WORKING PAPER

Estimating the Economic Effects of Sanctions on Russia: an Allied Trade Embargo

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Acknowledgments

Abstract

This brief aims to contribute to the ongoing discussion on the use of sanctions as a coercive tool of international policymaking, focusing on the economic effects of the sanctions on the Russian Federation ("Russia") following its invasion of Ukraine. Using computable general equilibrium modeling, we explore the short- to medium-term economic effects of a possible trade embargo by Allied countries imposed on Russia and Belarus. We consider the Allied trade embargo as a set of comprehensive trade sanctions that includes (i) import-related measures, (ii) export-related measures, (iii) FDI-related measures, and, as a spill-over effect, (iv) increased trade costs between Russia and non-Allies.

We find that Russia would sustain sizable losses of upwards of 14% of real GDP from an Allied trade embargo, even in the short run. The largest contribution to Russia's economic pain results from the exit of Allied foreign direct investment (FDI). Belarus is only marginally affected by an Allied trade embargo. Allied economies are unevenly affected by the sanctions, with real GDP losses between 0.1% and 1.6%. Non-allied economies benefit from some trade diversion, but experience even larger losses from the increased costs of trading and doing business with Russia. For example, real GDP losses to China, India, and Turkey are 0.02%, 0.04%, and 0.13%, respectively. China joining the group of Allies results in greater economic losses for Russia; Allied economies and China would be adversely affected by this move. Finally, Russia would suffer significantly higher losses if it were the party enacting countersanctions, rather than resigning itself to being a sanction target.

Keywords

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Introduction

Since 24 February 2022, Russia has waged a war of aggression against Ukraine. Russia invaded Ukraine's sovereign territory from multiple fronts, including from neighboring Belarus. Much of the world has shown remarkable unity in swiftly condemning Russia's actions. Many countries have acted with decisive resolve by sanctioning Russia for its actions, and Belarus for permitting Russia to use it as a staging ground for Russia's military action. At the time of writing at least 40 countries[1] are part of the coalition ("Allies") to impose economic sanctions on Russia and Belarus.

While some observers have characterized the sanctions as coordinated among the Allies, the fact of the matter is that each Allied country has selected its own set of sanction targets (institutions, companies, sectors, and individuals of Russian and/or Belarusian extraction) and its own sanction design. Sanctions include financial measures against Russia's central bank and/or commercial banks, import restrictions and bans, export controls, investment bans, travel restrictions, seizure of Russian offshore assets, and suspension of international cooperation.[2] Some of the most severe sanctions have been imposed by G7 countries and the EU.[3]

Since the beginning of Russia's attempted conquest of Ukraine, a large fraction of foreign companies that were invested in Russia and Belarus ("Russia+"[4]) have withdrawn or suspended operations, either for reasons of taking a stand against aggression, caving to political or social pressure at home, or in reaction to increasing difficulties of operating in these two markets.[5]

Responding to Allied sanctions, Russia has begun to impose its own countermeasures, or countersanctions (for example on wheat exports), against nations it considers "unfriendly".[6] In addition, Russia has implemented strong capital controls on nationals and foreign subsidiaries – presumably to stabilize its currency and to prevent an exodus of capital.

The purpose of this brief is to present estimates of potential short- to medium-term economic effects of Allied sanctions (and potential countersanctions) on Russia+, as well as on Allied and non-sanctioning economies.[7] Specifically, we explore a heightened conflict scenario, namely one in which Allies – in addition to their current sanctions – impose a comprehensive trade embargo on Russia+. While we cannot predict the probability that relations between Allies and Russia+ develop to such an extent, we believe that it is instructive to analyze the economic effects that such a "last resort" option on the part of the Allies may have on the global trading system and economies worldwide.[8]

As is customary for research of this kind, the modelling solution that we apply is a computable general equilibrium (CGE) analysis. We employ the well-known GTAP model-cum-database of the world trading system and international trade flows to carry out simulations. The model is appreciated among practitioners for its rigorous peer-review process and up-to-date datasets that is maintained by a global network of independent researchers.

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1 The most up-to-date list of sanctioning countries is maintained by PIIE. At the time of this writing, the sanctioning countries include Albania, Australia, Bahamas, Canada, EU 27, Iceland, Japan, Korea, Liechtenstein, Montenegro, New Zealand, North Macedonia, Norway, Singapore, Switzerland, Taiwan, the United Kingdom, and the United States.

2 For an up-to-date overview of Allied sanctions, *see,* e.g., publicly accessible resources by Sidley Austin LLP.

3 For example, all members of the G7 and the EU have agreed to revoke Russia's most-favored tariff (MFN) status, permitting them to increase import tariffs on Russian imports at their discretion. In a somewhat symbolic move, both the US and Canada have imposed an import ban on all Russian energy products.

4 As a convenient shorthand, we will use the term "Russia+" when referring to Russia and Belarus together. This reflects the facts that Russia not only launched this war, but also that the Russian economy is significantly larger and more integrated in world trade than Belarus' is. When referring to Russia or Belarus individually, we will drop the signifier "+".

5 *See* Yale University's CELI website for an up-to-date list of corporations that have withdrawn from or suspended operations in Russia. No similar list exists for Belarus.

6 We are not aware of an online source that comprehensively tracks Russian countersanctions.

7 The focus in this paper is on the short- to medium-term effects of economic sanctions. The Allies' stated intent is to impose economic strain on Russia+ *immediately* in order to effectuate change in the countries' actions. We hope our results underscore that those short-term effects on Russia+ can be sizable.

8 Such a trade embargo may be seen as a harbinger to a complete disintegration of the global economy into two separate economic blocs in the long run, as estimated by WTO (2022), Scenario 5.

We model the Allied trade embargo on Russia+ as a composite of four separate components: (i) an embargo on imports from Russia+; (ii) an embargo of Allied exports to Russia+; and (iii) partial withdrawal or suspension of FDI by companies headquartered in an Allied country. As a collateral consequence of the Allied trade embargo (iv), we consider the effects of increased trade costs of trade between Russian+ and non-Allies. The structure of our model allows us to generate results for each of the four elements individually, as well as for the total, composite, effects. We also consider policy-relevant extensions of our main model, including an estimation of economic effects of further non-sanctioning countries (specifically China) joining the club of the Allies.

Our main results can be summarized as follows: As a result of an Allied trade embargo

- Russia could forego as much as 14.80% of real GDP and Belarus 1.23% of real GDP in the short- to medium term.[9] The withdrawal of Allied FDI is a key driver of Russia's real GDP losses. Further, Russia would suffer total import losses of 50.7% and export volumes would decrease by 22.6% (import and export losses to Belarus would be 15.8% and 22.1%, respectively).

- Allied countries would be affected less by their imposition of the trade embargo. On average, Allies would lose 0.52% of real GDP, 0.21% total imports, and 0.28% total exports. Economic pain would be unevenly distributed, however, with several European countries (e.g., Netherlands, Germany) seeing real GDP losses well in excess of 1%. The US and Canada – economies that are less integrated with Russia+ and less dependent of energy imports – would stand to lose around a tenth of one percent of real GDP or less.

- Most non-sanctioning countries (including important Russian+ trading partners China, India, and Turkey) also stand to lose from an Allied trade embargo. Turkey, for example, would experience a 0.13% loss in real GDP by an Allied embargo on Russia+. The largest effects on non-Allies come from increased transaction costs of doing business with Russia+ that result from the web of Allied trade and financial sanctions.

- An accession of China to the group of Allies achieves mixed results (from the perspective of the Allies). While Russia would suffer higher GDP, welfare, and trade losses, both China and the Allies would also be adversely affected by this move.

- Our estimates of harm inflicted on Russia+ by an Allied trade embargo are likely conservative. Where modeling choices were required, we opted for estimates and approaches, that, while reasonable, yielded the least damaging results from the perspective of Russia+. In that sense, our results demarcate the lower end of potential harm that an Allied trade embargo may inflict on Russia+; more harmful effects on Russia+ are indeed likely.

Our analysis contributes to the existing literature on the economic effects of the war in Ukraine and of the subsequent sanctions on Russia in the following ways: *First*, our counterfactual is a trade embargo by the Allies. In that sense our counterfactual is more comprehensive than modeling the current set of sanctions,[10] across-the-board increases in import tariffs,[11] or increases in import tariffs on only energy products.[12] *Second*, our model allows us to decompose the total effects and analyze separately the economic impacts of each of the components that constitute a trade embargo. Hence, our analysis can provide information about which component "packs most punch"

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9 As we will discuss in more detail below, Belarus' economic losses from an Allied embargo are smaller than Russia's for various reasons. For one, Belarus is a relatively closed economy; what little FDI and trade occurs is mainly with Russia, China, and other non-sanctioning CIS states. Moreover, Belarus profits from the relative complementarity between the Russian and its own economy; less international trade exposure by Russia on account of sanctions means more trade with Belarus.
10 *Compare* WTO (2022), Scenarios 2(a), 2(c).
11 *Compare* Evenett and Muendler (2022), WTO (2022), Scenario 2(b).
12 *Compare* Chepeliev et al. (2022).

from the perspective of the Allies, and about the inherent trade-offs between inflicting economic pain on Russia+ and minimizing the pain that Allies may bring on themselves.[13] *Third,* our analysis considers the current group of Allies,[14] instead of a subset thereof,[15] as well as Russia and Belarus as sanction targets, instead of Russia only.[16] *Fourth,* the results we present can be interpreted as short- to medium-term effects, rather than long-term effects.[17] *Fifth*, our analysis includes topical model extensions that respond to recent policy discussions, for example, the question of the added value of enlarging the group of Allies.

The rest of this brief continues as follows: Section B introduces our methodology and describes the way we characterize the Allied trade embargo and implement that counterfactual in GTAP. Section C presents key findings and draws some policy implications. Section D introduces three policy-relevant model extensions of our main model. Section E concludes.

Box 1 provides the interested reader with a few key statistics about the Russian and Belarusian economies, and their integration in global trade flows.

Box 1. Background on the Russian and Belarusian economies[18]

The GDP of **Russia** was $1.48 trillion in 2020, down from $1.69 trillion in 2019. Russia's GDP had peaked at $2.29 trillion in 2013 just before its annexation of Crimea (and the subsequent sanctions by Western democracies). Total Russian exports amounted to $333 billion in 2020, down from $420 billion in 2019 and $522 billion in 2013. Russia's main export items (by value) are hydrocarbon energy products, iron and steel, agricultural commodities, and precious stones and metals. Allied countries purchased 59.2% of Russian exports in 2019. This share had been hovering around 60% since 2010 (source: ITC TradeMap). Total Russian imports amounted to $240 billion in 2020, also down from $254 billion in 2019 and $341 billion in 2013. Russia has decreased its reliance on imports from Allied countries after its annexation of Crimea. 54% of Russia's imports came from Allied countries in 2019, a reduction compared to 64% in 2011-2013 (source: ITC TradeMap). Main import articles were machinery and electrical equipment, transport equipment, and chemicals. Russia has attracted an annual average of $24.1 billion in FDI during 2015-2019, down from an annual average of $36.3 billion pre-Crimean annexation during the 2010-2014 period. According to the Central Bank of Russia, more than 95% of annual FDI flows had originated from Allied countries during the period 2010-2018; this share has dropped more recently to 85% (2019-2021). Total FDI stock in 2021 was $505 billion, $449 (or 88%) of which originated from Allied countries.

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13 WTO (2022) also models different mechanisms through which global trade will be affected by Allied sanctions against Russia. How-ever, in contrast to our paper, the results of the 5 scenarios in WTO (2022) cannot simply be added up so as to generate a total effect size of Allied sanctions (*see ibid.,* p. 16).

14 We define the group of Allies as consisting of US, UK, EU27, Japan, Korea, Taiwan, Singapore, Canada, Australia, Switzerland, and Norway. This appears to capture most countries that have imposed sanctions of Russia+, except for smaller players such as New Zealand, Iceland, Liechtenstein, some ex-Warsaw Pact countries, or the Bahamas (any of which are hard to separate out in GTAP).

15 *Compare* Evenett and Muendler (2022); Chepeliev et al. (2022). Felbermayr et al. (2022) and WTO (2022) include a majority of the currently sanctioning Allies.

16 *Compare* Evenett and Muendler (2022); Chepeliev et al. (2022); Felbermayr et al. (2022); and WTO (2022) – any of which provides results for Russia only.

