# Economic costs of friend-shoring*

**Beata S. Javorcik**† **Lucas Kitzmüller**‡ **Helena Schweiger**§
**Muhammed A. Yıldırım**¶

May 2023

**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 global economic integration of recent decades. This paper estimates the economic costs of friend-shoring using a quantitative model incorporating inter-country inter-industry linkages. The results suggest that friend-shoring may lead to real GDP losses of up to 4.7% of GDP in some economies. Thus, although friend-shoring may provide insurance against extreme disruptions and increase the security of supply of vital inputs, it would come at a significant cost.

**Keywords:** Friend-shoring; Regionalisation; Global Trade and Production Network; International I-O Linkages.
**JEL Codes:** F15, F51, F60, R15.

*The views presented are those of the authors and not necessarily of the EBRD or its shareholders.

†EBRD, Oxford University and CEPR. email: javorcib@ebrd.com.
‡EBRD. email: kitzmuel@ebrd.com.
§EBRD. email: schweigh@ebrd.com.
¶The Growth Lab, Harvard University and Koç University. email: muhammed_yildirim@hks.harvard.edu.

# 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 with the blocs defined based on the UN General Assembly Resolution ES-11/1 on "Aggression against Ukraine" on March 2, 2022. For robustness and in line with Kleinman et al. (2022), we also define the blocs using the various similarity measures (such as Signorino and Ritter, 1999; Scott, 1955; Cohen, 1960) in bilateral UN General Assembly voting between 2014 and 2021 (using updated Voeten, 2013, dataset), and the 2014-21 average 'ideal points' on a unidimensional scale and Jenks natural breaks classification with two clusters (see Bailey et al., 2017).[2] 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), and with and without the additional trade cost imposition on the coke, refined petroleum, and nuclear fuel industry.

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

[2]See more details in Table A.1.

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 also consider a scenario where the coke, refined petroleum, and nuclear fuel industry[3] is not affected. 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 is bad for most economies - generally it leads to real output losses globally, ranging from 0.1 to 4.7% of GDP. Only countries that manage to remain non-aligned may see real output gains, but such gains are much smaller than losses (up to 0.8% of GDP) and not guaranteed. Economies with the largest losses are those that have strong trade linkages with economies in all blocs; as such, the bloc definition used influences the list to a certain extent. However, Cyprus, Kazakhstan, Morocco, Russia, and Lithuania are among the top 8 losers regardless of the bloc definition used. 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. Inter-

[3] The coke, refined petroleum, and nuclear fuel industry is a strategically important area of the industry and trade. Russia is the world's third largest oil producer and the world's largest exporter of oil to global markets and the second largest crude oil exporter behind Saudi Arabia (see https://www.iea.org/reports/russian-supplies-to-global-energy-markets/oil-market-and-russian-supply-2).

estingly, 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, 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 do not look at FDI or account for technology transfers that may be happening through trade.[4] (vi) 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.

[4] Coelli et al. (2020) show that tariff cuts during the 1990s promoted innovation and growth, while International Monetary Fund (2023) analyses the impact of FDI fragmentation on output losses.

## 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)[5] 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.

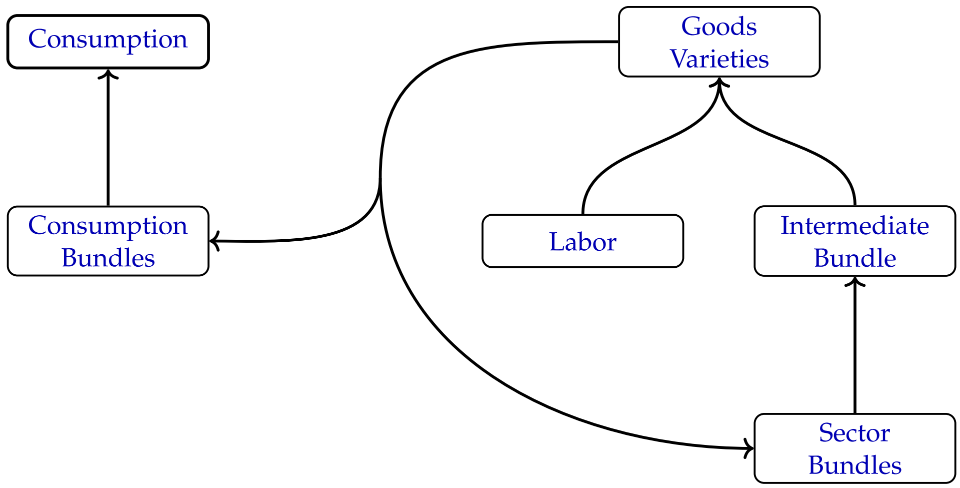
To capture this heterogeneity between varieties, industries, sector bundles and factors, we opt for using nested production and consumption utility functions as in Baqaee and Farhi (2019) and Çakmaklı et al. (2021). Specifically, we use constant elasticity of substitution (CES) functions at each step. 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.

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

[5] 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.

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.

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 $\tau^c_{jm}$ 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 $\mathcal{N} \bigcup \{0\}$.[6]

**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 $\phi$. We assume that all production 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 $\varepsilon$ 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 $\xi_i$, the

[6] 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.

price index for the sectoral bundle can be written as:

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

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

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

where $\sigma$ 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 $\xi_i'$, the price index for the sectoral bundle can be written as:

$$p_j^{0c} = \left[ \sum_{m \in \mathcal{C}} \frac{\Omega_{jm}^{0c}}{\sum_{m' \in \mathcal{C}} \Omega_{jm'}^{0c}} \left( p_{jm}^{c} \right)^{1-\xi_i'} \right]^{\frac{1}{1-\xi_i'}}. \tag{7}$$

**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 $\xi_i$ 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, $\phi$ in Equation (3), is set to 0.6. For the consumption bundle, we choose $\sigma$ 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[7] and the effectively applied tariff rates calculated by WITS as the lowest available tariff.[8]

### 3.4 Country Blocs

We define four different country blocs using the United Nations (UN) voting behaviour. 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. We describe the bloc definitions below; detailed allocations can be found in Table A.1.

