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Economic Costs of Friend-Shoring

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Abstract

Geo-political tensions and disruptions to global value chains have led policy makers to re-evaluate their approach to globalisation. Many countries are considering regionalisation and friend-shoring – trading primarily with countries sharing similar values – as a way of minimising exposure to weaponisation of trade and securing access to critical inputs. If followed through, this process has the potential to reverse the global economic integration of recent decades. This paper estimates the economic costs of friend-shoring using a quantitative model that incorporates inter-country inter-industry linkages. The results suggest that friend-shoring may lead to real GDP losses of up to 4.6% of global GDP. Thus, although friend-shoring may provide insurance against extreme disruptions and increase the security of the supply of vital inputs, it would come at a significant cost.

Keywords: Friend-shoring; regionalisation; global trade and production networks; international I-O linkages

JEL Classification Number: F15, F51, F60, R15

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1 Introduction

International trade has changed significantly since the early 1990s: the liberalisation of cross-border transactions, advances in information and communication technology, reductions in transport costs and innovations in logistics have given firms greater incentives to break up the production process and locate its various stages across many countries. As a result, global supply chains have become very common, accounting for around a half of global trade in 2020 (World Bank, 2020).

However, the recent years have witnessed a number of disruptions of global value chains, ranging from cyber-threats, the US-China trade war, and the Russian invasion of Ukraine to systemic issues such as the Covid-19 pandemic and the climate crisis. At the same time, international political cooperation has begun to falter. The combination of these trends has forced a rethinking of global supply chains and catapulted their resilience to the top of policymakers' agendas. Friend-shoring – a preference for sourcing inputs from economies that share similar values (such as democratic institutions or maintaining peace) – has come to be regarded as an alternative to a free-market offshoring approach (under which operations moved to countries with cheaper labour).

A case in point: on April 13, 2022 in a speech at a special edition of Atlantic Council Front Page, US Secretary of the Treasury Janet Yellen said: "Favoring the friend-shoring of supply chains to a large number of trusted countries, so we can continue to securely extend market access, will lower the risks to our economy as well as to our trusted trade partners." She further clarified what friend-shoring stands for: "... friend-shoring means [...] that we have a group of countries that have strong adherence to a set of norms and values about how to operate in the global economy and about how to run the global economic system, and we need to deepen our ties with those partners and to work together to make sure that we can supply our needs of critical materials."[1] Since then, the US administration passed the CHIPS and Science Act as well as the Inflation Reduction Act which increase incentives for manufacturers to source inputs from US allies in the semiconductor, critical minerals, and battery sectors. Similarly, the European Union's Chips Act proposes "semiconductor partnerships with like-minded countries" and the EU's Important Projects of Common European Interest (IPCEI) programme promotes supply chain cooperation between EU member states (Harput, 2022).

[1]See https://www.atlanticcouncil.org/news/transcripts/transcript-us-treasury-secretary-janet-yellen-on-the-next-steps-for-russia-sanctions-and-friend-shoring-supply-chains/.

In contrast to optimisation under free trade, friend-shoring – by imposing constraints – is likely to be less efficient. But how high is the price that needs to be paid for the insurance benefits brought about by friend-shoring? To shed some light on this question, this paper assesses the economic costs of friend-shoring, with a focus on broadly defined emerging Europe and European neighbourhood. To quantify the costs of friend-shoring, it is important to account for the goods and services being traded between the groups of countries either as intermediate inputs or for final consumption. Thus to evaluate the impact of friend-shorting it is necessary to use a general equilibrium framework capturing such intricate linkages.

We model friend-shoring as a polarised world with two blocs. These blocs are defined based on the UN General Assembly vote on the resolution ES-11/1 on "Aggression against Ukraine" that took place on March 2, 2022. The "Yes" bloc (Bloc 1) contains countries that voted in favour of condemning the aggression against Ukraine and the "No" bloc (Bloc 2) encompasses countries that voted against the measure, abstained from voting or were absent from the General Assembly. We assume that trade between the two blocs is subject to substantial (close to prohibitive) trade costs. We consider scenarios with and without the ability of countries to collect tariff revenues. The latter approach would be compatible with economic sanctions or other increases in non-tariff barriers.

We incorporate international linkages between industries using an economic model based on Baqaee and Farhi (2019) and Çakmaklı et al. (2021). In this model, the production in an industry requires intermediate inputs and other factors of production. Since we do not model productivity changes or factor supply shocks, we assume a single factor of production, namely labour, in each country. Labour is mobile across sectors within a country but not across countries. We assume intermediate inputs have a nested structure. At the bottom level, the varieties of same industry from different countries are bundled to make the sectoral bundles. At the upper level, these sectoral inputs are combined to make the intermediate inputs. On the consumption side, we have a similar nested structure with the consumption decisions made at the sectoral level with a nested consumption bundle composed of final good varieties coming from different countries. All our production and consumption functions are assumed to exhibit constant elasticity of substitution.

We use the most recent data from OECD Inter-Country Input-Output (ICIO) Tables (OECD, 2021) and complement them with the tariff data from the UNCTAD Trade Analysis Information System

(TRAINS). We use elasticity values that are consistent with the literature (Costinot and Rodríguez-Clare, 2014; Caliendo and Parro, 2015; Baqaee and Farhi, 2019; Çakmaklı et al., 2021; di Giovanni et al., 2022). On the production side, labour, intermediate inputs and sectoral bundles are assumed to be complements, while country varieties are assumed to be substitutes. On the consumption side, country varieties are also assumed to be substitutes.

We model friend-shoring by an overall increase in trade costs in all industries across blocs. We find that while friend-shoring may provide insurance against extreme disruption (for instance, as a result of a war) or increase the security of supply for vital inputs (such as energy), our results indicate that, in the medium-run, friend-shoring leads to real output losses globally, ranging from 0.1 to 4.6% of GDP. Cyprus, Kazakhstan, Morocco, Russia, and south-east Asia lose the most, as they tend to have strong trade linkages with economies in both blocs. The costs are lower if the countries can generate revenues through tariffs.

To put these figures into perspective, we compare them to the losses associated with other recent shocks. Our analysis of these alternative scenarios reveals that the economic costs of friend-shoring are higher than the economic costs of either sanctions imposed on Russia after its invasion of Ukraine or extreme Covid-19 lockdowns in China. Under both of these scenarios, there are some countries poised to make a small gain (less than 0.5% of real GDP) by scaling up exports of goods previously exported by Russia or China. In contrast, no country gains under the friend-shoring scenario. Interestingly, some of the countries that are most severely affected by friend-shoring, such as south-east Asia and Kazakhstan, benefit under the alternative scenarios.