17 *Compare* Evenett and Muendler (2022); Felbermayr et al. (2022); WTO (2022), Scenario 5. Chepeliev et al. (2022) and WTO (2022), Scenarios 1-4, on the other hand, also model short-term effects.

18 Unless noted otherwise, the statistics in this text box are taken from UNCTAD. Useful and up-to-date economic indicators for Russia can also be found in the World Trade Organization's 2022 Trade Policy Review of the Russian Federation. WTO (2022), Chapter 1, also provides useful statistics on Russia's integration into the world economy.

As for **Belarus**, the GDP of Belarus was $60.3 billion in 2020 compared to $64.4 billion in 2019, and a peak at $78.8 billion in 2014. Historically, Russia has been the main trade partner of Belarus; in 2021, it accounted for 49% of foreign trade in goods (41.1% of total exports and 56.6% of total imports). Total Belarusian exports amounted to $29 billion in 2020, down from $33 billion in 2019 and considerably lower than the country's export peak at $46 billion in 2012. By far the largest export destination was (and is) Russia. Allied countries purchased 39% of Belarus exports in 2019, a reduction compared to 43% during 2010-2018 (source: ITC TradeMap). Belarus' main export items are mineral fuels, fertilizers, transport equipment, dairy products, and machinery. Total imports amounted to $33 billion in 2020, down from $39 billion in 2019 and $46 billion in 2012. The overwhelming majority of imports originate in Russia, followed by China. 26% of Belarus' imports came from the Allied countries in 2019, a decrease from 29% during 2010-2018 (source: ITC TradeMap). Belarus has attracted annual FDI worth $1.4 billion during 2015-2019, down from an average $2.2 billion annually during the 2010-2014 period.

Methodology, data, and modeling the Allied trade embargo

We conduct our analysis using an approach common among trade economists, the Global Trade Analysis Project (GTAP). GTAP is a micro-founded multi-country, multi-sector macro-economic framework that considers intermediate linkages. The model was specifically designed for trade policy analysis. GTAP is used around the globe for economic impact assessment of trade and investment policy measures.

GTAP has two key elements: (1) a standard modeling framework and (2) a global dataset. The GTAP modeling framework is based on standard economic theory and has been described in detail elsewhere.[19] The model allows comparisons of the global economy in two environments: a baseline scenario in which the base values of policies are unchanged (the "baseline"), and one in which model variables are "shocked" to reflect the set of policies or events under examination (the "counterfactual").[20] Comparison of counterfactual and baseline yields the estimated economic effects of the policy shocks introduced. GTAP is able to report effects in various economic metrics, including changes in real GDP, real income,[21] export and import volumes and prices, exchange rates, and terms of trade.[22]

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19 The GTAP model is further documented in Hertel (1997) and in Corong et al. (2017). Equilibrium quantity and prices are determined through constrained optimization processes. The behavioral (functional) side of the model is complemented by accounting relationships that ensure consistence with expenditures, income and production flows. Trade flows are modeled following an Armington approach with a constant elasticity of substitution functional form. The simulated general equilibrium effects and their decomposition were obtained using the General Equilibrium Modeling Package (GEMPACK), *see* Harrison et al. (1996), Harrison et al. (2000), and Horridge et al. (2018).

20 We run our scenarios in a comparative-static environment. This is different from WTO (2022), which applies the WTO Global Trade Model in recursive dynamic mode. Dynamic recursive approaches are typically used for long-term analysis. They are methodologically and computationally more complex and tend to be more speculative, since they require subjective projections of future economic developments.

21 Real GDP measures the productive capacity of an economy – the aggregate quantity of goods and services produced. Improvements (deterioration) in real GDP are generated from more (less) efficient allocation of resources, technological progress, changes in productivity, and capital or labor growth. Real GDP does not incorporate relative price changes (such as terms-of-trade effects or inflation). Real income is the income of countries after adjusting for relative price changes. Real income changes are typically interpreted as a useful indicator of changes in a country's economic welfare since real income measures the amount of goods and services that a country can actually purchase.

22 "Terms of trade" is a measure of a country's export prices expressed as a function of import prices. All things equal, a deterioration of terms of trade – lower export prices relative to import prices – is harmful to the welfare of an economy, because it has to export more goods and services to be able to afford the same amount of imports. Conversely, an improvement in terms of trade is beneficial to an economy, because it can enjoy more imports for the same amount of exports. A change in terms of trade can be caused by international supply or demand shocks, exchange rate movements, or structural changes in the domestic economy.

The second GTAP element is a well-documented global database of international trade, economy-wide inter-industry relationships, and national income accounts. The GTAP dataset and economic parameters we apply are adapted from Narayanan et al. (2012). We updated the version 8 GTAP data inputs to reflect economic conditions around 2017-2019 using macro-economic statistics from IMF's World Economic Outlook data and disaggregated trade statistics from the World Bank's World Integrated Trade Solution (WITS) system. For purposes of our analysis, we defined 32 geographic regions (whereby Russia, Belarus, and the most important Allies and non-Allies are separate regions), and used all 65 available sectors, including important Russian export sectors (such as the oil, gas, coal, raw materials, and wheat), as well as key import sectors for Russia (such as pharmaceuticals, machinery & equipment, and electronics).

As mentioned, we simulate an Allied trade embargo by defining a counterfactual that consists of four components, each of which is implemented as a separate model shock:

i. An embargo imposed by Allies on imports from Russia+ ("Allied import embargo");

ii. An embargo of Allied exports into Russia+ ("Allied export embargo");

iii. Partial withdrawal or suspension of FDI by companies headquartered in an Allied country ("Withdrawal of Allied FDI"); and

iv. As a collateral consequence of the Allied trade embargo, higher trade costs at which Russia continues to trade with non-sanctioning countries ("Trade cost increases").[23]

The design and implementation of the sanctions in the model are as follows:[24]

- *First,* to estimate the effects of an Allied import embargo on Russia+, we impose prohibitively high across-the-board import tariffs by each Ally on Russian+ imports. Specifically, we increased the power of import tariffs by 260% for each Allied country and for each sector.[25]

- *Second,* we modeled the Allied export embargo as prohibitively high across-the-board export taxes. Specifically, we increased the power of export tariffs by 95% for each Allied country and for each sector.[26,27]

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23 As we will explain in more detail below, this element reflects increased transaction costs of doing trade with Russia+ and a weaker negotiation position by Russian+ importers and exporters.

24 An alternative to our approach of modeling the complete deterioration of trading relationships between the Allies and Russia+ as an import/export embargo imposed by the *Allies* is to contemplate the imposition of comprehensive *countersanctions by Russia+* on imports from Allies and exports destined to Allies. In that scenario, Russia+ would preempt Allied sanctions by imposing their own embargo. We consider this alternative scenario in Section D, below. As we report, countersanctions by Russia+ would be significantly more disadvantageous for Russia+ and more advantageous for the Allies, as compared to an Allied trade embargo.

25 The power of an import tariff is (1+ tariff rate); for example, the power of a 10% import tariff is 1.10. In initial equilibrium, import tariff rates may differ by country, sector, and trade partner. We allow the new (post-shock) equilibrium tariff rates to differ as well, but increase them by 260%. To illustrate, suppose the pre-embargo import tariff was 10%, then post-embargo, the new import tariff rate would be 296% (i.e., 1.10*2.60 = 2.96). An import tariff of 296% leads to a reduction of Russian+ imports to Allies by nearly 100%, thus satisfying the requirements of an import embargo.

26 An export tax is a negative export subsidy. The power of a 10% export subsidy is 1.1, that of a 10% export tax is 0.90. Since the GTAP database does not contain many export interventions, an across-the-board export subsidy shock of 95% to an export power of 1.00 thus typically yields an export tariff rate of 95% post-embargo. An export tariff of 95% achieves close to a complete reduction of Allied exports to Russia+, thus satisfying the requirements of a complete export embargo.

27 We have opted against implementing an Allied import/export embargo via an increases of non-tariff barriers (NTBs; *compare* Felbermayr et al. (2022) and WTO (2022), Scenario 2(a)). We did so for a number of reasons, among them the fact that many of the contemporary sanctions do take the form of tariff barriers, rather than behind-the-border regulations (see, e.g., Canada's imposition of an across-the-board import tariff of 35%). Also, from a modeling perspective, an increase in NTBs does not allow the GTAP modeler to obtain relevant allocative efficiency effects, which are the main component of the real GDP metric. This would have constrained our discussion to real income (or welfare) effects, rather than the customarily reported effects on real GDP. At any rate, as mentioned in the preceding two footnotes, our decision to implement the Allied sanction measures as import tariffs and export taxes results in a near-elimination of all trade between Allies and Russia+, thus properly characterizing a comprehensive trade ban. Also, we note that an implementation of the Allied trade embargo via NTBs would have resulted in significantly higher negative effects for Russia+ and most Allies and non-Allies.

- The *third* component of modeling the Allied trade embargo is partial <u>withdrawal</u> (or at least suspension) of FDI by Allied-owned subsidiaries invested in Russia.[28] It has been widely reported that a large number of foreign companies invested in Russia has already withdrawn or suspended operations since the beginning of Russia's invasion.[29] It appears reasonable to suppose that further rounds of sanctions culminate in a trade embargo on Russia would further exacerbate the ongoing FDI exodus. We are thereby agnostic as to subsidiaries' rationale for withdrawing or suspending operations: genuine outrage over Russian aggression by headquarters; social or political pressure at home; Allied rulemaking (*e.g.,* prohibition of nationals to do business in Russia or to make financial transactions); further capital controls imposed by Russia itself; criminal liability for compliance with Allied sanctions imposed by Russia; further decline of rule of law in Russia;[30] and/or a prohibitive increase in the cost of doing business in Russia (increased transportation or logistics costs, costs of financing and underwriting, problems purchasing intermediate goods abroad, restrictions on cross-border sales or repatriation of profits, etc.). We simply assume that half of Allied subsidiaries in Russia close or suspend operations, *i.e.,* that 50% of Allied subsidiaries cease production.[31] We implement this FDI withdrawal in GTAP as negative shocks in sector-specific total factor productivity (TFP) applied to those sectors with Allied-owned capital.[32]

- *Finally,* we consider the increased <u>trade costs</u> of doing business between Russia+ and non-Allies. In the face of an Allied embargo, and as compared to a no-sanction baseline, trade between Russia+ and the remaining non-sanctioning countries is likely going to be more onerous, and hence more expensive, than it already is under the current sanctions regime. Already today financing, insuring, and executing international trade deals between Russia+ and non-sanctioning countries has become significantly more costly and cumbersome as a result of Allied sanctions on Russia's central bank and the exclusion of certain Russian banks from the SWIFT clearing system. Furthermore, Russia is increasingly running low on foreign exchange due to Allied financial sanctions and diminished export volumes at lower export prices. Low reserves impair settlement of international contracts, most of which are denominated in US dollar or Euros. Once Allies pile on further sanctions, a considerable share of Russia's trade with non-Allies (mainly China and India) may even be executed in the form of barter trade deals in the near future.[33] Next, transportation costs are going to increase since Russia's infrastructure corridors into East Asia are underdeveloped, and since more and more shipping companies will discontinue service in and out of Russia.[34]

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28 We limit our discussion of FDI in Russia, since the majority of FDI in Belarus is by Russian companies; FDI by Western firms has traditionally been relatively minor, and, as reported by the US State Department, has decreased even further as a result of trade sanctions imposed by Western countries after the fraudulent August 2020 presidential elections and the subsequent government abuses against regime critics.

29 *See*, *e.g.*, Investment Monitor (2022).

30 For a summary of the weakening of rule of law in Russia, *see* U.S. Department of State, 2021 Investment Climate Statements: Russia.

31 For reasons discussed in the preceding sentences, we believe that a 50% withdrawal of Allied FDI in a trade embargo scenario is conservative. It may well be that in reaction to an Allied trade embargo an overwhelming majority of Allied companies would withdraw or suspend operations in Russia. We present the effects of such a *complete* withdrawal scenario in Section D, below. As we report, the economic effects of full Allied FDI withdrawal would be significantly worse for the Russian economy, while hardly affecting Allied countries.