In Bloc definition A, we differentiate between two blocs of economies based on the UN General Assembly vote on "Aggression against Ukraine" on March 2, 2022: (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.[9] Figure 2 shows the countries based on their vote.

[7]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).

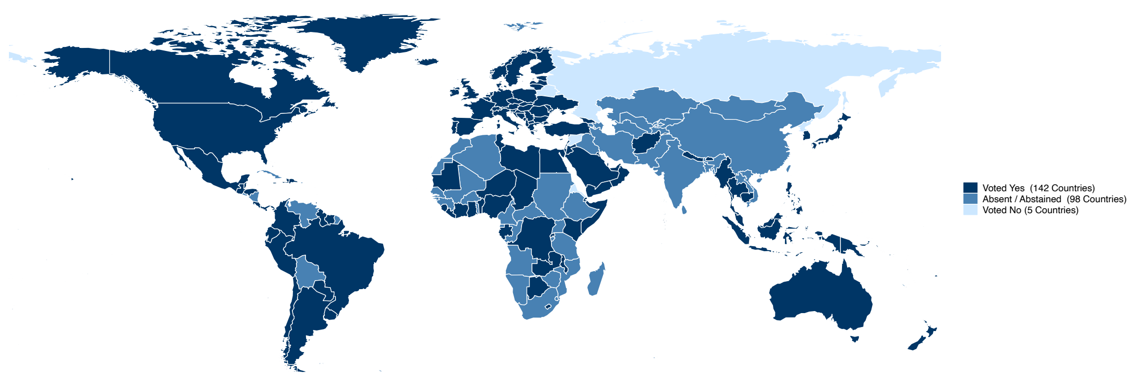
[8]This means that if a preferential tariff trade agreement exists, it is used as the effectively applied tariff. Otherwise, the Most Favoured Nation tariffs – the rates that countries impose in imports from other members of the WTO – are used.

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

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.

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.

Figure 2: UN Vote on "Aggression against Ukraine"



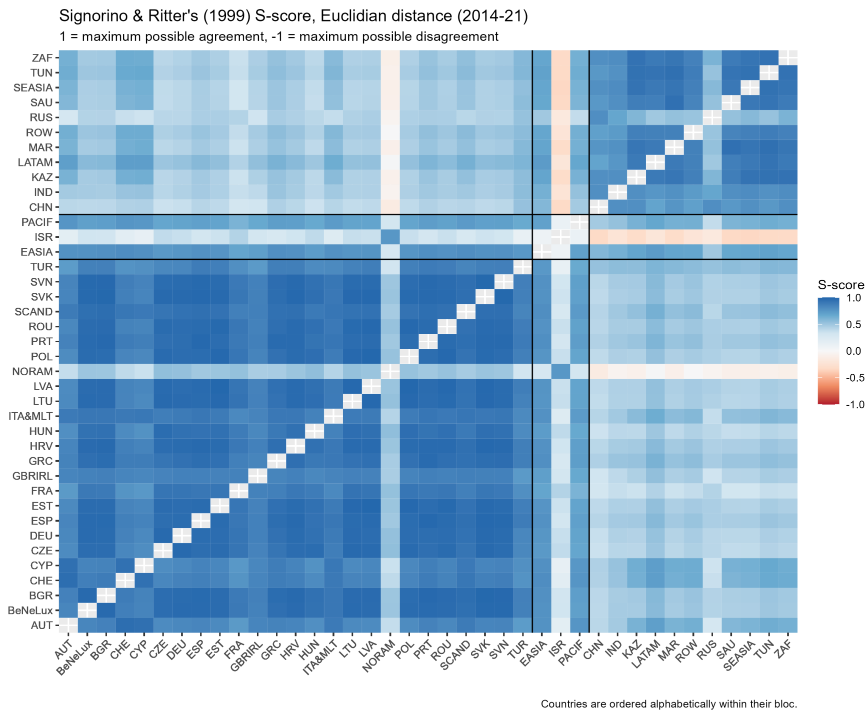

SOURCE: UN General Assembly Resolution ES-11/1.
NOTES: This figure summarises the vote on UN General Assembly Resolution ES-11/1. The dark blue countries are the ones that voted "Yes". Blue countries are either abstained or were absent from the voting. Light blue colored countries voted "No".

In the remaining three bloc definitions, we use data on bilateral UN General Assembly voting between 2014 and 2021 (using updated Voeten, 2013, dataset) and, following a large political science literature, measure countries' bilateral political attitudes towards one another using the similarity of their UN votes. Specifically, in Bloc definition B, we define three blocs – friends, non-friends, and non-aligned – based on the clusters visually emerging in heat maps of bilateral vote similarity using various similarity measures: S-score (Signorino and Ritter, 1999, Figure 3a), $\pi$-score (Scott, 1955,