Our model has some limitations. To name a few: (i) We model the complex sanction systems as simple trade costs. (ii) Our model does not account for extensive margins with new trade links emerging between countries. (iii) We do not model productivity changes in the current draft, though we could takes this into account in future work. (iv) We abstract from other forces, such as climate change, that might significantly change the production patterns that we observe. (v) We use data from the pre-Covid period and thus ignore the potential changes to the trading patterns induced by the pandemic. However, the economies may not have fully recovered from Covid recession, so we are conservative by using pre-Covid data. Despite these limitations, we believe that our exercise raises an important flag for the friend-shoring trends.

Our paper is an extension of Baqaee and Farhi (2019) into the friend-shoring realm. Similar studies have been done to model the effect of the pandemic (Bonadio et al., 2021; Çakmaklı et al., 2020), vaccine distribution (Çakmaklı et al., 2021) or Global Financial Crisis (Barrot and Sauvagnat, 2016; Bems et al., 2010) or natural disasters (Boehm et al., 2019; Carvalho et al., 2021). We also relate to the literature on modeling sanctions using industry linkages such as Bachmann et al. (2022), Hausmann et al. (2022), and Mahlstein et al. (2022). Our paper adds the dimension of friend-shoring to an emerging literature on the welfare effects of "reshoring", "localising" or "decoupling" production (see, for example, Arriola et al., 2020; Grossman et al., 2021; Eppinger et al., 2021; Felbermayr et al., 2022).

The rest of the paper is organized as follows. In Section 2, we show the details of our economic model. In Section 3, we explain our data sources and parameter choices. In Section 4 we report our basic results and compare them to alternative scenarios, such as zero-Covid policy in China and sanctions imposed on Russia following its invasion of Ukraine. We highlight the limitations of our model and conclude in Section 5.

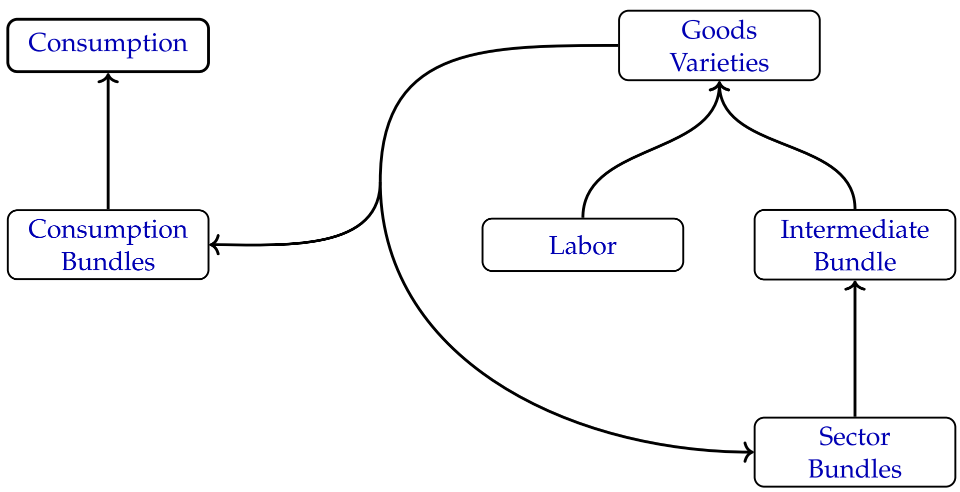
2 Economic Model

Before formalising our economic model, we illustrate the dimensions that we capture through an example of Turkish automotive industry. On the production side, this industry uses labour (or other factors)[2] and intermediate inputs that are formed as a bundle of goods from other sectors such as steel, plastics or chemicals. Each of these sectoral inputs are themselves bundles of varieties originating in different countries. For example, the steel used in the Turkish automotive industry could potentially come from Turkey, China, Germany or any other country that produces steel. On the consumption side, the goods produced by Turkish automotive industry can be consumed in different countries. The consumers in our model, on the other hand, first allocate their income at the sectoral level, deciding on the share of their income to be spent on automotive industry and then the variety of cars that they buy from different countries including Turkey.

[2]In our model, we do not incorporate technological change which affects the productivity or changes in the factor supply shocks. Hence, we use a single factor of production that captures the value-added share. In the short run, labour might not be as mobile, but in the medium run we assume that labour can easily switch between industries within the same country but not across countries.

To capture this heterogeneity between varieties, industries, sector bundles and factors, we opt for using nested production and consumption utility functions as in Baqaee and Farhi (2019) and Çakmaklı et al. (2021). Specifically, we use constant elasticity of substitution (CES) functions at each step. Figure 1 shows the schematic of the model. Each country produces a different variety in an industry. To produce this variety, a representative firm in this country combines labour and intermediate bundle, which consists of inputs from different industry bundles, formed by varieties coming from different countries. Consumers in a country, on the other hand, first decide to spend their income on so-called consumption bundles, which in turn consist of different varieties obtained from different countries.

Figure 1: Schematic of the model



NOTES: This figure summarises our model. The boxes on the left represent consumption, while the right side is related to production. Each country-industry pair is represented by the Goods / Varieties box. Each variety requires labour (country-specific) and intermediate input bundle to be produced. Labour is mobile between sectors within a country, but not across countries. Intermediate bundle consists of sector bundles, which in turn consist of goods / varieties. On the consumption side, individuals in each country decide first at the sector level what to consume and form consumption bundles from country varieties.

Before defining the functions governing the production and consumption decisions, we discuss the notation. We denote countries by c, m or v and the set of countries with $\mathcal{C}$. For industries, we use the indices i, j and k and show the set of industries with $\mathcal{N}$. We denote the output of industry i in country c with y_{ic}. Congruently, ic denotes a country variety.

Each variety / industry uses labour, which we denote with L_{ic}, and the total labour present in country c is denoted by $L_c = \sum_i L_{ic}$. We assume that labour is mobile across sectors within a country but not across countries.