32 Information about the share of inward FDI into Russia as a function of total asset investment is available from Rosstat, Russia's statistical agency, on the ISIC4 sector level for 2018-2020. The ISIC4 classification can be transposed into GTAP's sector classification (GSC3), using standard concordance tables. According to the Central Bank of Russia, 85% of all FDI flows into Russia originated from Allied countries. We thus multiplied the foreign FDI share in each GSC3 sector by 0.85 to get to the share of "Allied" FDI. To illustrate: According to the Rosstat, between 2018 and 2020 foreign subsidiaries owned an average of 63.0% of fixed assets in the motor vehicles and parts sector (GSC 43). With an 85% Allied share of total FDI this yields a share of 53.6% (63%*85%) of total assets held by Allies. The effect of a withdrawal of half of Allied FDI is then simulated as a TFP shock of 53.6%/2 = 26.8%.

33 Note that Iran was forced to engage into barter deals with non-sanctioning countries in response to the Western trade embargo over its nuclear ambitions. This has been reported by the Atlantic Council, among other sources.

34 Shipping giants Maersk, MSC and CMA CGM have already halted cargo bookings in and out of Russia. In addition, many Allies have imposed air travel bans on Russian aircraft; no Russian aircraft – whether cargo or charter – may enter Allied airspace, let alone land in Allied territory.

It appears reasonable to expect that non-Allied trading partners will shift as much of these extra transaction costs onto Russia+. Moreover, any rational non-Allied trade partner will seek to exploit Russia+'s weak negotiation position and demand sizable discounts on imports from Russian+, as well as surcharges for exports into Russia+, respectively.[35]

In sum, an Allied trade embargo will increase the costs of remaining trade between Russia+ and non-sanctioning countries, with Russia+ bearing a significant share of these cost increases. We model these cost increases of doing business between Russia+ and non-Allies as a combination of (1) a bilateral increase in NTBs of 5% for every transaction between Russia+ and a non-Allied trading partner, and (2) a 10% across-the-board export subsidy coupled with a 10% import tax by Russia+ on products traded with non-Allied countries.[36] The first element reflects the higher real trade costs on Russia+ and its remaining trading partners,[37] while the second element reflects Russia+'s weak negotiation position vis-à-vis non-Allied trading partners.[38]

These four shocks, added up, are then compared to a pre-embargo baseline, which allows us to estimate the economic effects of the Allied embargo.[39] We interpret our results as short-term effects. Since our simulations are run as comparative statics (*i.e.,* we do not allow labor and capital adjustment for each economy as a whole), our model reports short to medium-term adjustments.[40] In addition, two of the four components of our counterfactual imply a short- to medium-term horizon. *First,* our implementation of Allied FDI withdrawal (component (iii)) as TFP reduction (i.e., production stop) will unfold its main effects in the short term. In the long term, Russia may be able to substitute Allied-owned operations through domestic investment or through FDI from non-sanctioning countries.[41] *Second,* the inclusion of trade cost increases of doing business with Russia+ (component (iv)) as a corollary of the Allied trade embargo also suggests shorter-term effects. While trade costs are high now, in the long run, Russia+ and non-Allies will find new modes and ways of transacting more efficiently and equitably.

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35 According to various sources (including Reuters and CSNBC) Russia is already forced to sell its oil at a 20% discount to China and India.

36 We reasonably assume that bilateral trade between Russia and Belarus is not affected by this increase in trade costs.

37 The higher real trade costs are modeled as "sand in the gears of trade". Each trade transaction involving Russia+ becomes more costly but does not produce economic rents of any kind. *See* Harrison, Rutherford and Tarr (1994) for a motivation. As for the size of the shock, we follow DiCaprio, et al. (2020) who estimate the effects of extra time spent on export and import compliance; they translate the average shipping delay of 3.5 days across regions into a 5% ad valorem tariff equivalent. We conservatively adopt that 5% shock, even though the trade cost increases at issue here would presumably go far beyond a 3.5-day trade delay.

38 As mentioned, non-Allied trade partners are likely to exploit Russia+'s predicament and demand discounts. The combination of an export subsidy with an import tariff captures this situation well: Trade conditions change in Russia's disfavor and Russia imports fewer products from non-Allies.

39 The effects of the four components are additive and together yield the total economic effect. This is so, because we generated the four policy shocks in a single simulation run and then decompose them into four components. Quantifying each of the four components in a separate simulation run would fail to capture important interactions between the four shocks. (The relative proportions of effects between the individual components, however, would largely remain the same, even if we ran separate simulations. In that sense, performing a single simulation is without loss of generality.)

40 The comparative-statics nature of our model approach implies that the elasticities we use to calibrate the model represent short to medium-term adjustments. One way of further emphasizing the short-term nature of results would be to further decrease trade elasticities in the dataset. For example, WTO (2022) reduced the substitution elasticities of trade between different source countries to focus on the short-term nature of effects (*see* ibid., p. 25, endnote 1). As a sensitivity check we ran all scenarios with Armington elasticities reduced by 1/4 to simulate a shorter-term modeling horizon and sluggish substitutability between domestic and imported goods, and across import sources. While the economic effects of doing so are slightly larger, the direction and relative magnitudes of the results across scenarios remain intact. Notably, the adverse economic effects in that sensitivity check are worse for Russia+. The results of this sensitivity run are available from the authors upon request.

41 We note, however, that financing domestic investments has become increasingly difficult in Russia. At the time of writing the central bank interest rate in Russia is 20%, making investment expenditures extremely costly for the private sector in Russia. Also, replacing FDI with domestic ownership does not address the brain drain, nor the technology gap, nor the disruption of supply chains that an exit of foreign subsidiaries may entail.

Results and interpretation

Below we summarize the results and discuss how the economic and trade effects of the Allied trade embargo could affect different countries. We then offer some interpretations and policy implications. Finally, we compare our estimates of Allied sanctions on Russia with other reports recently published on the issue.

Simulated effects[42]

Figures 1-4 report the effects of an Allied trade embargo, as modeled in our main case, in terms of: percentage changes of real GDP (Figure 1), economic welfare or real income (Figure 2), total imports (Figure 3), and total exports (Figure 4). We break out results for Russia and Belarus (left panel), selected Allies (Allied average, US, Germany; middle panel), as well as certain non-Allies (China, India, Turkey; right panel). Each stacked bar decomposes the total effect in terms of the four components that characterize an Allied trade embargo.[43] Tables 1-4, attached at the end of this brief, report results for the full set of countries and regions.[44]

Real GDP

As Figure 1 and Table 1 report, an Allied trade embargo is expected to decrease Russia's real GDP by 14.80% and that of Belarus by 1.23%.[45] A decomposition of the effects indicates that by far the largest contribution to Russia's real GDP losses result from partial withdrawal of FDI (12.53%), followed by an increase in trade costs with non-Allies and the Allied export embargo (0.93% and 0.92%, respectively). For Belarus, the Allied import embargo on Belarusian products and the increased trade costs with non-Allies are the main drivers, causing real GDP losses of 1.18% and 0.56%, respectively. Belarus actually gains from the Allied export embargo (+0.10%) and the partial withdrawal of Allied FDI from Russia (+0.41%) as both shocks lead to an increase in Russia's demand for Belarusian goods and services.

Allied countries are affected significantly less by their trade embargo, although economic pains are unevenly distributed. Real GDP decreases most for Germany (1.20%) and the Netherlands (1.57%), while effects are less for other countries such as Switzerland (0.40%), Norway (0.31%), the United States (0.11%) and Australia (0.06%) (Table 1). Across all Allies, the weighted average of real GDP losses is 0.52%. The decomposition of effects shows that the Allied import embargo has a greater adverse effect on Allies (0.32%) than the export embargo (0.20%), and that Allies experience minimal effects overall from FDI withdrawal (0.01%). Allies are unaffected by trade cost increases between Russia+ and non-Allied trading partners.

Many non-sanctioning countries (notably China, India, and Turkey) also suffer real GDP losses from an Allied embargo. While non-Allies stand to benefit somewhat from trade diversion resulting from an Allied import and export embargo, the additional trade costs from doing business with Russia+ dominate, resulting in real GDP losses of 0.02% for China, 0.04% for India, and 0.13% for Turkey. Only a few resource-rich non-Allies (notably Saudi Arabia) experience real GDP gains (+0.03%).

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42 In addition to results reported below, we have also made available the full set of simulation results in a **Technical Appendix** that can be downloaded separately.

43 The effects of the four components are additive and together yield the total economic effect. This is so, because they were generated in a single simulation run. Quantifying each of the four components in separate simulation runs would fail to capture important inter-actions between the four shocks. However, the individual simulations would reveal the same information about the relative strength of each element relative to the others. In that sense, performing a single simulation is without loss of generality.

44 Note that we do not report estimated effects on Ukraine. These results would be meaningless given that we have not modeled the impact of Russia's invasion on Ukraine, such as the destruction of Ukrainian production factors, increased transaction costs due to destruction of infrastructure, and the country's transition towards a war economy. For an estimate of the economic effect of Russia's invasion of Ukraine, *see* WTO (2022), Scenario 1.

45 Belarus' GDP losses are significantly smaller, because it is a relatively closed economy. As mentioned, inward FDI mainly originates in Russia, and cross-border trade occurs mainly with Russia. In that sense, Allied sanctions have less reach on Belarus.

Finally, we estimate that global real GDP decreases by 0.61% as a result of the Allied trade embargo.

Figure 1. Percent change in real GDP (Russia+; selected Allies; selected Non-Allies)

Note: Scale does not match across panels.

Economic welfare (real income)

Changes in economic welfare resulting from an Allied trade embargo are reported in Figure 2 and Table 2. Economic welfare here can be thought of as real income or utility of the average household in a nation. The economic welfare effect for Russia is 29.79%, nearly twice as high as real GDP losses, which reflects the sizable terms-of-trade deterioration that Russia experiences as a results of the Allied trade embargo.[46] Belarus experiences real income gains of 0.41%, because positive trade diversion from Russia outstrips losses from the Allied import embargo. As before, the effects for Allies vary across countries, from a welfare gain for Norway and Canada (+3.61% and +0.65%, respectively) to losses of 1.16% for Germany and 1.37% for the rest of the EU. A decomposition reveals that welfare losses to European Allies are driven by the Allied import ban on Russian products, in particular the ban on Russian energy products and raw materials. For non-Allies, China and Turkey experience welfare gains of 0.12% and 0.23%, respectively, reflecting their improved terms of trade. India experiences a welfare loss of 0.32%, driven mainly by a considerable terms-of-trade loss. A few resource-rich non-Allies (Kazakhstan, Saudi Arabia, Gulf States) experience real income gains of up to 3.2% due to export price increases of fossil fuels. Finally, we estimate that an Allied trade embargo decreases global real income decreases by 0.73%.

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46 For an explanation of "terms of trade", *see* footnote 23, above.

Figure 2. Percent change in real income (Russia+; selected Allies; selected Non-Allies)

Russia/Belarus

Russia (total: -29.79)   Belarus (total: 0.41)

- Russia: -4.79, -7.83, -2.93, -14.25
- Belarus: 1.99, -2.60, 0.23, 0.80

Allies (selection)

USA (total: -0.13)   Germany (total: -1.16)   Allies (avg) (total: -0.51)

- USA: -0.10, -0.03, -0.01, 0.00
- Germany: -0.88, -0.26, -0.01, -0.01
- Allies (avg): -0.36, -0.12, -0.02, -0.01

Non-Allies (selection)

Turkey (total: 0.23)   China (total: 0.12)   India (total: -0.32)

- Turkey: 0.54, -0.16, -0.12, -0.02
- China: 0.01, 0.18, -0.06, -0.01
- India: 0.05, -0.26, -0.06, -0.05

■ Allied import embargo ■ Allied export embargo ■ Trade costs with non-Allies ■ Withdrawal of Allied FDI

Note: Scale does not match across panels.

Export volumes

An Allied trade embargo is expected to reduce <u>Russia's</u> export volumes by 22.6% and those of <u>Belarus</u> by 22.1% (Figure 3 and Table 3). Export effects for <u>Allies</u> are relatively small by comparison (0.28% on average), but, again, effects vary across countries. Countries that used to traded heavily with Russia pre-embargo (Germany, Netherlands) suffer sizable export losses, as do energy-rich Allies (Canada, Norway, Australia).[47] Countries less integrated with Russia (France, Italy, Japan) even gain competitiveness and achieve export volume increases owed to a relative decline in their export prices (*i.e.,* overall terms-of-trade losses). As expected, <u>non-Allies</u> typically experience export gains as they move to fill the void from the Allied embargo with increased exports to Russia+ and to Allies.

