7 Panel B). The exports of petroleum and coal experiences the largest volume decline in Russia with real losses of 1 USD tln (at base prices). Russian exports of metal products also make up a large share of the total decline in exports – decreasing 567 USD bln. These two sectors account for almost 40% of the 4 USD tln decline in Russian exports resulting from the reduction in trade with the G7 plus regions.

Most of the decline in Russian imports are accounted for by services and products which are mainly sourced from sanctioning countries. Imports of other services 22, business services, and financial services decline by 752 USD bln, 597 USD bln, and 248 USD bln respectively which is explained by the fact that at least 70% of the imports of these sectors come from G7, Europe, and Australia. Similarly, chemicals and pharmaceuticals as well as motor vehicle and parts imports are among the sectors with the largest decline in value terms. The majority of these imports (76% and 70%) is sourced from countries reducing bilateral trade with Russia in all sectors.

²² “Other services” is an aggregated sector which include electricity, water, construction, accommodation, food and service activities, warehousing and support activities, real estate activities, recreational and other services, and dwellings.

Figure 7. Change in sectoral trade resulting from reduced bilateral trade with Russia in all sectors



Source: OECD METRO Model simulations, medium-term.

There is also some redirection of trade (Table 3.6). Some of those goods and services no longer exported by Russia to the sanctioning countries are diverted to regions not imposing trade measures, mainly China, rest of CIS, Türkiye, and India.. Similarly, goods and services that Russia can no longer source from Australia, G7 and rest of Europe, are imported from other regions (e.g. China, rest of CIS, India, or Türkiye). However, as Table 3.6 shows not all the decline in trade between Russia and countries restricting trade will be replaced by trade from other regions because this involves paying higher prices and incomes in most countries are also reduced in these scenarios.

Table 4. Trade redirection is inevitable

Exporter	Importer	Sector	Base (USD bln)	Reduction type (change from base, USD bln)				
				Imported goods	Imported services	Exported goods	Exported services	All
Russia	G7 plus	Oil and Petroleum	80.4	-32.1	0.2	0.1	0.2	-31.7
Russia	Not	Oil and Petroleum	40.9	17.3	0.1	0.2	0.2	17.8
Russia	G7 plus	Gas	4.3	-1.7	0.0	0.1	0.1	-1.4
Russia	Not	Gas	1.1	0.8	0.0	0.1	0.1	1.0
Russia	G7 plus	Other goods [†]	65.7	-25.9	0.2	1.5	0.5	-23.7
Russia	Not	Other goods	87.0	3.3	0.4	1.7	0.7	6.0
Russia	G7 plus	All services [±]	31.7	0.0	-12.7	0.1	0.8	-11.8
Russia	Not	All services	16.3	0.1	1.3	0.0	0.3	1.8
G7 plus	Russia	Cars and parts	20.4	1.3	0.2	-8.2	-0.5	0.5
Not	Russia	Cars and parts	8.9	0.5	0.1	4.1	-0.2	0.1
G7 plus	Russia	Chem and pharma	20.5	-0.1	0.0	-8.2	-0.3	0.0
Not	Russia	Chem and pharma	6.4	0.0	0.0	3.8	-0.1	0.0
G7 plus	Russia	Business services	18.7	0.3	0.3	-0.4	-7.5	0.2
Not	Russia	Business services	7.3	0.1	0.1	-0.2	1.6	0.1
G7 plus	Russia	Other services [*]	19.9	0.2	0.0	-0.4	-7.9	0.2
Not	Russia	Other services	9.7	0.1	0.0	-0.2	0.9	0.1

Note: “G7 plus” are all the countries reducing trade with Russia by 40%: Canada, France, Germany, Italy, Japan, the United Kingdom, and the United, Norway, Ukraine, and Rest of Europe. “Not” refer to other regions excluding Russia. [†] “Other goods” cover all primary and manufactured goods in the database excluding Oil, oil products (Petroleum), and gas. [±] “All services” cover all the services sectors in the model database. ^{*} “Other services” is an aggregated sector which include electricity, water, construction, accommodation, food and service activities, warehousing and support activities, real estate activities, recreational and other services, and dwellings.