In the Input-Output accounts, we observe the flows between industries potentially from other countries. We show the input used by industry i in country c from industry j in country m by x^{ic}_{jm}. The price of this good differs in different countries. Let's denote the price of variety jm with p_{jm} at its home country m. In country c, the price of this variety becomes:

$$p^c_{jm} = t^c_{jm} \tau^c_{jm} p_{jm},$$

where t^c_{jm} is the tariff cost and τ^c_{jm} is the iceberg trade cost. The difference between a tariff and the iceberg trade cost is that the former creates revenues for the inhabitants of country c with the tariff revenue shared equally between them. We define the input-output relations using the purchaser's prices, that is, including the trade costs with each element corresponding to:

$$\Omega^{ic}_{jm} \equiv \frac{p^c_{jm} x^{ic}_{jm}}{p_{ic} y_{ic}} = \frac{t^c_{jm} \tau^c_{jm} p_{jm} x^{ic}_{jm}}{p_{ic} y_{ic}}. \tag{1}$$

We denote the consumption of country c with $0c$ and use same notation for the consumption goods as well. In the case of consumption the denominator becomes the expenditure in country c, which we denote by e_c. The expenditure is the summation of factor income (wL_c) and the total tariff revenue collected by country c. Formally, e_c is defined as:

$$e_c \equiv wL_c + \sum_{i \in \mathcal{N} \bigcup \{0\}} \sum_{j \in \mathcal{N}} \sum_{m \in \mathcal{C} \setminus \{c\}} (t^c_{jm} - 1) p^c_{jm} x^{ic}_{jm}. \tag{2}$$

The second term in the summation corresponds to the tariff revenue collected from all the goods used / imported in country c either as an intermediate input (i.e., $i \in \mathcal{N}$) or for consumption (i.e., $i = 0$). We show the union of these sets with $\mathcal{N} \bigcup \{0\}$.[3]

Production. The output of industry i in country c is obtained by combining labour and the intermediate input bundle with a constant elasticity of substitution ϕ. We assume that all production

[3] In the second summation we exclude the case where $c = m$ but since $t^c_{jc} = 1$ for every $j \in \mathcal{N}$, we can include c as well.

functions are calibrated and, hence, we can write the price index of industry variety ic as:

$$p_{ic} = \left[\left(1 - \sum_{j \in \mathcal{N}} \sum_{m \in \mathcal{C}} \Omega^{ic}_{jm} \right) w^{1-\phi} + \left(\sum_{j \in \mathcal{N}} \sum_{m \in \mathcal{C}} \Omega^{ic}_{jm} \right) \left(p^{ic}_{M} \right)^{1-\phi} \right]^{\frac{1}{1-\phi}}, \tag{3}$$

p^{ic}_{M} denotes the price index for the intermediate input bundle for industry ic. Intermediate input bundle is composed of sectoral bundles. Suppose the price for sectoral bundle j to be used in industry variety ic is denoted by p^{ic}_{j}. Then the price index for the intermediate bundle can be written as:

$$p^{ic}_{M} = \left[\sum_{j \in \mathcal{N}} \frac{\sum_{m \in \mathcal{C}} \Omega^{ic}_{jm}}{\sum_{j' \in \mathcal{N}} \sum_{m' \in \mathcal{C}} \Omega^{ic}_{j'm'}} \left(p^{ic}_{j} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}, \tag{4}$$

where ε is the elasticity of substitution. The weight of each sector is normalised with the total share of intermediate inputs. Finally, the sectoral bundle is the combination of different varieties of the same sector from different countries. Assuming a sector specific elasticity substitution of ξ_i, the price index for the sectoral bundle can be written as:

$$p^{ic}_{j} = \left[\sum_{m \in \mathcal{C}} \frac{\Omega^{ic}_{jm}}{\sum_{m' \in \mathcal{C}} \Omega^{ic}_{jm'}} \left(p^{c}_{jm} \right)^{1-\xi_i} \right]^{\frac{1}{1-\xi_i}}. \tag{5}$$

Consumption. Suppose the price for consumption bundle for sector j is denoted by p^{0c}_{j}. Then the price index for the consumption good in country c, p_{0c}, is:

$$p_{0c} = \left[\sum_{j \in \mathcal{N}} \left(\sum_{m \in \mathcal{C}} \Omega^{0c}_{jm} \right) \left(p^{0c}_{j} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}, \tag{6}$$

where σ is the elasticity of substitution. The weight of each sector is normalised with the total share of intermediate inputs. Sectoral consumption bundles are formed by different sector / industries from different countries. Assuming a sector specific elasticity substitution of ξ'_i, the price index for the sectoral bundle can be written as:

$$p^{0c}_{j} = \left[\sum_{m \in \mathcal{C}} \frac{\Omega^{0c}_{jm}}{\sum_{m' \in \mathcal{C}} \Omega^{0c}_{jm'}} \left(p^{c}_{jm} \right)^{1-\xi'_i} \right]^{\frac{1}{1-\xi'_i}}. \tag{7}$$

Equilibrium. In the equilibrium, given the labour endowments, production functions, consumption preferences, productivity levels, tariffs and iceberg trade costs, the wages and prices adjust and labour is allocated to different sectors such that good and service markets clear:

$$y_{jm} = \sum_{i \in \mathcal{N} \bigcup \{0\}} \sum_{c \in \mathcal{C}} x_{jm}^{ic}.$$

And the labour markets clear:

$$L_c = \sum_{i \in \mathcal{N}} L_{ic}.$$

Response to an iceberg trade cost shock or a tariff shock. Following Baqaee and Farhi (2019), we solve for perturbations to the equilibrium induced by an iceberg trade cost or a tariff shock via log-linearising around the equilibrium and quantifying the changes in equilibrium wages, prices and labour allocations through the differential hat-algebra, which is heavily used in the trade literature (see Costinot and Rodríguez-Clare, 2014, for a review). This is akin to Euler's method to solve for differential equations. To make the log-linearisation more precise, we split our aggregate shock into smaller shocks. We modify the Matlab code provided by Baqaee and Farhi (2019) to solve for these perturbations.

3 Data

3.1 Input-Output Data

We calibrate our model by using the 2018 (latest available) version of the OECD Inter-Country Input-Output (ICIO) Tables (OECD, 2021), which show input usage of any industry i in country c from any other industries globally. In its original form, the dataset covers 45 industries and 67 countries. To make the computations more feasible, we aggregate data to 39 countries or country groups (see Appendix Table A.1 for the list of countries) and 16 industries (see Appendix Table A.2 for the list of industries). On the country side, we kept the granularity for emerging Europe and European neighbourhood economies, because we would like to assess whether they might benefit from friend-shoring. On the industry side, main aggregation is for services, which are relatively less prevalent in international trade.

3.2 Elasticities

The model assumes that (1) the country varieties are substitutable, with industry-specific constant elasticity of substitution values, and (2) inputs are complementary to each other. We use the values used in the literature for these elasticities. Country varieties are either aggregated as a bundle for consumption or as a sector bundle to be used in the intermediate bundle (Figure 1). Their elasticities corresponds to ξ_i parameters in Equations (5) and (7); we use the elasticity values estimated by Caliendo and Parro (2015) that have been used widely in the literature (see, for example, Costinot and Rodríguez-Clare, 2014). For the intermediate bundle, whose price index is defined in Equation (4), we use the elasticity of $\varepsilon = 0.2$, corresponding to high degree of complementarity between sectors. This elasticity is also similar to the ones used in the literature (see, for instance, Atalay, 2017; Bonadio et al., 2021; Baqaee and Farhi, 2019; Çakmaklı et al., 2021). The elasticity of substitution between labour and intermediate bundles, ϕ in Equation (3), is set to 0.6. For the consumption bundle, we choose σ in Equation (6) to be 1 to follow a Cobb-Douglas aggregation.