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47 Export volume losses by resource-rich Allies are a function of a slow-down of economic growth worldwide and of relative price increases for export products (mainly energy products), as compared to Russian exports, in third markets.

Figure 3. Percent change in total exports (Russia+; selected Allies; selected Non-Allies)

Note: Scale does not match across panels.

Import volumes

Figure 4 and Table 4 report the total import volume changes resulting from an embargo by Allies. Russia experiences a 50.7% decline in import volume, and Belarus a decrease of 15.8%.[48] Import volumes for Allies are heterogeneous, but relatively small. On a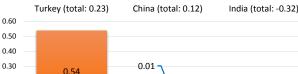verage, import volume decreases across Allies are 0.21%. US import volumes decline by 0.77%, which reflects increased product prices in China, the US' largest supplier. Resource-rich Allies such as Canada, Norway, and Australia experience increases in import volumes by up to 2.7% due to terms-of-trade gains. The additional imports are mainly sourced from other Allies. Non-Allies record small but positive overall imports increases.[49]

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48 Belarus' relatively minor import losses can be explained by import diversion towards Russian products.
49 A few resource-rich non-Allies, such as Kazakhstan, Saudi Arabia, and the Gulf States increase import volumes by up to 7.3%, bene-fitting from sizable terms-of-trade gains.

Figure 4. Percent change in total imports (Russia+; selected Allies; selected Non-Allies)

Russia/Belarus

Russia (total: -50.73)   Belarus (total: -15.76)

Allies (selection)

USA (total: -0.77)   Germany (total: -0.17)   Allies (avg) (total: -0.21)

Non-Allies (selection)

Turkey (total: 1.98)   China (total: 0.69)   India (total: 0.29)

■ Allied import embargo ■ Allied export embargo ■ Trade costs with non-Allies ■ Withdrawal of Allied FDI

Note: Scale does not match across panels.
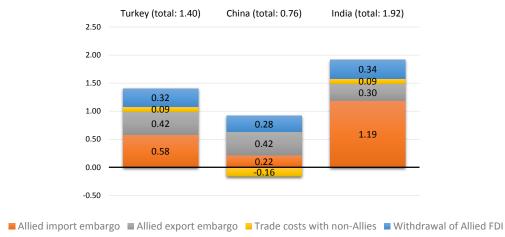
Sectoral Effects for Russia

Focusing on the Russian economy, faced with an Allied trade embargo (and Allied FDI withdrawal in particular), Russia is forced to engage in substantial resource reallocation across sectors. Put differently, the Allied embargo forces Russia to reshuffle domestic resources and to become more self-sufficient. Table A, attached at the end of this paper, reports sector-by-sector changes in total (i) exports, (ii) imports, and (iii) production in Russia for each GTAP sector. Russia's <u>exports</u> decline in raw materials (gas, coal, petrol products, minerals), in primary products that it used to export to European neighbors (steel, non-ferrous metals), and in a variety of goods and services in which Russia has been integrated in global value chains (motor vehicles and transportation equipment, electrical equipment, pharmaceuticals, finance). Exports to non-Allies increase in certain primary goods and commodities (oil, wheat, sugar, meat, and dairy). Russia's <u>imports</u> decrease across the board. Imports decline by half in many sectors, and in many service sectors (telecom, financial services, real estate) by three quarters or more. Russia's <u>domestic production</u> shifts away from raw materials and intermediate goods, and towards commodities and low-tech manufacturing (textiles and apparel, leather, metal products), as well as some advanced manufacturing (electronics, transportation equipment, pharma).

Interpretation and policy implications

While a country-by-country deep dive is beyond the scope of this brief, we summarize the results for some countries and regions below and provide some interpretations of the underlying economic mechanisms.

- **An Allied trade embargo on Russia has teeth:** Regardless of what economic effects are considered and how economic harm is measured, Russia would sustain substantial losses from an Allied embargo, even in the short run. The largest contribution to Russia's economic pain is the exit of Allied FDI (component (iii)). An Allied import and export embargo (components (i) and (ii)) leads to a deterioration of Russia's terms of trade and forces Russia's economy to become more self-sufficient. To the extent that Russia can maintain trade with non-Allies, the composition of trade changes considerably. Overall, there is a substantial inefficient reallocation of resources within the Russian economy as it reorganizes towards autarky and towards exporting more agricultural commodities, apparel, leather goods, and electronics to non-Allies.

- **Belarus is only marginally affected by an Allied trade embargo:** The Belarusian economy is largely dependent on trade with and investment from Russia, and so its economy actually benefits from the Allied sanctions. Less integration of Russia in the world economy implies a tighter integration of Belarus into the much larger Russian economy. While Belarus would lose slightly from an Allied embargo in terms of real GDP, and would thus experience lower import and export volumes, it would still achieve terms-of-trade gains and real-income improvements. As a result, Belarus enjoys higher import volumes from Russia and at lower prices, making Allied sanctions on Belarus relatively ineffective.

- **For Allies, the pain resulting from their trade embargo is unevenly distributed**: The economic effects on Allies can be divided into four groups: (1) Allies that have been relatively more integrated with Russia (Germany, Netherlands, Central/Eastern Europe); (2) resource-rich Allies (Canada, Norway, Australia, USA); (3) resource-poor Far East (Japan, Korea, Taiwan), and (4) Western European Allies (UK, France, Italy, UK, Switzerland).

  1. **Higher-integrated Allies** stand to experience the greatest economic losses from an Allied trade embargo. The import side is thereby particularly affected owing to the dependency on Russia's energy and raw materials that these countries have developed over the years. Overall, these countries import fewer fossil fuels from world markets. Real income losses would be slightly smaller than real GDP losses due to minor terms-of-trade gains, driven by export price increases in the chemical, motor vehicle, and air transport sectors.

  2. **Resource-rich Allies** experience losses in real GDP and total export volumes on account of a reallocation of resources towards extractive sectors. Real income, however, increases due to significant terms-of-trade gains driven by export price increases for fossil fuels, hydrocarbon products, and raw materials.

  3. **Resource-poor Far-Eastern Allies** have historically been less integrated with Russia, and therefore experience moderate real GDP losses. However, since they are dependent on imports of fossil fuels and raw materials, the prices of which increase, these Allies suffer terms-of-trade losses, and thus considerable real income losses and import decreases.

4. **Western European Allies**, finally, are affected similar to Far-Eastern Allies, albeit with a lower amplitude. Real GDP losses are at a moderate scale, but terms of trade typically decline since import price increases for fossil fuels and hydrocarbon products dominate. Relatively cheaper export prices increase competitiveness and bolster export volumes. As a result, real income losses tend to be slightly higher than real GDP losses, but only moderately so.

Looking at the unequal distribution of economic pains and gains, the Allies may wish to develop strategies to soften the blow, and to prevent countries to abandon the group of Allies. Given that Europe's largest economies (Germany, France, Italy, Netherlands, UK) stand to lose out substantially from an Allied trade embargo, an economic loss to Europe may send shockwaves throughout the world economy that is already reeling from the effects of the Covid 19 pandemic.[50] In that sense, strategies to aid the biggest losers among Allied countries may be in everyone's interest. One obvious strategy could be for the Allies to reduce trade barriers among themselves. Another strategy could be burden-sharing plans or adjustment assistance between the extreme and the moderate losers of an Allied trade embargo.[51]

• **The impact on non-Allies could be negative:** An Allied trade embargo is expected to have a negative effect on real GDP for most non-Allies. While, as expected, non-Allies benefit from trade diversion effects, they experience even higher losses from increased transaction costs of doing business with Russia+ (component (iv)). That is, non-Allies are trading more with a country that is more costly to do business with due to banking sanctions, trade sanctions, legal troubles, and reputational risks. In addition, non-Allies may generally suffer from stunted growth of the world economy as a whole. When effects are expressed in terms of real income, most non-Allies record small gains on account of terms-of-trade improvements.[52]

Allies may be able to turn the specter of welfare losses into a bargaining chip in negotiations with to non-Allies. Once non-sanctioning countries appreciate the negative externalities that an Allied trade embargo may have on their economies, they may be more willing to consider exercising additional political or economic pressure on Russia+.

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50 *See, e.g.,* Bloomberg's article on the harm of Russia sanctions to the German industry and the knock-on effects for the European economy.

51 We are not suggesting that such burden-sharing strategies would need to take the form of monetary compensation. Indeed, increased cooperation and non-monetary aid between Allies is already happening. For example, the US has announced plans to increase natural gas route 15 billion cubic meters of liquid natural gas to the EU over the course of 2022 to help the EU rid itself from its dependency on Russian gas. An alternative, suggested by Gros (2022), is for Allies to impose optimum tariffs on imports on Russian+ products – rather than a complete import ban. The tariff revenues collected in the process can then be used to (partially) compensate losers among the group of Allies. Of course this presupposes a selection of sectors with low pass-through, such that Russian+ producers, rather than Allied consumers, pay the import tariffs.

52 Notable exceptions here are India and South Africa. India's export prices decrease relative to import prices, which is mainly driven by import price increases of fossil fuels, chemicals, and non-ferrous metals which are overpowering export price increases in petroleum and coke products, chemicals and manufacturing. South Africa is mainly affected by import price increases of oil and gas, as well as petroleum products. Export price increases in coal, coal products, and extractive minerals cannot make up for import price increases, resulting in overall terms-of-trade losses.

Comparison of results with recent CGE estimates on the effects of Russia sanctions

Recent efforts to estimate the economic effects of the Ukraine invasion and the subsequent sanctions using CGE modeling include Evenett and Muendler (2022), Chepeliev et al. (2022), Felbermayr et al. (2022), and WTO (2022).[53] Methodological and modelling differences between the various papers notwithstanding, it is instructive to compare the results generated by above authors with ours. Since our model allows for a decomposition of total effects of an Allied trade embargo into four distinct components, we can compare previously published results with the substantively most similar components of our counterfactual. While this does not permit a full apples-to-apples comparison of estimates, it may still be useful to situate our approach within the literature.

Evenett and Muendler (2022) modeled an import ban on Russian energy products, coupled with an across-the-board import tariff of 35% and imposed by all G7 countries and the EU. Their approach compares most closely to component (i) of our counterfactual, namely an Allied *import* embargo imposed on all Russian+ products. Evenett and Muendler report long-term losses of real GDP to Russia of 1.06%, while real GDP losses to all sanctioning countries combined were 0.06%. Comparing these results to Figure 1, above (and column 2 in Table 1), we can see that our estimates of an Allied import ban are less advantageous from an Allied perspective: real GDP losses to Russia are only 0.42%, while GDP losses suffered across all Allies are 0.32%.

Chepeliev et al. (2022) modeled an import ban on Russian fossil fuels by the EU. They estimate short-term losses in real income (as a measure of welfare) of 6% for Russia and of 0.3%-0.6% for the EU. Again, this compares most closely (albeit imperfectly) to component (i) of our approach, an Allied *import* embargo on all Russian+ products. Looking at Figure 2 (and column 2 in Table 2), our estimates of an Allied import ban, in absolute terms, are slightly smaller for Russia (real income losses of 4.79%) and larger for the EU with average real income losses of 0.79%.

Felbermayr et al. (2022) modeled a "trade war" that the authors characterized as a comprehensive import and export embargo imposed by a large group of Allies[54] on Russia. The authors report economic effects in terms of changes in real income and in total exports. They estimate real income losses of 9.71% for Russia and of 0.17% across all Allies, as well as total export losses of 45.21% for Russia and 5.72% for Allies. The authors' trade war scenario compares most closely to components (i) and (ii) of our approach, i.e., Allied *import and export* embargos on all Russian+ products. Looking at Figures 2 and 3 (and adding up the appropriate cells in columns 2 and 3 in Tables 2 and 3), we see that our results, in absolute terms, are somewhat higher as regards real income loss: We estimate real income losses of 12.62% for Russia, and an average real income loss across all Allies of 0.49%. However, our estimates of export losses experienced by Russia are lower at 16.14%, as are those by Allies, with estimated export losses of 0.53%.

The most recent contribution to modeling the economic effects of the Ukraine conflict is WTO (2022). The report describes mechanisms through which global income and trade may be affected in the short- and long term. The counterfactuals cover a wide range of effects including those of: Russia's invasion (Scenario 1), the subsequent trade sanctions (Scenario 2), the macroeconomic repercussions of declining consumer and business confidence worldwide (Scenario 3), the effect of the Ukraine conflict on global food prices (Scenario 4), and the formation of two economic blocs as

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53 We do not consider projections by OECD (2022) here, because the authors impose exogenous shocks to commodity prices and other macroeconomic variables. The CGE models we discuss below define policy shocks on trade costs, factor supply or productivity, domestic absorption, etc., whereas trade and production flows, commodity prices, exchange rates, and other macroeconomic variables are endogenous to these models.