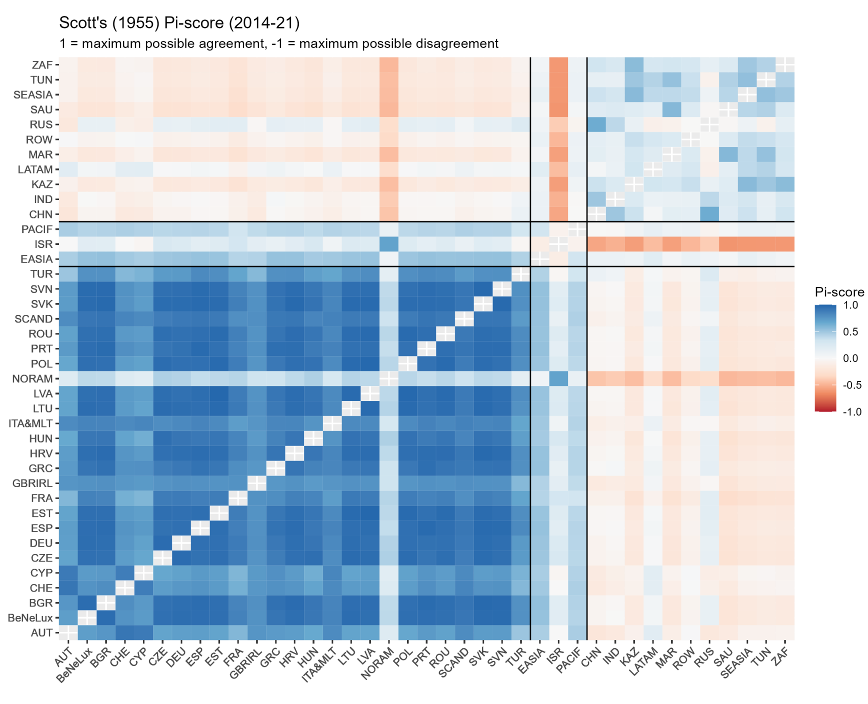
Figure 3b), and $\kappa$-score (Cohen, 1960, Figure 3c).[10]

Figure 3: Bloc definition B

(a) S-score (Signorino and Ritter, 1999)

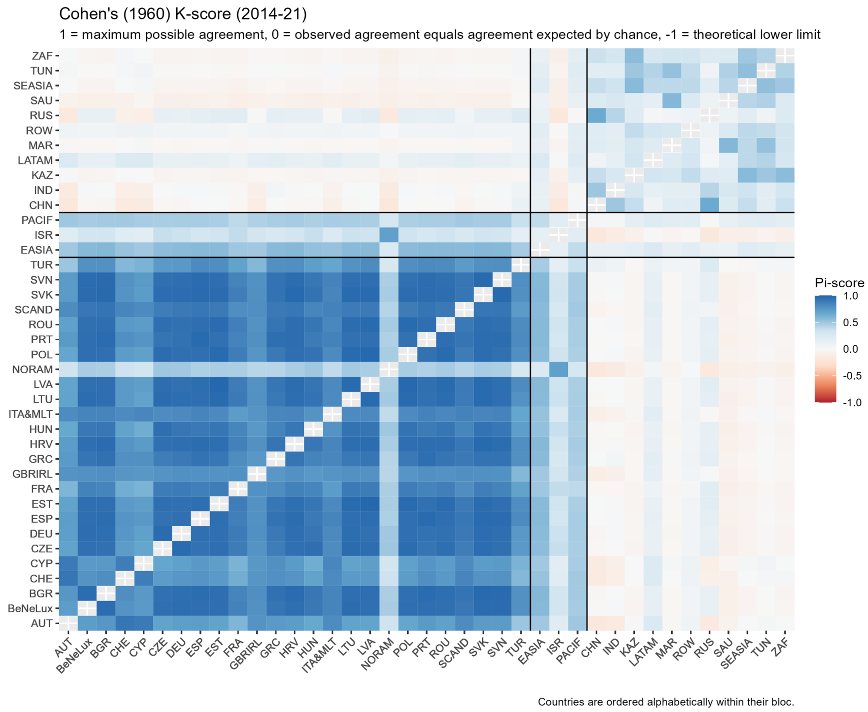



(b) $\pi$-score (Scott, 1955)




[10]See Kleinman et al. (2022) for a more detailed discussion of these measures.

(c) $\kappa$-score (Cohen, 1960)




SOURCE: Authors' calculations based on UN General Assembly voting between 2014 and 2021 (Voeten, 2013).
NOTES: Panel 3a shows the S-score of Signorino and Ritter (1999), using Euclidean distance. 1 - maximum possible agreement, -1 - maximum possible disagreement. Panel 3b shows the $\pi$-score of Scott (1955). 1 - maximum possible agreement, -1 - maximum possible disagreement. Panel 3c shows the $\kappa$-score of Cohen (1960). 1 - maximum possible agreement, 0 - observed agreement equals agreement expected by chance, -1 - theoretical lower limit. Economies are ordered alphabetically within their bloc. Economies are ordered alphabetically within their bloc (see Table A.1).

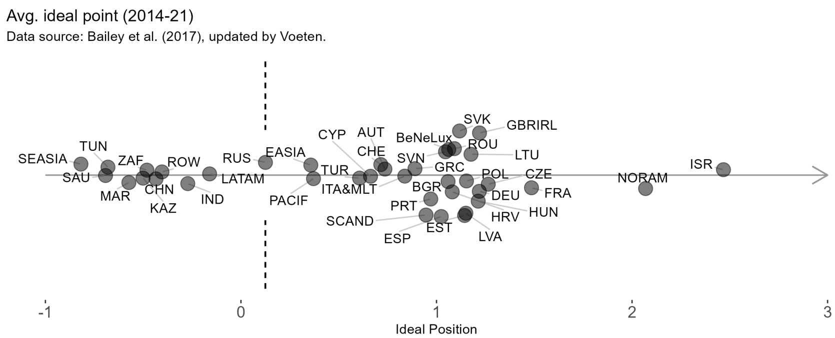
In Bloc definition C, countries are allocated to two blocs based on the 2014-21 average 'ideal points' on a unidimensional scale and Jenks natural breaks classification with two clusters (see Bailey et al., 2017). This yields Russia as a cut-off point (see Figure 4).