3.3 Tariff Data

We use tariff data from United Nations Conference on Trade and Development (UNCTAD) Trade Analysis Information System (TRAINS), accessible through the World Integrated Trade Solutions (WITS) tool. The original database contains information on tariffs for 119 countries at the reporter-partner-commodity level. To harmonise the tariff data with the input-output data, we first matched the 2-digits ISIC Rev 3 product codes in the tariff data to 2-digit ISIC Rev 4 product codes in the input-output-data and then aggregated the tariff data to the same 39 country groups and 16 industries using imports (in USD) as weights. We use the pre-pandemic tariff data from 2018[4] and the effectively applied tariff rates calculated by WITS as the lowest available tariff.[5]

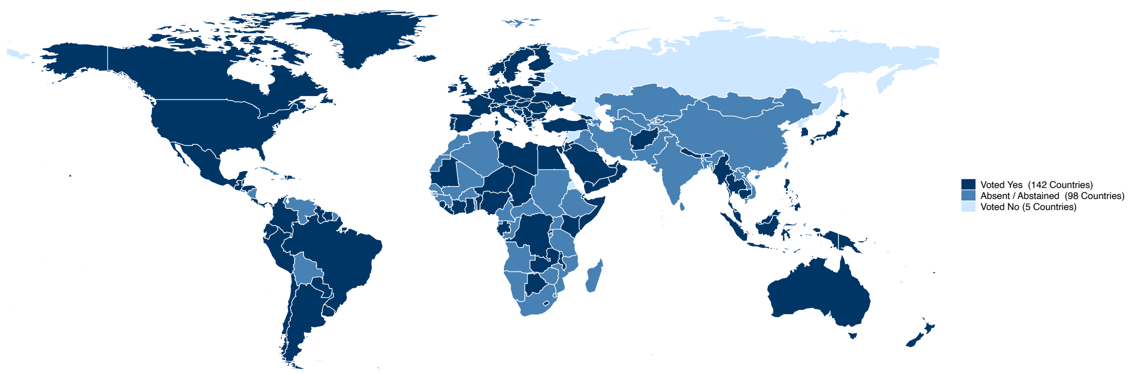
[4]In the case of four countries with missing tariff data in 2018, we use the most recently available data (Tunisia: 2016, Israel 2017, Morocco 2020, and Saudi Arabia, 2020).

[5]This means that if a preferential tariff trade agreement exists, it is used as the effectively applied tariff. Otherwise, the Most Favoured Nation tariffs – the rates that countries impose in imports from other members of the WTO – are used.

3.4 Country Blocs

UN General Assembly vote on the resolution on ”Aggression against Ukraine” on March 2, 2022 is used to differentiate between two blocs of economies: (i) the 141 countries that voted in favour of the UN General Assembly resolution condemning the aggression against Ukraine on 2 March 2022 and (ii) the 40 countries that voted against it, abstained or were absent from the voting.[6] Figure 2 shows the countries based on their vote.

Figure 2: UN Vote on ”Aggression against Ukraine”



SOURCE: UN General Assembly Resolution ES-11/1.
NOTES: This figure summarises the vote on UN General Assembly Resolution ES-11/1. The dark blue countries are the ones that voted ”Yes”. Blue countries are either abstained or were absent from the voting. Light blue colored countries voted ”No”.

As discussed above, we aggregate the 181 countries to 39 countries or country groups (see Appendix Table A.1) to make our model computations more feasible as well as due to input-output data availability. While in principle Bloc 1 consists of countries that voted in favour of the UN General Assembly resolution condemning the aggression against Ukraine on 2 March 2022 and Bloc 2 consists of those that voted against it, abstained or were absent from the voting, two of the country groupings we use – south-east Asia (Indonesia, Cambodia, Laos, Myanmar, Malaysia, Philippines, Thailand and Vietnam) and the rest of the world – contain both countries that should be in Bloc 1 and countries that should be in Bloc 2. To be more conservative, we assign these groups to Bloc 2.

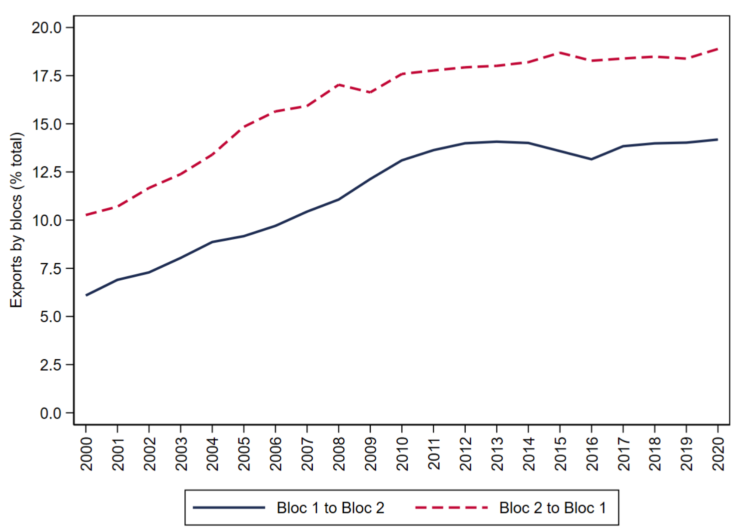
[6]See UN General Assembly Resolution ES-11/1: https://digitallibrary.un.org/record/3959039, last accessed 21 September 2022.

In the scenarios to which our model is applied, countries that condemned Russia's aggression (Bloc 1) are assumed to place value on sourcing inputs from other countries that condemned the invasion of Ukraine. We assume that Bloc 2 countries also employ similar measures in the medium run as a consequence of a polarised world.

3.4.1 Trade and tariffs between blocs

Before discussing the results, we illustrate the trade between these two blocs. The value of trade between Bloc 1 and Bloc 2 countries more than doubled between 2000 and 2008; it has continued to follow an increasing trend since then, though at a much slower pace. Figure 3 shows the evolution of share of exports of inter-bloc trade. In 2000, exports from Bloc 1 to Bloc 2 countries accounted for 6.1% of total exports and exports from Bloc 2 to Bloc 1 countries represented around a tenth of total exports. By 2020, exports from Bloc 1 to Bloc 2 countries increased to 14.2%, while exports from Bloc 2 to Bloc 1 countries reached 18.9%; this reflects the growth in supply chain-related trade between 2000 and 2020. Exports from Bloc 1 countries to Bloc 1 countries accounted for almost 62%; equivalent for Bloc 2 countries was only 5.2%.