54 The authors define the Allies as US, the EU 27, Albania, Australia, Canada, Iceland, Japan, New Zealand, Norway, Philippines, South Korea, Taiwan, Turkey, and the United Kingdom.

a long-run consequence (Scenario 5). Relevant for current purposes is Scenario 2, which seeks to model sanctions by Allies that have already been implemented or whose implementation is imminent, i.e., the *status quo*.[55] Scenario 2 is thereby a compound of three sub-scenarios:[56]

- Scenario 2(a) is composed of a number of export-related measures in certain sectors by Allies (not a complete export embargo), and of sanction-related transaction cost increases. The sub-scenario includes "boycotts of western companies", which is modeled as a 50% export tax in the manufacturing and services sectors.[57] It also includes transport cost increases resulting from Allied sanctions.[58] The WTO (2022) report uses real GDP as key output metric and breaks out results by scenario and by country/region. For Scenario 2(a), the paper estimates real GDP losses of 1.9% for Russia, 0.7% for the EU, and 0.3% across all Allies.

- Scenario 2(a) compares most closely with components (ii)-(iv) of our model – an Allied export embargo, withdrawal of Allied FDI, and higher trade costs for trade between Russia+ and non-Allies. Looking at Figure 2 (and adding up the appropriate cells in columns 3 to 5 in Table 1), we see that our results are slightly smaller, in absolute terms, for the Allies (0.20%) and the EU (0.66). For Russia, however, our estimated real GDP losses of 14.38% across components (ii)-(iv) are considerably higher – a result that is mainly driven by the different way in which we model withdrawal of Allied FDI (which WTO (2022) calls "boycott of western companies").

- Scenario 2(b) models the implications of a revocation of MFN status and subsequent 32% tariff hikes on all merchandise goods *except fossil fuels by Allies*.[59] The WTO (2022) report estimates incremental real GDP losses of 0.1% for Russia, 0.6% for the EU, and 0.4% across all Allies.[60]

- This sub-scenario thus compares most closely to (but is more limited than) our component (i) – Allied import embargo. Looking at Figure 2 and column 2 of Table 2), we see that our results are slightly smaller, in absolute terms – namely real GDP losses of 0.42% for Russia, 1.03% for the EU, and 0.32% across all Allies.

- Scenario 2(c) considers sanctions by Allied central banks and the resulting financial distress in Russia. The authors model this as a 5% drop in domestic absorption. The estimated incremental real GDP losses for this sub-scenario are 3.3% for Russia. The EU would experience real GDP gains of 0.2%. Real GDP gains of 0.1% would also result across all Allies. There is no component of our counterfactual that compares to this policy shock.

Table B summarizes the comparison between our estimates and recently published CGE analyses, decomposing the scenarios to achieve like-for-like comparisons. For the Allied import embargo, our loss estimates are typically smaller for Russia and larger for Allies than previous estimates (in absolute terms). For more comprehensive sanction scenarios our estimates tend to yield larger loss estimates for Russia than others have found, which is mainly due to the way we model partial FDI withdrawal in our counterfactual.

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55 The authors define the Allies as US, the EU 27, EFTA (Norway, Iceland, Liechtenstein, Switzerland), Japan, Korea, and UK.

56 *See* WTO (2022), Table 2.

57 Compare this to the way we model Allied withdrawal of FDI, namely as a 50% decline in sector-specific TFP applied to those sectors with Allied-owned capital. The difference in modeling withdrawal of Allied FDI is the main driver for diverging estimations of Russian losses between this paper and WTO (2022).

58 Note that WTO (2022) assumes an increase in transportation costs for all economies, and not just for countries involved in a trade with Russia+ (like we do in component (iv) of our counterfactual).

59 *See* WTO (2022), Table 2 and p. 24.

60 *See WTO (2022), Figure 7. It appears that the model implementation is such that the results of Scenarios 2(a) to 2(c) are cumulative (see ibid., p. 17, 20). So, in order to get to the incremental contribution of Scenarios 2(b) and 2(c) individually, one has to subtract the results of 2(a) from 2(b) and of 2(b) from 2(c), respectively. To illustrate, the incremental impact of Scenario 2(b), the revocation of Russia's MFN status, on Russia is 0.1% of real GDP (2.0% reported for Scenario 2(b) 1.9% reported for Scenario 2(a); see ibid., Figure 7).*

Table B. Comparing our results to the recent literature

	Evenett and Muendler (2022)	Chepeliev et al. (2022)	Felbermayr et al. (2022)	WTO (2022)	Our findings
Policy scenario	Import ban on energy products and 35% import tariff for rest	Import ban on fossil fuels	Trade war: import and export embargo by Allies	*Status quo* of sanctions: financial sanctions (incl. on central bank), export restrictions, boycotts, transportation costs, revocation of MFN status (Scenario 2(a)-(c))	Allied trade embargo (components (i)-(iv))
Estimation horizon	Medium-/long-term	Short term	Medium-/long term	Short term	Short-/medium term
Group of Allies	G7 + rest EU	EU	See footnote 54	See footnote 55	See footnote 14
Changes in real GDP	• Russia: -1.06% • Allies: -0.06%	-	-	Fin. sanctions, exp. restrictions, boycotts, transp. costs (Scenario 2(a)) • Russia: -1.9% • EU: -0.7% • Allies: -0.3% Revocation of MFN (Scenario 2(b)) • Russia: -2.0 • EU: -1.3% • Allies: -0.7%	Allied import embargo (component (i)): Russia: -0.42%, Allies: -0.32%. Allied export embargo, trade cost increases, withdrawal of Allied FDI (components (ii)-(iv)): • Russia: -14.38% • EU: -0.66% • Allies: -0.20% Allied import embargo (component (i)): • Russia: -0.42% • EU: -1.03% • Allies: -0.32%
Changes in real income	-	• Russia: -6% • EU: -0.3% to -0.6%	• Russia: -9.71% • Allies: -0.17%	-	Allied import embargo (component (i)): • Russia: -4.79% • EU: -0.79% Allied import and export embargo (components (i) and (ii)): • Russia: -12.62% • Allies: -0.49%
Changes in total exports	-	-	• Russia: -45.21% • Allies: -5.72%		Import and export embargo: • Russia: -16.14% • Allies: -0.53%

Model extensions

We next consider three additional scenarios with particular policy relevance:

- Extension 1: if China were to join the coalition of Allies;

- Extension 2: if Russia+ were to preempt an Allied trade embargo by imposing a counter embargo on the Allies; and

- Extension 3: if Allied multinational companies were to withdraw the entirety of their FDI from Russia.

Figures 5-7 compare real GDP results of our main case with those of Extensions 1-3 for Russia and Belarus (Figure 5), Allies (Figure 6), and non-Allies (Figure 7).[61] Below, we motivate each scenario and summarize the estimated effects.

Figure 5. Percent change in real GDP – main case vs. extensions (Russia+)

Russia/Belarus

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61 Tables 5-7 provide a comprehensive overview over country/region results.

Figure 6. Percent change in real GDP – main case vs. extensions (selected Allies)

Figure 7. Percent change in real GDP – main case vs. extensions (selected non-Allies)

Extension 1: What if other countries joined the group of Allies?

Observers have wondered how much more effective sanctions on Russia could be if the circle of Allies were enlarged.[62] The current group of Allies is economically powerful, yet Turkey, China, and India continue their trade relationships with Russia+. The role of China is of particular significance, as the country is the largest non-Allied trading partner to both Russia and Belarus. Extension 1 of our modeling approach considers the economic and trade potential of China joining the Allies.[63] Our estimates indicate that adding China to the group of Allies would increase the economic pain (measured in real GDP losses) on Russia, but both China and the Allies would also be adversely affected from this move.[64]

The first two bars of Figures 5-7 compare real GDP changes of our main case with the results of Extension 1. While Russia would certainly suffer higher economic losses from China joining the Allied coalition (compare main case of real GDP losses of 14.80% in main case with 18.77% in Extension 1), Belarus would not (compare 3.78% with 0.28%).[65] Hardly surprising, China would turn from being mildly affected to becoming a net loser (compare main case of real GDP losses of 0.02% with real GDP losses of 0.32% for Extension 1). Most interestingly, however, Allies would stand to lose as well from China joining their circle. Take Germany as an example: German real GDP losses in the main case are 1.20%, while losses with China as a co-Ally would be 1.42% in Extension 1.[66] As Table 5 reports, Germany is thereby not an outlier: most Allies would record steeper losses if China joined the group of Allies. Most of the remaining non-Allies (except for India) would record smaller losses and higher gains, respectively, if China were to join the group of sanctioning countries.

To summarize, if China were to join the circle of Allies, Russia would suffer considerably higher losses, but so would both China and the Allies. Among "Allies", China would experience the largest incremental losses, but incremental losses to Germany, the Netherlands, and other EU countries would also be considerable. From a purely economic angle, these results of real GDP losses to Allies and China suggest that the economic case for convincing China to become an Ally may be less persuasive than previously thought: The specter of additional economic losses may dampen the zeal with which current Allies court China to join their ranks.[67] And given its relative losses vis-à-vis Western countries China may not be very receptive to the idea in the first place.

Extension 2: Countersanctions – what if Russia+ were the party imposing a trade embargo?

From the moment the Allies began imposing sanctions, Russia has retorted with its own measures targeted at Allies, including capital, financial, import restrictions and export bans. While a subset of these measures may have been enacted to prevent collapse of the Russian economy, other measures were likely taken with the aim of causing economic harm to the Allies. For example, in early April 2022 it was reported that Russia was threat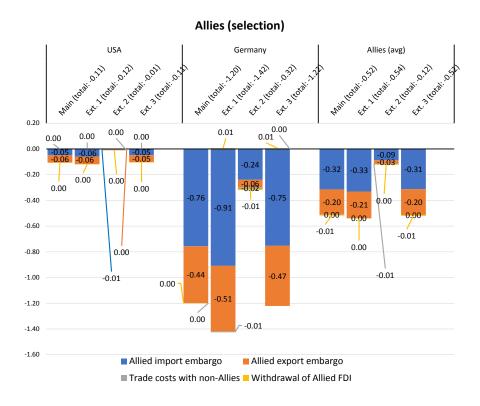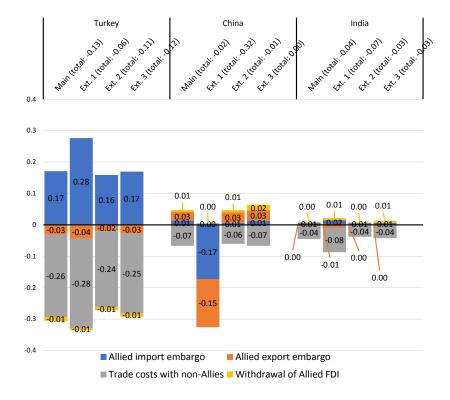ening to ban exports of certain agricultural and food products, timber, pharmaceuticals, and electronics to nations it considers "unfriendly".[68] Also, a recent Presidential Decree prohibits the procurement of foreign software and IT infrastructure by government entities. Moreover, Russian users of Allied trademarks and patents were authorized to forego royalty payments to holders of intellectual property (IP) owners

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62 *See,* e.g., Evenett and Muendler (2022).
63 In this scenario, China, like the other Allies, would impose an import and export embargo on Russia+, and would withdraw 50% of its FDI in Russia.
64 We strongly suspect that similar results would hold for India and Turkey joining the Allied coalition, albeit at with a smaller amplitude of effects, given the relatively smaller role of these two countries in world trade.
65 While not reported in the main body of this brief, the effects reported for real GDP also hold for real income (*see* Technical Appendix).
66 China's accession would result in a deterioration of its real GDP and terms of trade, and consequently in slower economic growth. Since China is one of Germany's most important export markets, a demand shock in China would have nontrivial knock-on effects for the German and European economies.
67 This statement only holds true as long as China abstains from actively undermining Allied sanctions (*e.g.*, via parallel imports). Moreover, we are, of course, not making statements about the expediency of a potential accession by China for political, diplomatic, or national-security reasons. An accession by China may be desirable for purely non-economic reasons.
68 *See,* e.g., reporting in Politico from 1 April, 2022.

from "unfriendly" countries, irrespective of whether such IP is used with the IP holder's consent.[69]

This begs the question what economic effects would ensue if it was Russia+ taking escalatory steps and imposing a trade embargo on the Allies, rather than *vice versa.* We find Russia+ would suffer much higher real GDP losses in that alternative scenario. The first and third bars of Figures 5-7, as well as Table 6, compare the effects on real GDP. Both Russia and Belarus suffer significantly higher real losses if they were the parties enacting the trade embargo (for Russia, compare main case of real GDP losses of 14.80% with Extension 2 losses of 24.90%; for Belarus, compare losses of 1.23% with losses of 16.48%). The deterioration of real GDP in the scenario of a Russian+ trade embargo is owed to the fact that Russia+ would have to enact costly changes in resource allocation – away from efficient sectors – upon the imposition of its own import and export embargos.[70]

Economic damage measured in terms of real GDP to Allies would be substantially smaller in Extension 2 (compare real GDP losses across Allies of 0.52% in the main case with losses of 0.12% under Extension 2). Allies would not have to engage in resource reallocation and could passively wait for Russia+ to make their policy moves. Non-Allies (China, India, Turkey) would also stand to gain from a trade embargo initiated by Russian+: real GDP losses would be smaller (in absolute terms) under Extension 2, relative to the main case.