In Bloc definition D, we use the same bloc definition as in Bloc definition B, but assign the Rest of the World to the non-aligned bloc.

### 3.4.1 Trade and tariffs between blocs

Before discussing the results, we illustrate the trade between the two blocs in Bloc definition A. 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 5 shows the evolution of share of exports of inter-bloc trade. In 2000, exports from Bloc 1 to Bloc 2 countries

Figure 4: Bloc definition C: Average ideal points, 2014-2021



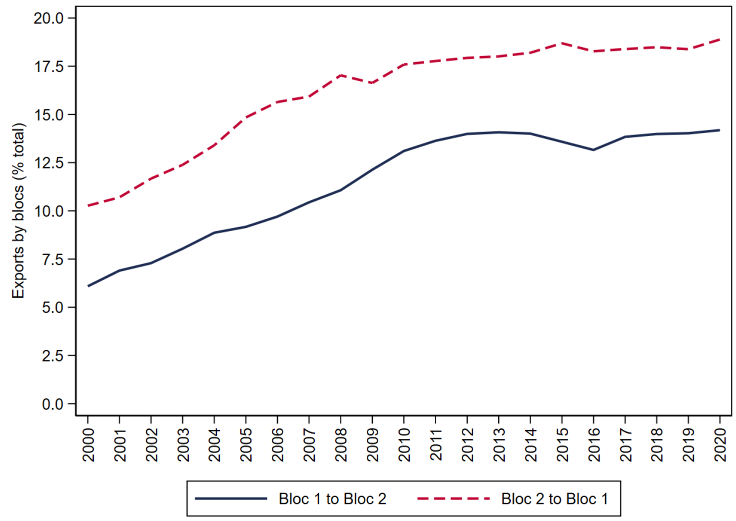

SOURCE: Authors' calculations based on UN General Assembly voting between 2014 and 2021 (Bailey et al., 2017; Voeten, 2013).
NOTES: This figure shows the average ideal point using Bailey et al. (2017), updated by Voeten (2013). The list of country aggregations and bloc assignments can be found in Table A.1.

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%.

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 6). 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

Figure 5: Evolution of exports between Bloc 1 and Bloc 2 countries (Bloc definition A)

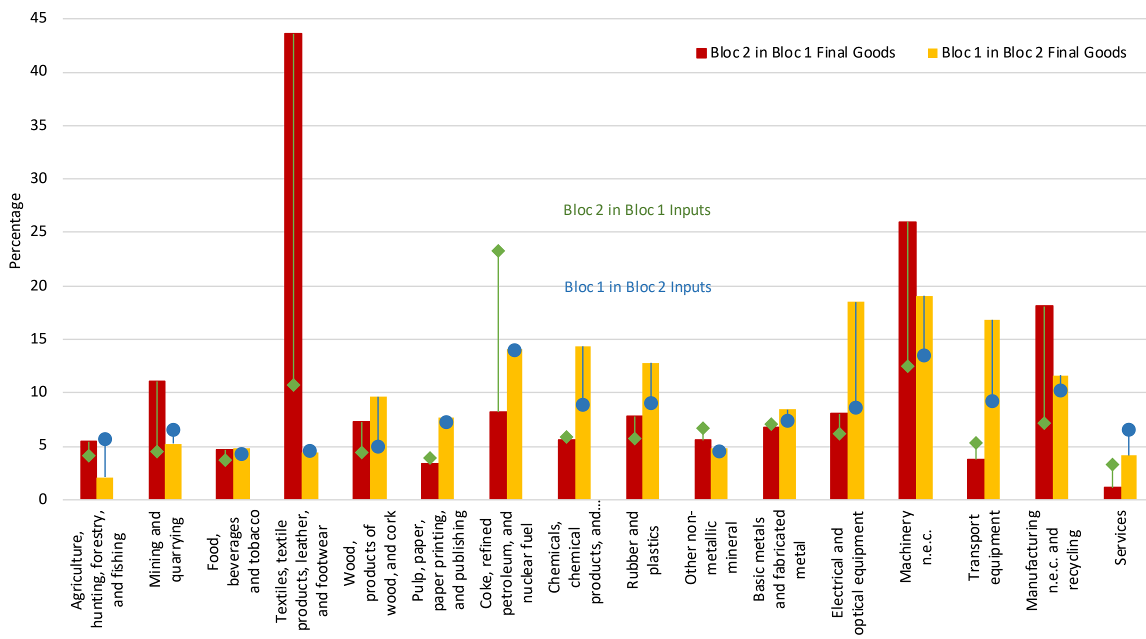



SOURCE: UN Comtrade, UN General Assembly Resolution ES-11/1 and authors' calculations.
NOTES: This figure shows the share of exports from Bloc 1 countries to Bloc 2 countries (under Bloc definition A) and vice versa. Export values are adjusted following Head et al. (2010). Bloc 1 consists of countries that voted "Yes" on UN General Assembly Resolution ES-11/1 and Bloc 2 consists of the rest of the countries. The list of country aggregations and bloc assignments can be found in Table A.1.

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 7a 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 7b 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.