Figure 3: Evolution of exports between Bloc 1 and Bloc 2 countries



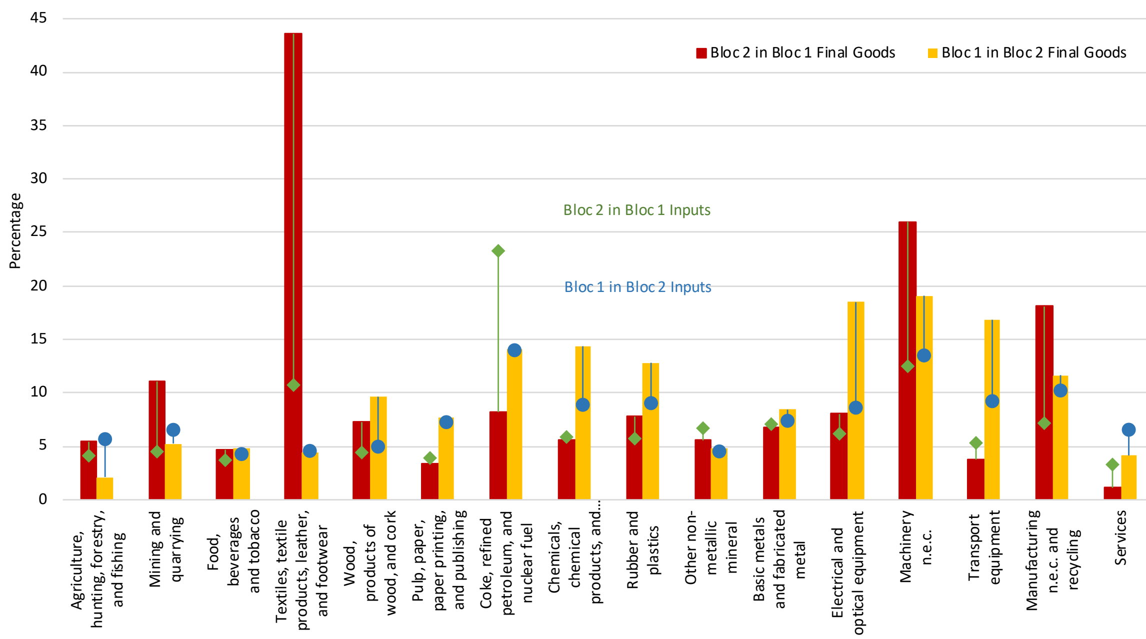
SOURCE: UN Comtrade, UN General Assembly Resolution ES-11/1 and authors' calculations.
NOTES: This figure shows the share of exports from Bloc 1 countries to Bloc 2 countries and vice versa. Export values are adjusted following Head et al. (2010). Bloc 1 consists of countries that voted "Yes" on UN General Assembly Resolution ES-11/1 and Bloc 2 consists of the rest of the countries.

Which final goods and intermediate inputs are traded the most between Bloc 1 and Bloc 2? We use OECD ICIO tables to separate the final goods trade from intermediate goods trade for 2018, the latest year this data is available for. In terms of final goods, the highest share of Bloc 2 goods in Bloc 1 final goods is textiles, textile product, leather and footwear - more than 43% of goods in this sector used by Bloc 1 originate from Bloc 2 (see Figure 4). This is followed by machinery not elsewhere classified (n.e.c.) (26%), manufacturing n.e.c. and recycling (18.1%), and mining and quarrying sectors (11.1%). Bloc 2 imports relatively higher shares of final goods in machinery n.e.c. (19.1%), electrical and optical equipment (18.5%), and transport equipment (16.8%) sectors.

On the intermediate inputs side, the highest shares of Bloc 2 inputs into Bloc 1 production are in the coke, refined petroleum and nuclear fuel sector (23.3%), followed by machinery, NEC (12.5%) and textiles, textile product, leather and footwear (10.7%). The highest shares of Bloc 1 inputs into Bloc 2 production are also in the coke, refined petroleum and nuclear fuel sector (14%). This is not surprising since both blocs include major oil producers (USA, Saudi Arabia, Canada and United Arab Emirates in Bloc 1, and Russia, Iraq, China and Iran in Bloc 2). As expected, services are not highly exchanged between blocs and this justifies our aggregation of the service sector.

We use the increase in trade costs as our policy instrument while modelling friend-shoring and sanctions. Figure 5a shows the current landscape of tariffs at the industry level that we use in our empirical exercises. All effective tariff rates are below 12%, exhibiting the nature of a globalised world in international trade. In general, Bloc 2 applies higher tariff rates than Bloc 1 with the exception of the textiles, textile product, leather and footwear and wood, products of wood and cork industries. The highest effective tariff rate for Bloc 1 is observed in the food, beverages and tobacco industry; this industry's effective tariff rate is the second highest for Bloc 2. The industry with the highest tariff rate for Bloc 2 is transport equipment. Interestingly, mining and quarrying has the lowest tariff in both blocs, showing the propensity of both blocs for importing raw minerals for production. Figure 5b shows the temporal trends of the average tariff rate between these two blocs since 2000. Bloc 2 countries have been lowering their tariff rates with Bloc 1. Friend-shoring would be undoing this rapprochement process between these two blocs.