Source: METRO model simulations, medium-term.

Impacts on output of industries of the countries reducing bilateral trade is small but output in some Russian sectors declines significantly depending on the scenario

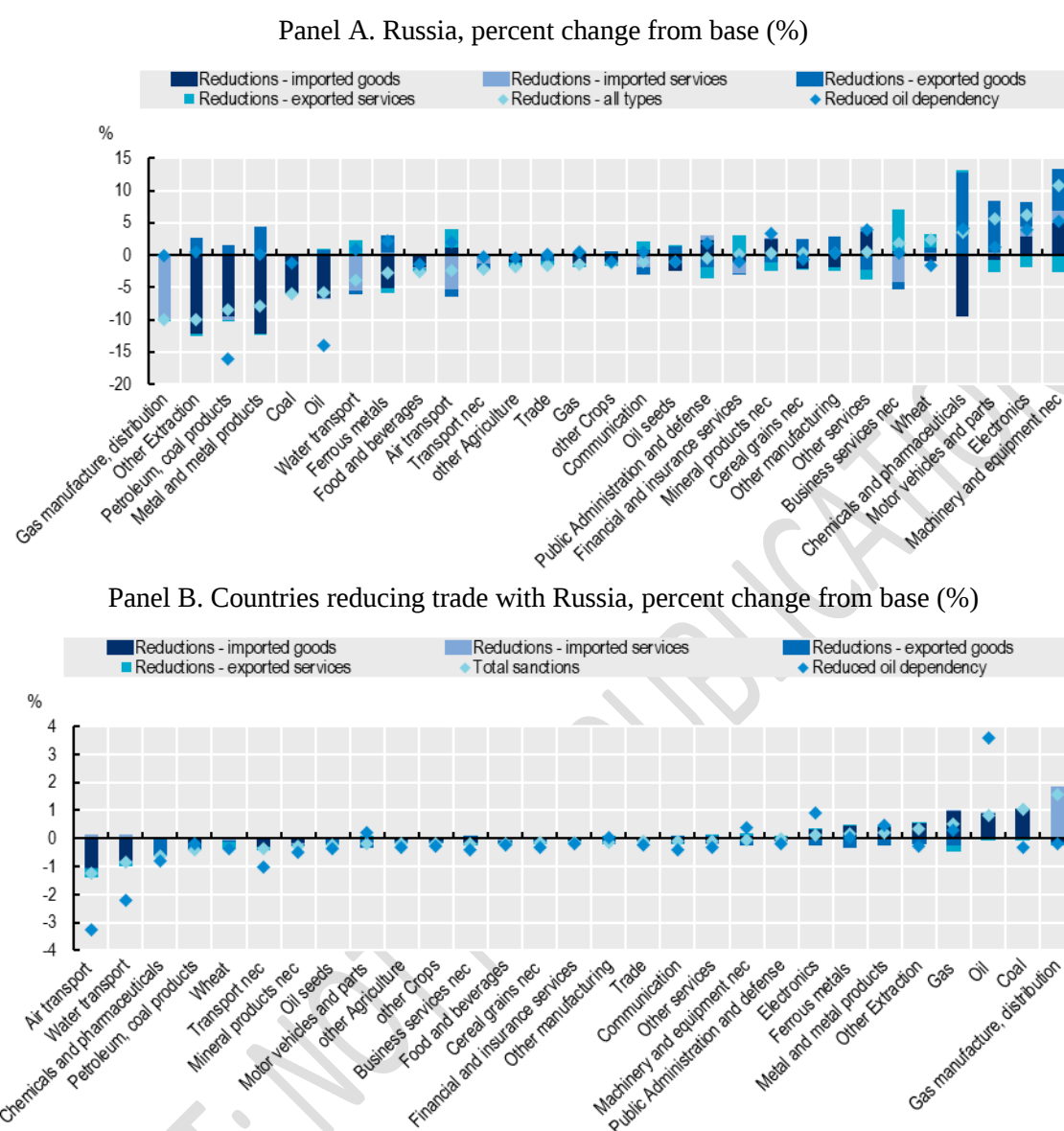
The impact on sectoral production in countries reducing all bilateral trade by 40% with Russia are smaller and notably much less severe than a full reduction of imports of Russian oil (Figure 8 Panel B). The transportation sector is most negatively affected, particularly by the 40% reduction of goods imported from Russia, which results in higher oil prices. Production in the chemicals and pharmaceuticals sectors is also negatively impacted by restrictions on

Russian trade, but more so by limiting exports of goods to Russia than other types of trade reductions. However, some sectors benefit from reduced trade with Russia. The energy sectors gains from higher prices and higher demand from the countries restricting trade.