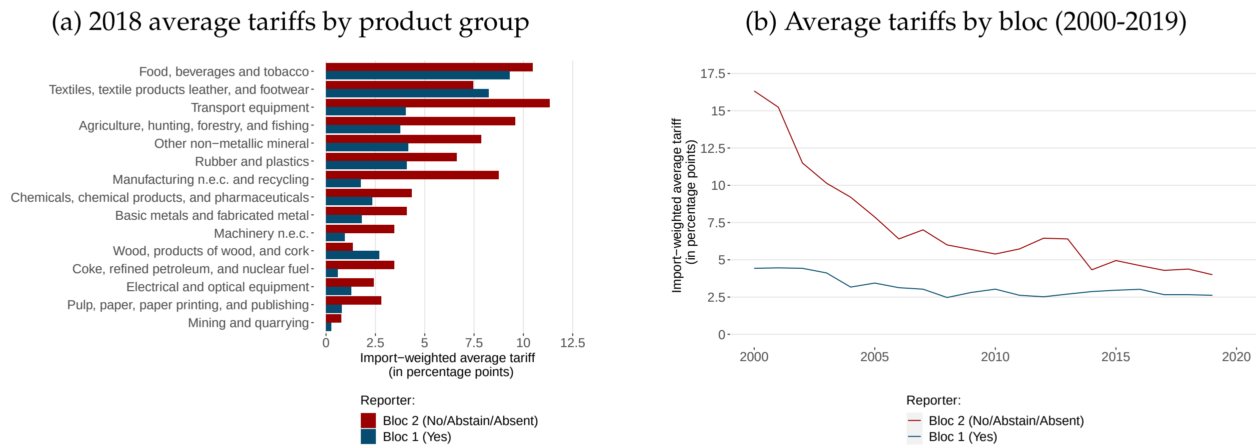
Figure 6: Sectoral composition of trade between Bloc 1 and Bloc 2 countries (Bloc definition A)




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). The list of country aggregations and bloc assignments can be found in Table A.1.

Figure 7: Sectoral and average tariff rates (Bloc definition A)




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 by imposing either an additional iceberg trade cost of 20% or an additional 20% increase in tariffs. Iceberg trade cost does not generate any revenues for the countries and could be used to model the cases such as sanctions[11] or other non-tariff barriers. An increase in tariffs results in tariff revenues for countries, so losses are lower than with the iceberg trade cost. We impose the same cost in each industry, but also consider the case where such cost is not imposed on the coke, refined petroleum and nuclear fuel industry. These gives us four different approaches in total; we describe each in turn below.

### 4.1.1 All industries affected in the same way

In the first approach, we impose an additional iceberg trade cost of 20% in each industry. Figure 8a shows the results of this approach for each of the four bloc definitions.

Under Bloc definition A, we observe that there are no winners, with all the countries losing between 0.6 and 4.6% of GDP. The largest losses are experienced by Morocco (4.6% of GDP), south-east Asia (2.9%), Kazakhstan (2.8%), Cyprus (2.8%) and Russia (2.8%). Scandinavian countries (Denmark, Sweden, Norway, Finland and Iceland), on the other hand, have the lowest cost after polarization. Overall, the model suggests world GDP would decrease by 1.3% of GDP.

When using Bloc definitions B, C or D, on the other hand, Tunisia experiences the largest losses (4.2 to 4.5% of GDP), followed by Morocco (3.9 to 4.2% of GDP). The reason Tunisia is not among the top losers under Bloc definition A is that it voted in favour of the UN General Assembly resolution condemning the aggression against Ukraine on 2 March 2022 and was thus in the "friends" bloc. Its bilateral voting record between 2014 and 2021, however, puts it into the group of less politically aligned countries - "non-friends" bloc. A similar, though less striking pattern, is observed for Saudi Arabia. The common pattern among the countries that are the biggest losers is that they have integrated economies with both blocs.

[11] 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.

There are also a few economies that experience gains in real GDP when we allow some countries to remain non-aligned (Bloc definitions B and D). Largest gains are experienced by Israel (0.4 to 0.8% of GDP) and East Asia (0.1 to 0.2% of GDP). Rest of the world also experiences a 0.1% gain in GDP under Bloc definition D. The common denominator is that under these definitions, these economies manage to remain non-aligned. However, managing to remain non-aligned does not always result in gains from friend-shoring - it may merely reduce the losses, as is the case for the Pacific region.

In the second approach, we impose an additional 20% increase in tariffs. We choose this tariff level to be above the observed tariffs reported in Figure 7. This increase results in tariff revenues for countries, so the losses are lower than with the iceberg trade cost, but again there are no winners under Bloc definition A - all countries lose between 0.1 and 2.3% of GDP (see Figure 8b). 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% of GDP. Despite being in Bloc 1, Cyprus experiences the third highest cost with a 1.8% GDP loss. Scandinavian countries again have the lowest cost after polarisation.

As in the case of iceberg trade cost, the ranking of countries in terms of the impact of friend-shoring on real GDP changes somewhat if we use a different bloc definition. Tunisia remains the most affected under Bloc definitions B, C and D (with around 2% GDP loss), followed closely by Kazakhstan. While the real GDP losses are lower with tariff cost than with iceberg cost, the magnitude of real GDP gains of non-aligned countries in Bloc definitions B and D remains roughly the same.