Figure 4: Sectoral composition of trade between Bloc 1 and Bloc 2 countries

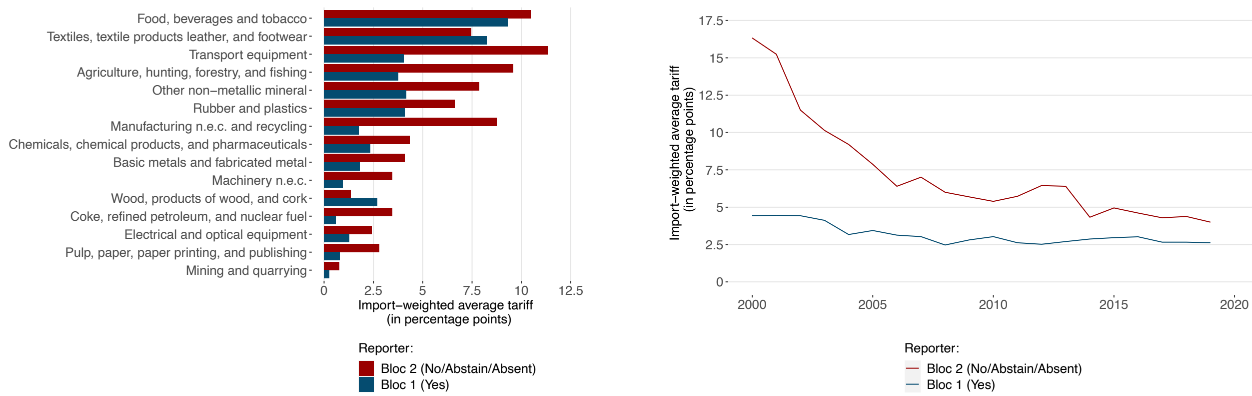


SOURCE: OECD Inter-Country Input-Output Database (OECD, 2021), UN General Assembly Resolution ES-11/1 and authors' calculations.
NOTES: To distinguish between final goods and intermediate input trade, we use OECD Inter-Country Input-Output Database (OECD, 2021). Sectoral aggregations in terms of ISIC Rev. 4 codes are provided in Table A.2. Bloc 1 consists of countries that voted "Yes" on UN General Assembly Resolution ES-11/1 and Bloc 2 consists of the rest of the countries. The red (yellow) bars correspond to the share of final goods used by Bloc 1 (Bloc 2) that are provided by Bloc 2 (Bloc 1) in each industry. Green diamonds (blue circles) show the share of intermediate inputs of each sector in Bloc 1 (Bloc 2) provided by Bloc 2 (Bloc 1).

Figure 5: Sectoral and average tariff rates

(a) 2018 average tariffs by product group

(b) Average tariffs by bloc (2000-2019)



SOURCE: UNCTAD TRAINS, UN General Assembly Resolution ES-11/1 and authors' calculations.
NOTES: Bloc 1 consists of countries that voted "Yes" on UN General Assembly Resolution ES-11/1 and Bloc 2 consists of the rest of the countries. Panel (a) shows the average tariff rates of Bloc 1 and Bloc 2 countries in each sector. Sectoral aggregations in terms of ISIC Rev. 4 codes are provided in Table A.2. Panel (b) shows the historical trends of average tariff rates between these two blocs.

4 Results

4.1 Friend-shoring

We model the impact of friend-shoring with two approaches. In the first approach, we impose an additional 20% increase in tariffs. We choose this tariff level to be above the observed tariffs reported in Figure 5. This increase results in tariff revenues for countries. We observe that there are no winners in this case with all countries losing between 0.1 and 2.3% of GDP (see Figures 6a and 6c). The biggest cost is experienced by Kazakhstan as its economy is integrated with both blocs but it remained in Bloc 2 by abstaining from voting. The second biggest cost is incurred by Morocco (absent in the voting) with 2%. Despite being in Bloc 1, Cyprus experiences the third highest cost with a 1.8% GDP loss. Scandinavian countries (Denmark, Sweden, Norway, Finland and Iceland), on the other hand, have the lowest cost after polarization.

In the second approach, we impose an additional iceberg trade cost of 20% in each industry. This type of cost does not generate any revenues for the countries and could be used to model the cases such as sanctions[7] or other non-tariff barriers. Figure 6a shows the results of this approach and Figure 6c shows the comparison between the results of tariff and iceberg trade costs. As expected, costs are much larger with the iceberg trade costs, with the losses ranging from 0.6 to 4.6% of GDP. The largest losses are experienced by Morocco (4.6% of GDP, up from 2%), south-east Asia (2.9%, up from 1.5%), Kazakhstan (2.8%, up from 2.3%), Cyprus (2.8%, up from 1.8%) and Russia (2.8%, up from 1.8%). Again, the common pattern among the countries who are the biggest losers is that these countries have integrated economies with both blocs.

The estimates obtained by both approaches make it clear that friend-shoring results in real GDP losses for all economies. "Friends" - countries with similar values and institutions - tend to have similar levels of income, so prioritising trade with such countries will eliminate any gains from the exploitation of comparative advantages and result in welfare losses.

4.2 Alternative scenarios

How do the economic costs of friend-shoring compare with economic costs of other policies? We consider two alternative scenarios: (1) zero-Covid policy pursued by China, and (2) sanctions imposed on Russia owing to its invasion of Ukraine. For both scenarios, we assume a 20% hike in iceberg trade costs in trade with the bloc of countries that voted in favour of the UN resolution condemning the invasion of Ukraine (Bloc 1 countries). These scenarios are also isomorphic to imposing trade barriers individually to China and Russia instead of applying sanctions to whole Bloc 2. Hence, the results change considerably for other countries in Bloc 2.

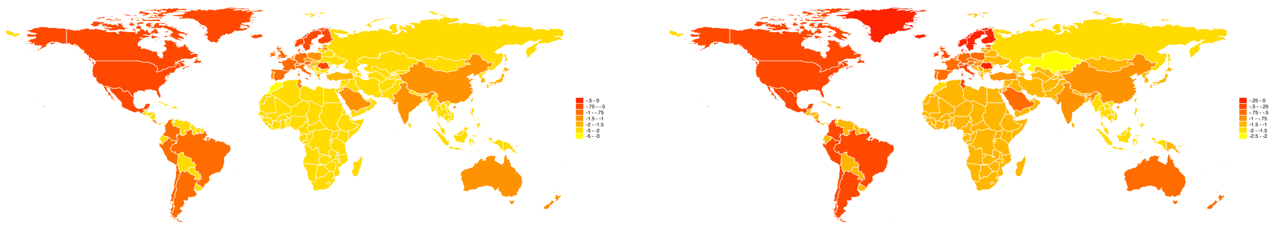
4.2.1 Zero-Covid policy in China

Zero-Covid policy pursued by China results in frequent lockdowns and stops in production. The model approximates an extreme version of these disruptions by means of a 20% increase in iceberg trade costs between China and Bloc 1 countries. Figure 7 shows the results. In contrast to the friend-shoring scenario, there are some economies that benefit - those that can replace China as a trade partner: south-east Asia (0.2% of GDP), Kazakhstan, Morocco and Russia (0.1% of GDP