These results suggest that it may be in the Allies' economic interest to begin with the imposition of an *export* embargo on Russia+, and to wait and see whether Russia+ impose their own set of export measures on the Allies.[71] With both sides imposing export embargos on each other the Allies' intended outcome – a complete trade embargo – would ensue, but economic losses to the Allies would be substantially smaller than in the main case.

Extension 3: Total withdrawal of Allied FDI

In our main model of the Allied trade embargo, we have assumed that half of Allied multinational companies invested in Russia withdraw or suspend operations. However, if relations with Russia deteriorate to an extent to which keeping up operations in Russia+ is simply no longer tenable, then it is reasonable to assume a complete exodus of Allied FDI. In our model, a complete withdrawal of FDI from Russia would be implemented as a 100% downward TFP shock applied to Allied-owned capital.[72]

Figures 5-7 and Table 7 report the results of this modeling alternative on real GDP. Comparing the first and the final bars in Figures 5-7 shows that Russia would suffer significantly higher real GDP losses if it were to lose all FDI (compare real GDP losses of 14.80% in the main case with losses of 28.17% in Extension 3).[73] Real GDP of Allies and non-Allies would remain unaffected, or even improve marginally compared to the main case.[74]

These results suggest that, in order to impose maximum harm on Russia+, Allies could consider carrot-and-stick measures with domestic multinationals invested in Russia+. The "stick" would be to pressure their private sectors to exit Russia – rather sooner than later. Whether such pressure is social, political, or fiscal is thereby secondary, as long as a swift and complete withdrawal from

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69 For example, Newsweek reported that the Russian government has given a *de facto* all-clear for patent theft of Western brands. Subsequently, more than 50 applications by Russian applicants have been filed to Rospatent, Russia's Federal Service for Intellectual Property, to claim major international brands (e.g., Mastercard, American Express, Audi, Levi's, Christian Dior, Shiseido, Clarins, IKEA, Nespresso, Facebook and Instagram).

70 Note, however, that the resource reallocation by Russia+ in Extension 2 would produce significant terms-of-trade gains for both countries; thus, real income losses for Russia would be smaller under Extension 2, as compared to the main case. In the same vein, real income gains for Belarus would be larger in Extension 2. *See* Technical Appendix for details.

71 From the perspective of the Allies, real GDP losses in the event of an Allied *export* embargo (component (ii)) are smaller, when compared to an import embargo (component (i)). The same is true for Russia+. Compare columns (2) and (3) with columns (7) and (8) of Table 6 to see this.

72 Recall footnote 29, in which we noted that we only consider Russian FDI and disregard FDI in Belarus.

73 Since exit of Allied FDI would exacerbate a reshuffling of domestic resources, real income losses to Russia would be significantly higher under Extension 3 (real GDP losses of 28.17% versus real income losses of 45.7%; *see* Technical Appendix).

74 *Compare* columns (1) and (6) of Table 7 to see this.

the Russian+ markets ensues. In return for companies' compliance, and as a "carrot", Allies may contemplate launching compensation payments or assistance programs to ease the adjustment pressures associated with withdrawal from Russia. Government support programs during the Covid 19 pandemic – that nearly every Ally enacted over the last two years – may serve as templates for this.

Concluding remarks

This brief adds to the existing literature on the economic effects of the war in Ukraine and the subsequent sanctions on Russia. We model the Allied trade embargo as a set of comprehensive trade sanctions that includes import-, export-, and FDI-related measures, as well as spillover effects in the form of increased trade costs between Russia and non-Allies. Our key results can be summarized as follows:

1. **Sanctions are costly for Russia**: Regardless of which economic effects are considered and how economic harm is measured, Russia would sustain meaningful losses from an Allied trade embargo, even in the short run. The largest contribution to Russia's economic pain is the exit of Allied FDI. Moreover, an Allied import and export embargo forces Russia's economy to engage in inefficient reallocation of resources as it reorganizes towards autarky and towards increased trade with non-Allies a and leads to large deterioration of Russia's terms of trade.

2. **Belarus is only marginally affected by an Allied trade embargo:** The Belarusian economy is largely dependent on trade with and investment from Russia, and so its economy may actually benefit from the Allied sanctions. Less integration of Russia in the world economy implies a tighter integration of Belarus into the much larger Russian economy.

3. **For Allies, the economic pain resulting from their trade embargo is unevenly distributed:** Countries that have been more integrated into the Russian economy (Germany, Netherlands, Central/Eastern Europe) stand to experience the greatest economic losses from an Allied trade embargo. Some resource-rich Allies (Australia, Canada, Norway) experience welfare gains. Considering the unequal distribution of economic pains and gains, and the potential ripple-effects that severe losses by EU economies may have on the global economy, the Allies may wish to develop burden-sharing plans to prevent the coalition from breaking apart. An additional measure could be for Allies to reduce trade barriers among themselves.

4. **Non-Allies also stand to lose:** Our model results suggest that an Allied trade embargo will negatively affect the world economy – global real GDP decreases by 0.61%, global real income by 0.73%, and global trade by 0.59%. We find that most non-Allies will suffer real GDP losses as a result of an Allied trade embargo. While, as expected, non-Allied benefit from trade diversion effects, they experience losses from increased transaction costs of doing business with Russia and Belarus. The specter of economic losses may sway non-sanctioning countries to help the Allies persuade Russia to ceased its aggression.

5. **Don't wait for China:** China's accession to the group of Allies achieves mixed results. While Russia would suffer higher economic losses, both China and the Allies would also be adversely affected by this move. This suggests that the economic case for convincing China to become an Ally is less persuasive than previously thought, as long as China abstains from actively undermining Allied sanctions (e.g., via parallel imports).

6. **Countersanctions by Russia and Belarus would be self-defeating:** Both Russia and Belarus would experience significantly higher losses from enacting a trade embargo on Allies, rather than being a sanction target. At the same time, Allies would incur less economic pain, as compared to an Allied-imposed trade embargo. This may suggest that the Allies hold off with imposing the full battery of trade sanctions but instead wait to see whether Russia and Belarus retaliate with their own measures on Allies first.

7. **Withdrawal of Allied FDI is a powerful sanction tool:** A complete withdrawal or suspension of Allied FDI stock of nearly $450 billion would cause colossal damage to the Russian economy, while leaving Allied and non-Allied economies largely unaffected. This would suggest that, in order to impose maximum harm on Russia (while minimizing self-harm), Allies could enact policies to further reduce FDI. To make that work, they might consider taking certain measures vis-à-vis domestic multinationals invested in Russia, such as applying political, social, and/or regulatory pressure to compel their private sectors to exit Russia swiftly and completely. In return for companies' compliance, Allies may contemplate compensation or adjustment assistance programs for severely affected companies.

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Appendix

Table A. Economic effects for Russia from Allied Embargo, by sector (in % changes)

GSC3 Sectors	GSC3 Abb.	Russian exports to world	Russian imports to world	Sector production
Paddy rice	1 pdr	121.25	-35.21	12.42
Wheat	2 wht	51.43	-55.41	35.42
Cereal grains nec	3 gro	13.24	-62.89	2.72
Vegetables, fruit, nuts	4 v_f	50.14	-19.79	10.30
Oil seeds	5 osd	7.57	-9.91	25.84
Sugar cane, sugar beet	6 c_b	103.28	-94.23	-0.33
Plant-based fibers	7 pfb	-23.13	-16.01	6.11
Crops nec	8 ocr	21.46	-1.29	24.63
Bovine cattle, sheep and goats, horses	9 ctl	24.89	-66.00	-9.12
Animal products nec	10 oap	-45.24	-48.64	-14.08
Raw milk	11 rmk	-21.23	-39.44	-19.71
Wool, silk-worm cocoons	12 wol	41.90	-18.25	21.76
Forestry	13 frs	30.26	-54.77	9.24
Fishing	14 fsh	8.17	-38.10	-8.61
Coal	15 coa	-21.71	-67.11	-12.43
Oil	16 oil	7.99	-83.43	-5.46
Gas	17 gas	-25.16	-97.36	-2.93
Other Extraction (Minerals)	18 oxt	-40.97	-27.66	-18.46
Bovine meat products	19 cmt	60.87	-66.06	-16.15
Meat products nec	20 omt	206.93	-71.66	3.16
Vegetable oils and fats	21 vol	41.96	-56.49	16.19
Dairy products	22 mil	104.03	-65.18	-7.89
Processed rice	23 pcr	18.07	-25.58	10.52
Sugar	24 sgr	2.36	-54.48	-10.90
Food products nec	25 ofd	1.80	-55.11	-2.43
Beverages and tobacco products	26 b_t	0.24	-61.59	-1.01
Textiles	27 tex	-35.43	-19.68	23.39
Wearing apparel	28 wap	49.77	-37.41	21.56
Leather products	29 lea	66.57	-49.61	53.52
Wood products	30 lum	-17.23	-58.85	-11.26
Paper products, publishing	31 ppp	-34.99	-56.05	14.14
Petroleum, coal products	32 p_c	-54.86	-58.58	-18.00
Chemical products	33 chm	-17.60	-55.30	12.95
Basic pharmaceutical products	34 bph	-25.33	-56.77	26.93
Rubber and plastic products	35 rpp	-42.75	-30.40	11.29
Mineral products nec	36 nmm	-35.53	-36.05	6.13
Ferrous metals	37 i_s	-54.24	-27.30	-0.48

Metals nec	38 nfm	-83.52	-31.36	-29.95
Metal products	39 fmp	8.09	-40.07	26.18
Computer, electronic and optical products	40 ele	38.29	-40.53	44.42
Electrical equipment	41 eeq	-22.38	-31.97	24.82
Machinery and equipment nec	42 ome	-3.98	-45.07	32.60
Motor vehicles and parts	43 mvh	-76.45	-14.16	-11.10
Transport equipment nec	44 otn	-26.64	-50.93	45.85
Manufactures nec	45 omf	-19.82	-60.13	10.87
Electricity	46 ely	-3.86	-71.17	-7.49
Gas manufacture, distribution	47 gdt	-11.44	-69.27	-10.22
Water	48 wtr	-1.56	-76.03	-14.04
Construction	49 cns	-36.76	-75.41	2.90
Trade	50 trd	-46.09	-71.59	-10.83
Accommodation, Food and service activities	51 afs	-46.17	-78.15	-26.55
Transport nec	52 otp	-38.86	-63.69	-5.15
Water transport	53 wtp	-62.34	-44.65	-11.27
Air transport	54 atp	-47.02	-62.53	1.47
Warehousing and support activities	55 whs	-44.86	-53.06	-5.91
Communication	56 cmn	-68.86	-75.93	-9.53
Financial services nec	57 ofi	-71.40	-77.72	17.04
Insurance (formerly isr)	58 ins	-20.09	-61.90	11.05
Real estate activities	59 rsa	11.94	-82.18	-12.91
Business services nec	60 obs	-53.13	-68.88	9.92
Recreational and other services	61 ros	-46.83	-75.32	-10.62
Public Administration and defense	62 osg	-26.18	-40.47	-17.98
Education	63 edu	-16.89	-60.09	-12.93
Human health and social work activities	64 hht	-32.46	-55.08	-22.88