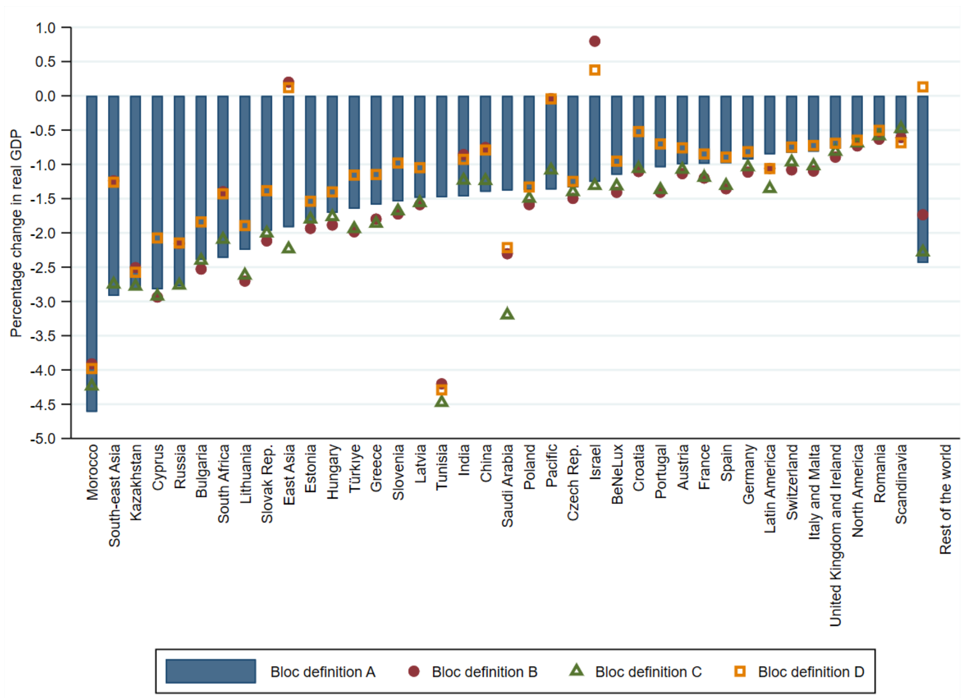
#### 4.1.2 No change for the coke, refined petroleum, and nuclear fuel industry

In the third approach, we impose an additional iceberg trade cost of 20% in all industries except the coke, refined petroleum, and nuclear fuel industry, and in the fourth approach, we do the same with an additional 20% increase in tariffs. Figure 9 shows the results of these two approaches for each of the four bloc definitions.

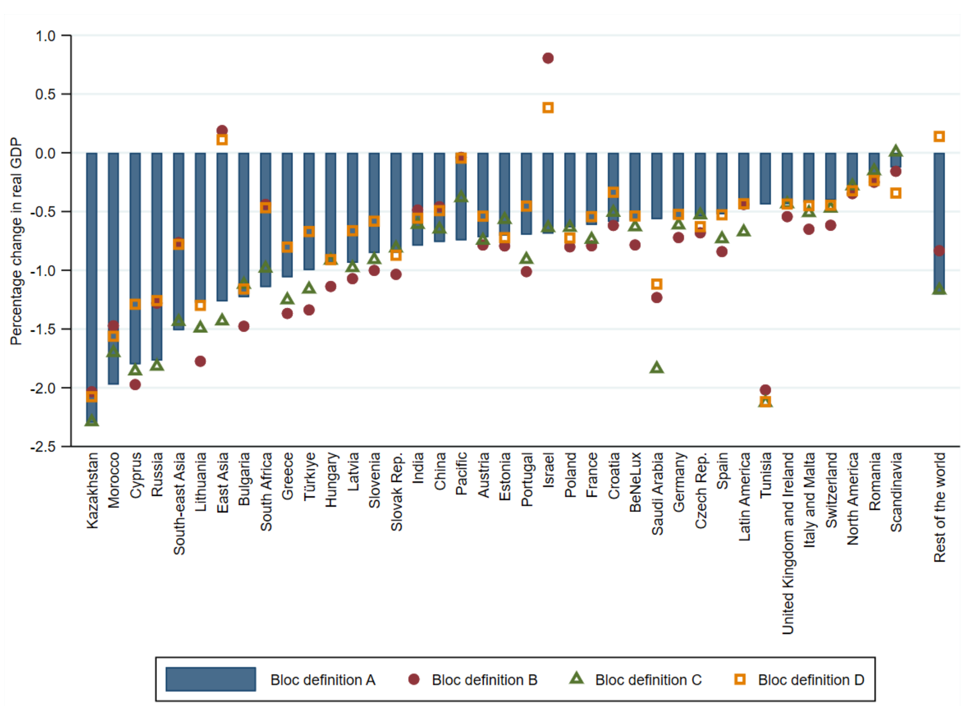
Under Bloc definition A, we again observe that there are no winners when we impose an additional 20% iceberg trade cost, with all the countries losing between 0.7 and 4.7% of GDP; the

Figure 8: Relative decline in GDP after 20% increase in trade cost between Blocs (% GDP)

(a) Iceberg cost




(b) Tariff cost




NOTES: The economic costs of friend-shoring are calculated by either imposing a 20% additional trade cost with no revenues (Panel 8a) or a 20% additional tariff (Panel 8b) in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

losses are on average are 0.1 percentage points higher than when the cost is imposed on all industries equally. The largest losses are experienced by Morocco (4.7% of GDP), south-east Asia (2.9%), Cyprus (2.8%), Kazakhstan (2.6%), and South Africa (2.3%). Russia's loss under this scenario is lower by more than 30% - 1.9% of GDP, which is expected since crude oil is its biggest export; Russia is the world's largest exporter of oil to global markets and the second largest crude oil exporter. North America (Canada and USA), on the other hand, have the lowest cost. Overall, the model suggests world GDP would decrease by a similar amount as before - 1.3% of GDP.

When using Bloc definitions B, C or D, on the other hand, Tunisia again experiences the largest losses (4.1 to 4.4% of GDP), followed by Morocco (4.0 to 4.4% of GDP). There same economies as before experience gains in real GDP when we allow some countries to remain non-aligned (Bloc definitions B and D), but the gains are now about half of those in the first approach: 0.2% of GDP for Israel and 0.1% of GDP for East Asia. Rest of the world experiences a similar 0.1% gain in GDP under Bloc definition D as before.