Output in some Russian sectors declines significantly depending on the scenario. Restricting exports to Russia has mixed effects which include increases in Russian production to replace the loss of imports. The chemicals and pharmaceuticals, motor vehicles and parts, as well as machinery and equipment sectors in Russia see positive output effects ranging from 4% to 13% when G7 plus regions restrict merchandise exports to Russia (Figure 8 Panel A). However, sanctions on exports of services from G7, Europe, and Australia have a negative impact on production in almost all sectors in Russia with the exception of air transport, business, and financial services. These gains are however reduced, or even eliminated in the case of air transport, when countries also restrict exports of goods to Russia or reduce imports of Russian services. Lastly, reducing imports from Russia have a negative effect on the production of Russia's main exports including gas manufacturing and distribution, oil and oil products, and metals. Import sanctions, on goods and services, reduce output in these sectors around 10%.

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Figure 8. Changes in sectoral production



Source: OECD METRO model simulations, medium-term.

Reducing Russian trade on a broader range of industries is more impactful than oil sanctions

Overall, over the medium-term, reducing trade with Russia on a broader range of products and services has less of a negative effect on countries imposing trade reductions than a full reduction of oil imports from Russia. While a 40% reduction of goods imported from Russia, much of which consists of oil and oil products, would have a negative impact on sectors that heavily rely on fuel, the impact on households in countries applying the sanctions is much less than a 100% reduction of Russian oil. Moreover, including restrictions on exports of goods and services to Russia adds at least as much economic pressure as oil sanctions on Russian households and a broader range of industries would face even larger losses.

The impact of sanctions diminishes when markets adjust

Economic agents and markets will adjust to sanction environment, and this is what the CGE analysis captures. It allows for the possibility for Russian producers to find alternative markets for their products, domestically or abroad. The model allows also for producers in countries reducing trade with Russia to find other sources of inputs for Russian goods over the medium

term. Producers and consumers react to changes in relative prices and income and all these adjustments occur under the assumption of full employment of production factors which is a key analytical concept in long-term economic analysis. The latter assumption in particular implies that resources released from sectors that decline under sanctions on Russia ultimately end up in other sectors. The macroeconomic impact of such resource reallocations will depend on the relative productivities of declining and growing activities, but the full employment of factors mitigates the overall macro-level changes. These additional features of CGE analysis provide more insights on the economic impact of Russian sanctions in the medium run, that is, when markets and the Russian economy will have adjusted to the initial shocks.

In particular, in the CGE analysis presented here, some of the real income losses in Russia are mitigated by domestic industries' increased access to more and cheaper inputs, particularly Russian oil and oil products as well as labour and capital released from the declining oil and oil products sectors. The CGE analysis thus brings to light how some of the potential severity intended by sanctions on imports might be diminished over the medium term.²³ It also highlights that restrictions on exports to Russia are potentially more effective in the longer term. Even without taking knock-on productivity effects on Russian industries into account, curbing exports that serve as intermediate inputs diminish its production potential.

3.3 The impact of increasing trade links between OECD economies

[TBC]

4. Concluding remarks

[TBC]

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²³ Recall also that the ICIO and CGE analysis have slightly different assumptions on how much trade will be reduced between Russia and sanctioning countries. See **Error! Reference source not found.** and Section 0. The METRO assumptions reduced trade 40% between all industries while ICIO analysis had higher reductions in trade between Russia and sanctioning countries in the air transport industry, the finance sector, and in some cases the energy sector. Applying the same percent change in reduction in the METRO model, the change in real GDP (-0.87%) is well below the results from the ICIO analysis due to the reasons explained in the text.

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