Table 1. Change in real GDP by country/region

	Percent Change in real GDP	Main Scenario				
			Decomposition of total effect			
		(1) Total effect	(2) Allied import embargo	(3) Allied export embargo	(4) Trade costs increases	(5) Withdrawal of Allied FDI
	Russia	-14.80	-0.42	-0.92	-0.93	-12.53
	Belarus	-1.23	-1.18	0.10	-0.56	0.41
Allies	USA	-0.11	-0.05	-0.06	0.00	0.00
	Canada	-0.07	-0.02	-0.05	0.01	0.00
	Germany	-1.20	-0.76	-0.44	0.00	0.00
	France	-0.53	-0.30	-0.22	0.00	-0.01
	Italy	-0.82	-0.53	-0.27	-0.01	-0.01
	Netherlands	-1.57	-1.16	-0.37	-0.03	-0.01
	Rest of EU	-1.42	-0.87	-0.53	0.00	-0.02
	Great Britain	-0.64	-0.38	-0.25	0.00	-0.01
	Switzerland	-0.40	-0.15	-0.25	0.01	-0.01
	Norway	-0.31	-0.16	-0.16	0.01	0.00
	Australia	-0.06	-0.02	-0.04	0.00	0.00
	Japan	-0.31	-0.21	-0.10	-0.01	0.00
	South Korea	-0.74	-0.44	-0.30	0.00	0.00
	Taiwan	-0.39	-0.27	-0.11	0.00	0.00
Non-Allies	China	-0.02	0.01	0.03	-0.07	0.01
	India	-0.04	0.01	0.00	-0.04	0.00
	Turkey	-0.13	0.17	-0.03	-0.26	-0.01
	Indonesia	-0.02	-0.01	0.00	-0.02	0.00
	Kazakhstan	-0.23	0.11	0.03	-0.44	0.07
	Mexico	-0.03	0.00	-0.01	-0.02	0.00
	Brazil	-0.05	-0.02	0.00	-0.03	0.00
	Egypt	-0.13	0.04	-0.01	-0.13	-0.03
	Saudi Arabia	0.03	0.04	0.01	-0.02	0.00
	South Africa	-0.05	-0.01	-0.02	-0.02	0.00
	Rest of Asia	-0.05	-0.01	0.01	-0.06	0.00
	Rest of Americas	-0.02	0.00	0.01	-0.03	0.00
	MENA	-0.03	0.06	0.00	-0.08	0.00
	SSA	0.05	0.04	0.02	-0.02	0.01
	Rest of World	-0.03	0.12	0.03	-0.20	0.02
	Allies	-0.52	-0.32	-0.20	0.00	-0.01
	EU 27	-1.69	-1.03	-0.64	-0.01	-0.02
	World	-0.61				

Table 2. Change in real income by country/region

	Percent Change in Welfare (Real Income)	Main Scenario				
			Decomposition of total effect			
		(1) Total effect	(2) Allied import embargo	(3) Allied export embargo	(4) Trade costs increases	(5) Withdrawal of Allied FDI
	Russia	-29.79	-4.79	-7.83	-2.93	-14.25
	Belarus	0.41	-2.60	0.23	1.99	0.80
Allies	USA	-0.13	-0.10	-0.03	0.00	-0.01
	Canada	0.65	0.38	0.14	0.09	0.04
	Germany	-1.16	-0.88	-0.26	-0.01	-0.01
	France	-0.73	-0.46	-0.19	-0.04	-0.04
	Italy	-1.14	-0.68	-0.32	-0.07	-0.06
	Netherlands	-0.89	-0.69	-0.19	0.00	-0.01
	Rest of EU	-1.37	-0.93	-0.36	-0.03	-0.05
	Great Britain	-0.71	-0.43	-0.22	-0.03	-0.03
	Switzerland	-0.35	-0.37	-0.01	0.02	0.01
	Norway	3.61	2.25	0.78	0.36	0.23
	Australia	0.41	0.21	0.12	0.05	0.03
	Japan	-0.73	-0.49	-0.15	-0.05	-0.04
	South Korea	-1.15	-0.86	-0.23	-0.03	-0.03
	Taiwan	-0.97	-0.74	-0.13	-0.05	-0.05
Non-Allies	China	0.12	-0.06	0.18	-0.01	0.01
	India	-0.32	-0.26	0.05	-0.06	-0.05
	Turkey	0.23	0.54	-0.02	-0.16	-0.12
	Indonesia	0.36	0.14	0.17	0.04	0.01
	Kazakhstan	3.20	3.64	-0.10	0.14	-0.48
	Brazil	-0.08	0.00	-0.01	-0.04	-0.03
	Mexico	0.20	0.17	0.03	0.02	-0.01
	Egypt	0.55	0.57	0.11	-0.03	-0.10
	Saudi Arabia	2.65	1.67	0.46	0.34	0.17
	South Africa	-0.10	-0.10	0.03	-0.03	0.00
	Rest of Asia	0.01	-0.10	0.16	-0.04	-0.02
	Rest of Americas	0.26	0.15	0.10	0.01	0.00
	MENA	2.46	1.57	0.48	0.26	0.15
	SSA	1.18	0.71	0.24	0.14	0.09
	Rest of World	1.22	0.94	0.32	-0.03	-0.01
	Allies	-0.51	-0.36	-0.12	-0.01	-0.02
	EU 27	-1.15	-0.79	-0.29	-0.03	-0.04
	World	-0.73				

Table 3. Change in total exports by country/region

	Percent Change in Exports to the World	Main Scenario				
			Decomposition of total effect			
		(1) Total effect	(2) Allied import embargo	(3) Allied export embargo	(4) Trade costs increases	(5) Withdrawal of Allied FDI
	Russia	-22.56	-6.09	-10.05	-0.38	-6.04
	Belarus	-22.05	-18.08	-2.93	0.88	-1.92
Allies	USA	-0.52	-0.01	-0.80	0.05	0.25
	Canada	-1.36	-0.78	-0.44	-0.18	0.04
	Germany	-0.65	0.02	-0.89	0.06	0.16
	France	0.63	0.76	-0.47	0.06	0.27
	Italy	1.04	1.00	-0.42	0.13	0.33
	Netherlands	-1.39	-0.69	-0.79	-0.03	0.11
	Rest of EU	-0.27	0.27	-0.79	0.07	0.18
	Great Britain	0.07	0.40	-0.65	0.06	0.26
	Switzerland	0.50	0.34	-0.06	0.03	0.20
	Norway	-3.67	-2.23	-1.08	-0.26	-0.10
	Australia	-0.81	-0.41	-0.45	-0.05	0.11
	Japan	0.96	0.73	-0.31	0.17	0.37
	South Korea	-0.17	-0.05	-0.39	0.07	0.19
	Taiwan	0.18	-0.01	0.02	0.05	0.13
Non-Allies	China	0.76	0.22	0.42	-0.16	0.28
	India	1.92	1.19	0.30	0.09	0.34
	Turkey	1.40	0.58	0.42	0.09	0.32
	Indonesia	-0.51	-0.28	-0.18	-0.15	0.10
	Kazakhstan	0.33	0.66	0.43	-0.55	-0.21
	Brazil	0.79	0.35	0.18	-0.04	0.30
	Mexico	-0.56	-0.55	-0.03	-0.06	0.08
	Egypt	-0.50	-0.36	-0.33	-0.18	0.38
	Saudi Arabia	0.14	0.04	0.05	-0.01	0.06
	South Africa	0.83	0.49	0.18	0.03	0.13
	Rest of Asia	0.01	0.04	-0.11	-0.01	0.10
	Rest of Americas	0.62	0.63	0.04	-0.13	0.08
	MENA	-0.54	0.04	-0.27	-0.25	-0.06
	SSA	-0.65	-0.46	-0.02	-0.18	0.01
	Rest of World	1.48	1.72	0.17	-0.40	-0.01
	Allies	-0.28	0.12	-0.66	0.05	0.20
	EU 27	-0.21	0.27	-0.74	0.06	0.19

Table 4. Change in total imports by country/region

	Percent Change in Imports from World	Main Scenario				
			Decomposition of total effect			
		(1) Total effect	(2) Allied import embargo	(3) Allied export embargo	(4) Trade costs increases	(5) Withdrawal of Allied FDI
	Russia	-50.73	-19.71	-29.25	-4.21	2.42
	Belarus	-15.76	-13.60	-3.36	2.53	-1.33
Allies	USA	-0.77	-0.32	-0.37	0.02	-0.10
	Canada	0.35	0.20	0.11	0.03	0.01
	Germany	-0.17	0.16	-0.41	0.03	0.04
	France	-0.11	0.11	-0.19	-0.01	-0.01
	Italy	0.22	0.54	-0.35	0.01	0.02
	Netherlands	0.26	0.54	-0.31	0.01	0.02
	Rest of EU	0.05	0.30	-0.31	0.02	0.04
	Great Britain	-0.21	0.06	-0.30	0.03	0.00
	Switzerland	0.67	0.15	0.36	0.01	0.15
	Norway	2.66	1.77	0.48	0.26	0.15
	Australia	0.62	0.42	0.11	0.09	0.00
	Japan	-0.82	-0.29	-0.45	-0.04	-0.05
	South Korea	-0.44	-0.29	-0.16	-0.02	0.04
	Taiwan	-0.42	-0.39	-0.01	-0.04	0.02
Non-Allies	China	0.69	0.13	0.55	0.02	-0.02
	India	0.29	0.10	0.25	0.02	-0.08
	Turkey	1.98	1.30	0.26	0.52	-0.11
	Indonesia	0.10	0.05	0.22	-0.02	-0.15
	Kazakhstan	7.33	7.79	0.06	1.01	-1.53
	Brazil	0.26	0.13	0.36	0.00	-0.23
	Mexico	-0.39	-0.30	-0.02	-0.03	-0.04
	Egypt	1.62	1.25	0.15	0.22	0.00
	Saudi Arabia	5.33	3.61	0.80	0.65	0.27
	South Africa	0.60	0.28	0.29	-0.01	0.04
	Rest of Asia	-0.02	-0.04	-0.01	0.01	0.01
	Rest of Americas	1.42	1.06	0.38	0.06	-0.08
	MENA	3.45	2.60	0.42	0.34	0.10
	SSA	2.40	1.44	0.57	0.28	0.11
	Rest of World	3.61	3.00	0.64	0.11	-0.14
	Allies	-0.21	0.06	-0.28	0.02	0.00
	EU 27	0.01	0.28	-0.32	0.02	0.03

Table 5. Percent Change in real GDP – main case vs. Extension 1 (China joins group of Allies)