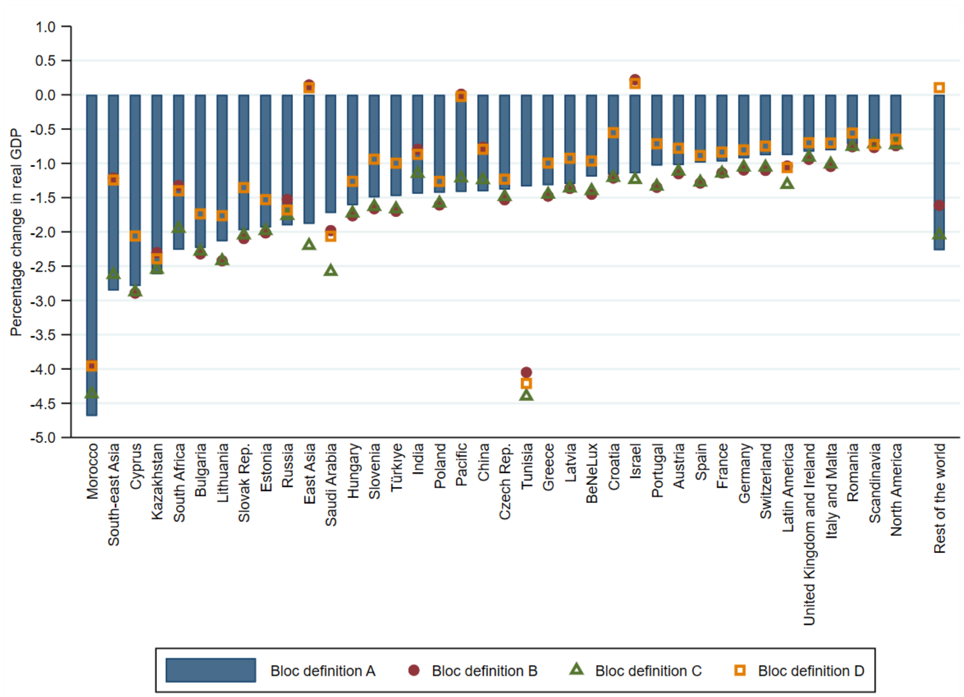
In the fourth approach, we impose an additional 20% increase in tariffs on all industries except the coke, refined petroleum, and nuclear fuel industry. The losses are lower than with the iceberg trade cost, but again there are no winners under Bloc definition A - all countries lose between 0.3 and 2.0% of GDP (see Figure 9b). The biggest cost is experienced by Kazakhstan (2% of GDP), followed by Cyprus and Morocco (1.9% of GDP.) Scandinavian countries have the lowest cost after polarisation.

As in the case of iceberg trade cost, the ranking of countries in terms of the impact of friend-shoring on real GDP changes somewhat if we use a different bloc definition. Cyprus is the most affected under Bloc definitions B and C (with around 2% GDP loss), while Tunisia is the most affected under Bloc definition D.

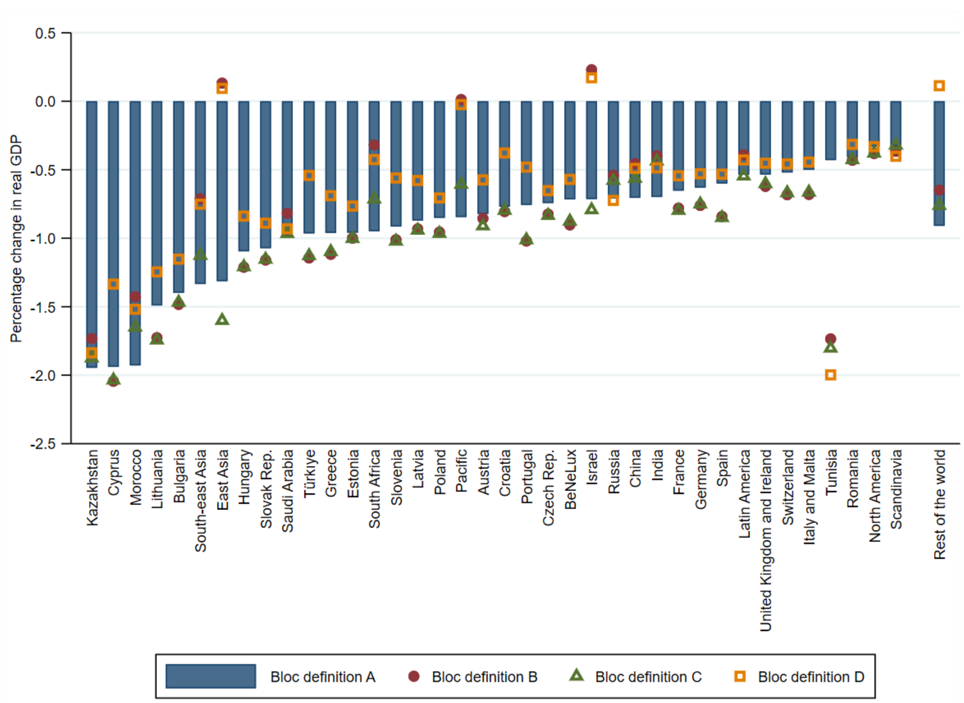
The estimates obtained by all four approaches make it clear that friend-shoring results in real GDP losses for most economies, though the exact costs depend on which industries are targeted. Some economies may be better off if they manage to remain non-aligned, but non-alignment does not necessarily guarantee real GDP gains. "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.