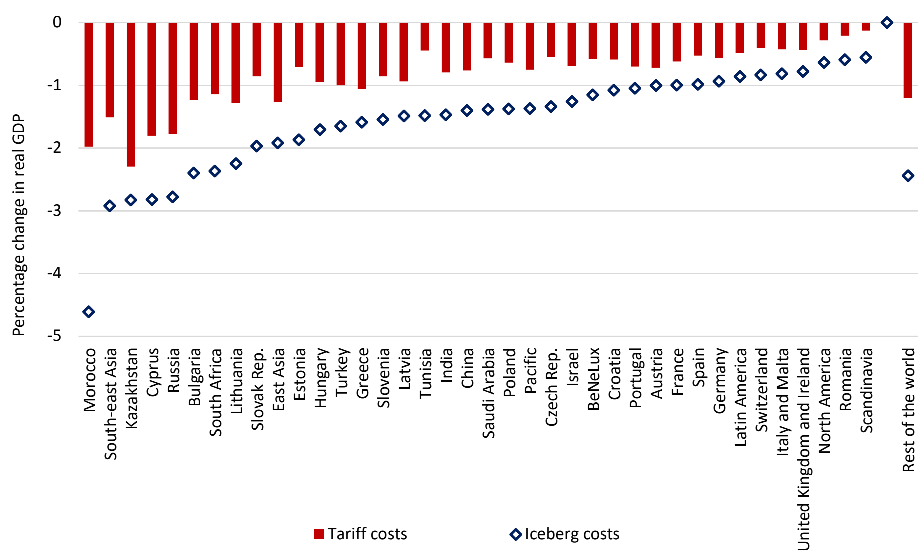
[7] Sanctions imposed at a more detailed aggregation could be modeled this way, since at our 16 industry level, they could be reflected as iceberg trade costs.

Figure 6: Relative decline in GDP after 20% increase in trade cost between Blocs (% GDP)

(a) Tariff Cost (b) Iceberg Cost



(c) Comparing costs

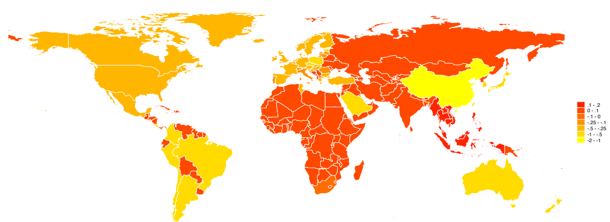


NOTES: The economic costs of friend-shoring are calculated by either imposing a 20% additional tariff (panel (a)) or 20% additional trade cost with no revenues (panel (b)) using our economic model. Panel (c) compares these costs. The list of country aggregations and bloc assignments can be found in Table A.1.

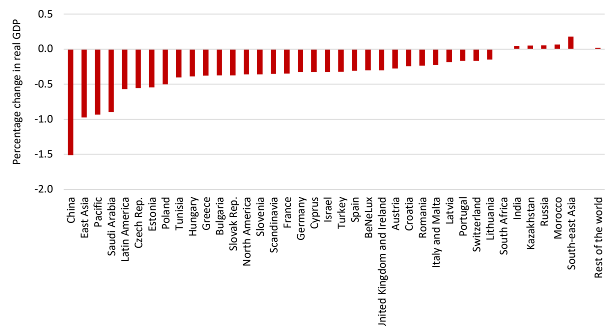
each). Interestingly, same set of countries that are most severely affected by friend-shoring seems to be gaining when the trade costs with China are increased. Those with a heavy reliance on Chinese inputs are more likely to be negatively affected, with the losses highest for China (1.5% of GDP), east Asia (1% of GDP), Pacific and Saudi Arabia (0.9% of GDP each). Countries in emerging Europe also experience significant GDP losses: for example, Czech Republic loses 0.6% of GDP, while Estonia and Poland lose 0.5% of GDP. For all of them, though, losses from zero-Covid policy in China are lower than the losses under the friend-shoring scenario using iceberg trade costs.

Figure 7: Relative decline in GDP after 20% increase in iceberg trade costs between Bloc 1 countries and China (% GDP)

(a) World Map of impact



(b) Country results



NOTES:This figure shows the economic costs resulting from extreme lockdowns resulting from China's zero-Covid policy using a non-revenue generating trade cost of 20% by Bloc 1. This scenario also corresponds to imposing an additional trade cost to China instead of whole Bloc 2. The list of country aggregations and bloc assignments can be found in Table A.1.

4.2.2 Sanctions imposed on Russia owing to its invasion of Ukraine

Following Russia's invasion of Ukraine, many countries imposed trade sanctions on Russia. While these sanctions often concern specific products or industries, their economic impact can be modelled as a 20% increase in the overall cost of trade between Russia and the bloc of economies that condemned the invasion of Ukraine (Bloc 1 countries). In this scenario, an increase in the cost of trade leads to a decline of nearly 3% of Russia's real GDP (see Figure 8).[8] Countries where produc-

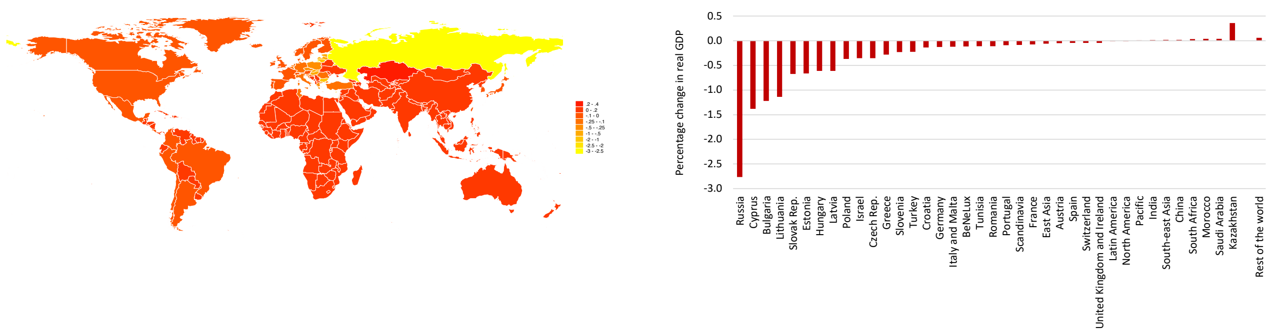
[8]Current estimates by forecasters point to a larger contraction in Russia in 2022 (see Guriev, 2022). The 20% increase in the cost of trade that is applied here is just a proxy, as this modelling cannot fully capture the complexity of sanctions in the real world. Ultimately, the primary focus of our analysis is the impact that sanctions have on emerging European and European Neighbourhood economies, rather than their impact on the Russian economy.

tion is more reliant on imports from Russia also experience sizeable losses (with declines of more than 1% of GDP estimated for Cyprus, Bulgaria and Lithuania, for instance). Kazakhstan, on the other hand, is poised to make a small gain (0.4% of GDP) as it scales up exports of goods that were previously exported by Russia. These estimates are broadly in line with the findings presented by Baqaee et al. (2022), who used a similar model to estimate the impact that stopping energy imports from Russia would have on the EU's 27 member states. In their model, Lithuania, Bulgaria and the Slovak Republic experienced the largest declines in gross national income.