Percent Change in real GDP	Main Scenario					Extension 1 (Allies includes China_HK for trade embargo and FDI)				
		Decomposition of total effect					Decomposition of total effect			
	(1) Total effect	(2) Allied import embargo	(3) Allied export embargo	(4) Trade costs increases	(5) Withdrawal of Allied FDI	(6) Total effect	(7) Allied import embargo	(8) Allied export embargo	(9) Trade costs with non-Allies	(10) Withdrawal of Allied FDI (incl. China)
Allies										
Russia	-14.80	-0.42	-0.92	-0.93	-12.53	-18.77	-0.96	-1.52	-0.69	-15.60
Belarus	-1.23	-1.18	0.10	-0.56	0.41	-0.28	-0.88	0.66	-0.45	0.39
USA	-0.11	-0.05	-0.06	0.00	0.00	-0.12	-0.06	-0.06	0.00	0.00
Canada	-0.07	-0.02	-0.05	0.01	0.00	-0.06	-0.02	-0.04	0.00	0.00
Germany	-1.20	-0.76	-0.44	0.00	0.00	-1.42	-0.91	-0.51	-0.01	0.01
France	-0.53	-0.30	-0.22	0.00	-0.01	-0.62	-0.36	-0.24	-0.01	-0.01
Italy	-0.82	-0.53	-0.27	-0.01	-0.01	-0.96	-0.62	-0.32	-0.01	-0.01
Netherlands	-1.57	-1.16	-0.37	-0.03	-0.01	-1.87	-1.40	-0.42	-0.03	-0.01
Rest of EU	-1.42	-0.87	-0.53	0.00	-0.02	-1.62	-1.01	-0.58	-0.01	-0.02
Great Britain	-0.64	-0.38	-0.25	0.00	-0.01	-0.72	-0.44	-0.27	-0.01	-0.01
Switzerland	-0.40	-0.15	-0.25	0.01	-0.01	-0.44	-0.18	-0.26	0.01	-0.01
Norway	-0.31	-0.16	-0.16	0.01	0.00	-0.30	-0.16	-0.16	0.01	0.01
Australia	-0.06	-0.02	-0.04	0.00	0.00	-0.07	-0.03	-0.04	0.00	0.00
Japan	-0.31	-0.21	-0.10	-0.01	0.00	-0.38	-0.25	-0.13	-0.01	0.00
South Korea	-0.74	-0.44	-0.30	0.00	0.00	-0.89	-0.54	-0.36	0.00	0.01
Taiwan	-0.39	-0.27	-0.11	0.00	0.00	-0.44	-0.31	-0.13	0.00	0.00
Non-Allies										
China	-0.02	0.01	0.03	-0.07	0.01	-0.32	-0.17	-0.15	0.00	0.00
India	-0.04	0.01	0.00	-0.04	0.00	-0.07	0.02	-0.01	-0.08	0.01
Turkey	-0.13	0.17	-0.03	-0.26	-0.01	-0.06	0.28	-0.04	-0.28	-0.01
Indonesia	-0.02	-0.01	0.00	-0.02	0.00	-0.02	-0.01	0.01	-0.02	0.00
Kazakhstan	-0.23	0.11	0.03	-0.44	0.07	-0.16	0.18	0.05	-0.47	0.08
Brazil	-0.05	-0.02	0.00	-0.03	0.00	-0.06	-0.05	0.01	-0.04	0.01
Mexico	-0.03	0.00	-0.01	-0.02	0.00	-0.03	0.00	-0.01	-0.02	0.00
Egypt	-0.13	0.04	-0.01	-0.13	-0.03	-0.11	0.07	0.00	-0.15	-0.04
Saudi Arabia	0.03	0.04	0.01	-0.02	0.00	0.06	0.06	0.02	-0.02	0.00
South Africa	-0.05	-0.01	-0.02	-0.02	0.00	-0.08	-0.04	-0.01	-0.02	0.00
Rest of Asia	-0.05	-0.01	0.01	-0.06	0.00	-0.06	0.00	0.03	-0.09	0.01
Rest of Americas	-0.02	0.00	0.01	-0.03	0.00	-0.03	0.00	0.02	-0.05	0.00
MENA	-0.03	0.06	0.00	-0.08	0.00	-0.01	0.09	0.01	-0.10	0.00
SSA	0.05	0.04	0.02	-0.02	0.01	0.10	0.08	0.04	-0.03	0.01
Rest of World	-0.03	0.12	0.03	-0.20	0.02	0.00	0.13	0.09	-0.25	0.03
Allies	-0.52	-0.32	-0.20	0.00	-0.01	-0.54	-0.33	-0.21	0.00	0.00
EU 27	-1.69	-1.03	-0.64	-0.01	-0.02	-2.21	-1.36	-0.84	-0.01	-0.01

Table 6. Percent Change in real GDP – main case vs. Extension 2 (Countersanctions by Russia+)

Percent Change in real GDP	Main Scenario					Extension 2 (Russia/Belarus tariffs and export taxes)				
	(1) Total effect	Decomposition of total effect				(6) Total effect	Decomposition of total effect			
		(2) Allied import embargo	(3) Allied export embargo	(4) Trade costs increases	(5) Withdrawal of Allied FDI		(7) Allied import embargo	(8) Allied export embargo	(9) Trade costs with non-Allies	(10) Withdrawal of Allied FDI
Russia	-14.80	-0.42	-0.92	-0.93	-12.53	-24.90	-7.07	-5.63	-0.87	-11.33
Belarus	-1.23	-1.18	0.10	-0.56	0.41	-16.48	-10.24	-6.16	-0.50	0.43
USA	-0.11	-0.05	-0.06	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00
Canada	-0.07	-0.02	-0.05	0.01	0.00	0.02	0.02	0.00	0.01	0.00
Germany	-1.20	-0.76	-0.44	0.00	0.00	-0.32	-0.24	-0.06	-0.02	-0.01
France	-0.53	-0.30	-0.22	0.00	-0.01	-0.18	-0.12	-0.04	-0.01	-0.01
Italy	-0.82	-0.53	-0.27	-0.01	-0.01	-0.24	-0.15	-0.06	-0.02	-0.01
Netherlands	-1.57	-1.16	-0.37	-0.03	-0.01	-0.46	-0.35	-0.07	-0.02	-0.01
Rest of EU	-1.42	-0.87	-0.53	0.00	-0.02	-0.34	-0.24	-0.07	-0.01	-0.01
Great Britain	-0.64	-0.38	-0.25	0.00	-0.01	-0.21	-0.16	-0.04	-0.01	-0.01
Switzerland	-0.40	-0.15	-0.25	0.01	-0.01	-0.08	-0.06	-0.02	0.00	0.00
Norway	-0.31	-0.16	-0.16	0.01	0.00	0.07	0.03	0.02	0.01	0.01
Australia	-0.06	-0.02	-0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Japan	-0.31	-0.21	-0.10	-0.01	0.00	-0.08	-0.06	-0.01	-0.01	0.00
South Korea	-0.74	-0.44	-0.30	0.00	0.00	-0.13	-0.09	-0.03	-0.01	-0.01
Taiwan	-0.39	-0.27	-0.11	0.00	0.00	-0.03	-0.02	0.00	0.00	0.00
China	-0.02	0.01	0.03	-0.07	0.01	-0.01	0.01	0.03	-0.06	0.01
India	-0.04	0.01	0.00	-0.04	0.00	-0.03	0.01	0.00	-0.04	0.00
Turkey	-0.13	0.17	-0.03	-0.26	-0.01	-0.11	0.16	-0.02	-0.24	-0.01
Indonesia	-0.02	-0.01	0.00	-0.02	0.00	-0.02	-0.01	0.01	-0.01	0.00
Kazakhstan	-0.23	0.11	0.03	-0.44	0.07	-0.18	0.12	0.03	-0.39	0.07
Brazil	-0.05	-0.02	0.00	-0.03	0.00	-0.05	-0.02	0.00	-0.03	0.00
Mexico	-0.03	0.00	-0.01	-0.02	0.00	-0.02	0.00	-0.01	-0.01	0.00
Egypt	-0.13	0.04	-0.01	-0.13	-0.03	-0.12	0.04	-0.01	-0.12	-0.03
Saudi Arabia	0.03	0.04	0.01	-0.02	0.00	0.04	0.04	0.01	-0.01	0.00
South Africa	-0.05	-0.01	-0.02	-0.02	0.00	-0.05	-0.01	-0.02	-0.02	0.00
Rest of Asia	-0.05	-0.01	0.01	-0.06	0.00	-0.04	-0.01	0.01	-0.05	0.01
Rest of Americas	-0.02	0.00	0.01	-0.03	0.00	-0.02	0.00	0.01	-0.03	0.00
MENA	-0.03	0.06	0.00	-0.08	0.00	-0.02	0.05	0.00	-0.07	0.00
SSA	0.05	0.04	0.02	-0.02	0.01	0.06	0.05	0.02	-0.01	0.01
Rest of World	-0.03	0.12	0.03	-0.20	0.02	-0.01	0.11	0.04	-0.18	0.02
Allies	-0.52	-0.32	-0.20	0.00	-0.01	-0.12	-0.09	-0.03	-0.01	0.00
EU 27	-1.69	-1.03	-0.64	-0.01	-0.02	-0.41	-0.29	-0.08	-0.02	-0.02

Row groups (left margin): "Allies" spans the upper set of countries; "Non-Allies" spans the lower set.

Table 7. Percent Change in real GDP – main case vs. Extension 3 (total FDI withdrawal)

Percent Change in real GDP		Main Scenario					Extension 3 (100% of FDI share)				
		Decomposition of total effect					Decomposition of total effect			
		(1) Total effect	(2) Allied import embargo	(3) Allied export embargo	(4) Trade costs increases	(5) Withdrawal of Allied FDI	(6) Total effect	(7) Allied import embargo	(8) Allied export embargo	(4) Trade costs increases	(10) Withdrawal of Allied FDI (100%)
Allies	Russia	-14.80	-0.42	-0.92	-0.93	-12.53	-28.17	-0.42	-0.96	-0.99	-25.81
	Belarus	-1.23	-1.18	0.10	-0.56	0.41	-0.59	-1.18	0.14	-0.58	1.02
	USA	-0.11	-0.05	-0.06	0.00	0.00	-0.11	-0.05	-0.05	0.00	0.00
	Canada	-0.07	-0.02	-0.05	0.01	0.00	-0.07	-0.02	-0.05	0.01	0.00
	Germany	-1.20	-0.76	-0.44	0.00	0.00	-1.22	-0.75	-0.47	0.00	0.01
	France	-0.53	-0.30	-0.22	0.00	-0.01	-0.53	-0.29	-0.22	0.00	-0.02
	Italy	-0.82	-0.53	-0.27	-0.01	-0.01	-0.82	-0.52	-0.28	-0.01	-0.01
	Netherlands	-1.57	-1.16	-0.37	-0.03	-0.01	-1.57	-1.16	-0.37	-0.03	-0.01
	Rest of EU	-1.42	-0.87	-0.53	0.00	-0.02	-1.43	-0.86	-0.54	0.00	-0.03
	Great Britain	-0.64	-0.38	-0.25	0.00	-0.01	-0.64	-0.38	-0.24	0.00	-0.01
	Switzerland	-0.40	-0.15	-0.25	0.01	-0.01	-0.39	-0.15	-0.24	0.01	-0.01
	Norway	-0.31	-0.16	-0.16	0.01	0.00	-0.30	-0.16	-0.15	0.01	0.00
	Australia	-0.06	-0.02	-0.04	0.00	0.00	-0.06	-0.02	-0.04	0.00	-0.01
	Japan	-0.31	-0.21	-0.10	-0.01	0.00	-0.32	-0.21	-0.11	-0.01	0.00
	South Korea	-0.74	-0.44	-0.30	0.00	0.00	-0.76	-0.44	-0.33	0.00	0.01
	Taiwan	-0.39	-0.27	-0.11	0.00	0.00	-0.38	-0.27	-0.11	0.00	0.00
Non-Allies	China	-0.02	0.01	0.03	-0.07	0.01	0.00	0.01	0.03	-0.07	0.02
	India	-0.04	0.01	0.00	-0.04	0.00	-0.03	0.01	0.00	-0.04	0.01
	Turkey	-0.13	0.17	-0.03	-0.26	-0.01	-0.12	0.17	-0.03	-0.25	-0.01
	Indonesia	-0.02	-0.01	0.00	-0.02	0.00	-0.02	-0.01	0.00	-0.01	0.00
	Kazakhstan	-0.23	0.11	0.03	-0.44	0.07	-0.15	0.11	0.03	-0.41	0.12
	Brazil	-0.05	-0.02	0.00	-0.03	0.00	-0.04	-0.02	0.01	-0.03	0.00
	Mexico	-0.03	0.00	-0.01	-0.02	0.00	-0.03	0.00	-0.01	-0.02	0.00
	Egypt	-0.13	0.04	-0.01	-0.13	-0.03	-0.14	0.04	-0.01	-0.13	-0.05
	Saudi Arabia	0.03	0.04	0.01	-0.02	0.00	0.03	0.04	0.01	-0.02	0.00
	South Africa	-0.05	-0.01	-0.02	-0.02	0.00	-0.05	-0.01	-0.02	-0.02	0.00
	Rest of Asia	-0.05	-0.01	0.01	-0.06	0.00	-0.04	-0.01	0.01	-0.06	0.01
	Rest of Americas	-0.02	0.00	0.01	-0.03	0.00	-0.02	0.00	0.01	-0.03	0.00
	MENA	-0.03	0.06	0.00	-0.08	0.00	-0.04	0.06	0.00	-0.08	-0.01
	SSA	0.05	0.04	0.02	-0.02	0.01	0.05	0.04	0.02	-0.02	0.02
	Rest of World	-0.03	0.12	0.03	-0.20	0.02	-0.01	0.12	0.04	-0.19	0.03
	Allies	-0.52	-0.32	-0.20	0.00	-0.01	-0.52	-0.31	-0.20	0.00	-0.01
	EU 27	-1.69	-1.03	-0.64	-0.01	-0.02	-1.70	-1.02	-0.65	-0.01	-0.02

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