Figure 8: Relative decline in GDP after 20% increase in iceberg trade costs between Bloc 1 countries and Russia (% GDP)

(a) World Map of impact

(b) Country results



NOTES: This figure shows the economic costs resulting from the sanctions to Russia using a non-revenue generating trade cost of 20% by Bloc 1. This scenario also corresponds to imposing an additional trade cost to Russia instead of whole Bloc 2. The list of country aggregations and bloc assignments can be found in Table A.1.

5 Limitations and Conclusion

5.1 Limitations

As is the case with most economic models, our analysis is subject to some limitations. First, there are some data limitations. Our input-output data is from 2018 and the world trade patterns might have changed with the pandemic. Moreover, the tariff data also changed (for example, with the trade war between the US and China). However, the economies may not have fully recovered from Covid recession yet, so we are being conservative by using pre-Covid data. Due to computational limitations and data availability, we work at a rather aggregated industrial level of 16 industries and

39 countries or country groups.

Second, we use the iceberg trade costs as a way to introduce complex trade frictions between countries. For instance, sanctions done using the detailed Harmonized System at six digit level are modelled to be an iceberg trade shock. Moreover, our model does not allow a complete shut down of one of our 16 industries - that would be equivalent to an infinite iceberg cost which cannot be approximated by log-linearisation.

Third, our model is not capable of predicting changes on the extensive margin. This means we cannot predict a new trade partnership at the industry or at the country level. This model captures solely the shifts among the already existing trade partnerships.

Fourth, with a single mobile factor of production - labour - we might not be capturing all dimensions of the value-added. Labour mobility assumes that labour can easily move from one sector to another within a country. In the short-run, this will not be possible. In the long-run, extensive margin could be important, making our model more suitable for the medium term.

Fifth, friend-shoring might imply movement of production coupled with knowledge transfers. Hence, with technological improvements leading to higher productivity, the costs of friend-shoring might decrease.

Finally, there are other underlying changes in the consumption and production patterns. For example, climate change and push for green technologies might replace some of the dependencies between countries. Hence, energy sources such as hydrocarbon-based products might lose their prevalence, while minerals such as lithium might be more important as the world requires more of these metals to transition to green production and consumption.

5.2 Conclusions

Due to recent political climate and geoeconomics, many countries are considering adopting friend-shoring to minimise the social cost of supply chain disruption by decreasing their dependence on the countries that they deem unfriendly. This policy could undo the globalisation that has been the prevalent force that shaped the international trade in recent decades. Given the intricate global value chains built during the globalisation period, it is inevitable that some economic costs will accrue in the friend-shoring era.

Using a rich economic model incorporating international production networks, we show that no country benefits from friend-shoring in the medium run. Our results indicate that the countries with deep economic ties with both blocs are the ones that bear the largest costs. Friend-shoring efforts will eventually force these countries to be more integrated with one of these blocs.

As we highlight above in the limitations section, our model does not account for the changes in the extensive margin and productivity gains. For the friend-shoring costs to minimise for Bloc 1 countries, new trade linkages need to emerge, replacing the dependency of Bloc 1 countries on Bloc 2. Moreover, this process should also involve knowledge transfers to increase productivity in countries where the industries will move into, especially for Bloc 1 countries that have cost advantages.

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APPENDIX

A List of Countries and Industries

Table A.1: List of countries

ID	ISO3/Abb.	Bloc	ID	ISO3/Abb.	Bloc	ID	ISO3/Abb.	Bloc
1	AUT	1	14	HRV	1	27	ISR	1
2	BeNeLux	1	15	HUN	1	28	LATAM	1
3	BGR	1	16	ITA&MLT	1	29	MAR	2
4	CHE	1	17	KAZ	2	30	SAU	1
5	CYP	1	18	LTU	1	31	TUN	1
6	CZE	1	19	LVA	1	32	NORTHAM	1
7	DEU	1	20	POL	1	33	IND	2
8	SCAND	1	21	PRT	1	34	ZAF	2
9	ESP	1	22	ROU	1	35	PACIF	1
10	EST	1	23	RUS	2	36	CHN	2
11	FRA	1	24	SVK	1	37	EASIA	1
12	GBR&IRL	1	25	SVN	1	38	SEASIA	2
13	GRC	1	26	TUR	1	39	ROW	2

NOTES: The Blocs are based on the UN General Assembly Resolution ES-11/1 on ”Aggression against Ukraine” on March 2, 2022. Countries who voted ”Yes” are in Bloc 1 and rest of the countries are in Bloc 2. We put countries in Southeast Asia (SEASIA) and rest of the world (ROW) in Bloc 2 although the countries in these groups voted heterogeneously. The country aggregations are:

- BeNeLux: Belgium, the Netherlands & Luxembourg.
- SCAND: Denmark, Sweden, Norway, Finland & Iceland.
- GBR&IRL: United Kingdom & Ireland.
- ITA&MLT: Italy & Malta.
- NORTHAM: USA & Canada.
- LATAM: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico & Peru.
- PACIF: Australia, New Zealand & Brunei.
- EASIA: East Asia: Japan, Republic of Korea & Singapore.
- SEASIA: Indonesia, Cambodia, Laos, Myanmar, Malaysia, Philippines, Thailand & Vietnam.
- ROW: Rest of the World.

Table A.2: List of Industries

ID	ISIC Rev 4	Description	Trade Elasticity
1	D01-03	Agriculture, hunting, forestry, and fishing	8.11
2	D05-09	Mining and quarrying	15.72
3	D10-12	Food, beverages and tobacco	2.55
4	D13-15	Textiles, textile products, leather, and footwear	5.56
5	D16	Wood, products of wood, and cork	10.83
6	D17-18	Pulp, paper, paper printing, and publishing	9.07
7	D19	Coke, refined petroleum, and nuclear fuel	51.08
8	D20-21	Chemicals, chemical products, and pharmaceuticals	4.75
9	D22	Rubber and plastics	4.75
10	D23	Other non-metallic mineral	2.76
11	D24-25	Basic metals and fabricated metal	7.99
13	D26-27	Electrical and optical equipment	10.6
12	D28	Machinery n.e.c.	1.52
14	D29-30	Transport equipment	0.37
15	D31-33	Manufacturing n.e.c. and recycling	5
16	D35-99	Services	5

NOTES: The trade elasticities are obtained from Caliendo and Parro (2015) via Costinot and Rodríguez-Clare (2014). n.e.c. - not elsewhere classified.