Figure 9: Relative decline in GDP after 20% increase in trade cost between Blocs (% GDP), no change for the coke, refined petroleum and nuclear fuel industry

(a) Iceberg cost




(b) Tariff cost




NOTES: The economic costs of friend-shoring are calculated by either imposing a 20% additional trade cost with no revenues (Panel 9a) or a 20% additional tariff (Panel 9b) in all industries except the coke, refined petroleum, and nuclear fuel industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

## 4.2 Alternative scenarios

How do the economic costs of friend-shoring compare with economic costs of other policies? We consider two alternative scenarios under Bloc definition A: (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

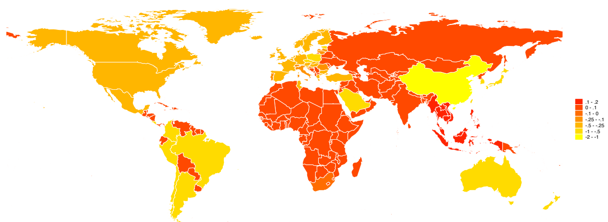
Zero-Covid policy pursued by China results in frequent lockdowns and stops in production. The model approximates an extreme version of these disruptions by means of a 20% increase in iceberg trade costs between China and Bloc 1 countries (Bloc definition A). Figure 10 shows the results. In contrast to 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 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.

### 4.2.2 Sanctions imposed on Russia owing to its invasion of Ukraine

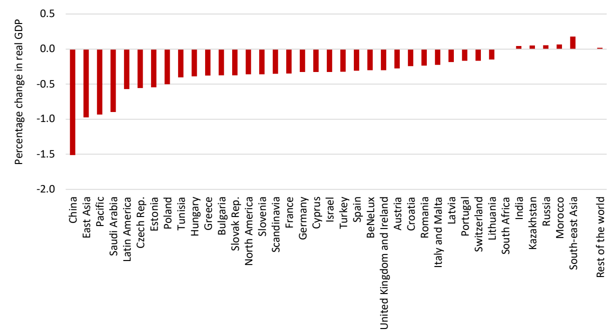
Following Russia's invasion of Ukraine, many countries imposed trade sanctions on Russia. While these sanctions often concern specific products or industries, their economic impact can be modelled as a 20% increase in the overall cost of trade between Russia and the bloc of economies that condemned the invasion of Ukraine (Bloc 1 countries using the Bloc A definition). In this scenario,

Figure 10: 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.

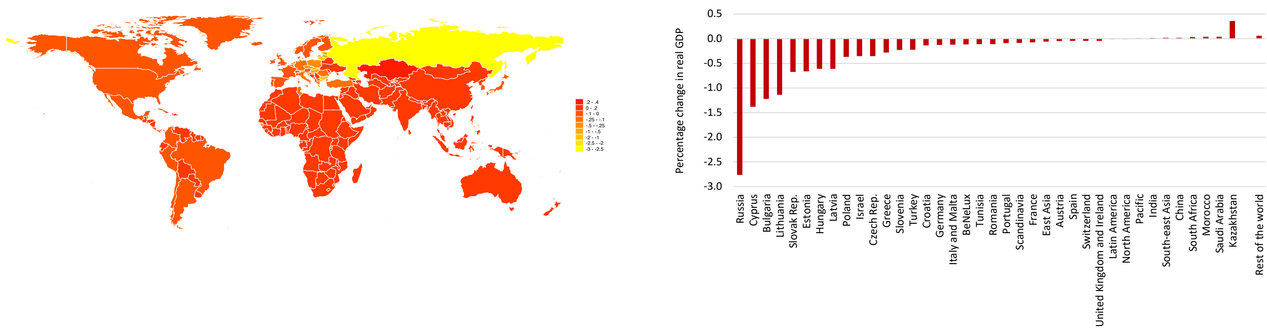
an increase in the cost of trade leads to a decline of nearly 3% of Russia's real GDP (see Figure 11).[12] Countries where production is more reliant on imports from Russia also experience sizeable losses (with declines of more than 1% of GDP estimated for Cyprus, Bulgaria and Lithuania, for instance). 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.

[12]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.

Figure 11: 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 innovation and higher productivity, the costs of friend-shoring might decrease. We also do not look at FDI.

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 with a focus on economies in emerging Europe tied to European global value chains, we show that most countries do not benefit 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.

Only countries that manage to remain non-aligned may see some benefit from friend-shoring, but non-alignment is not a guarantee of gains from friend-shoring.

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

## References

**Arriola, Christine, Przemyslow Kowalski, and Frank van Tongeren**, "Localising value chains in the post-COVID world would add to the economic losses and make domestic economies more vulnerable," *VoxEU, November*, 2020, *15.*

**Atalay, Enghin**, "How important are sectoral shocks?," *American Economic Journal: Macroeconomics*, 2017, *9* (4), 254–80.

**Bachmann, Ruediger, David Baqaee, Christian Bayer, Moritz Kuhn, Andreas Löschel, Benjamin Moll, Andreas Peichl, Karen Pittel, Moritz Schularick et al.**, "What if? The economic effects for Germany of a stop of energy imports from Russia," Technical Report 028, ECONtribute Policy Brief 2022.

**Bailey, Michael A., Anton Strezhnev, and Erik Voeten**, "Estimating dynamic state preferences from United Nations voting data," *Journal of Conflict Resolution*, 2017, *61* (2), 430–456.

**Baqaee, David and Emmanuel Farhi**, "Networks, barriers, and trade," Working Paper 26108, National Bureau of Economic Research 2019.

**_ , Benjamin Moll, Camille Landais, and Philippe Martin**, "The economic consequences of a stop of energy inputs from Russia," Working Paper 084-2022, French Council of Economic Advisors 2022.

**Barrot, Jean-Noël and Julien Sauvagnat**, "Input specificity and the propagation of idiosyncratic shocks in production networks," *The Quarterly Journal of Economics*, 2016, *131* (3), 1543–1592.

**Bems, Rudolfs, Robert C Johnson, and Kei-Mu Yi**, "Demand spillovers and the collapse of trade in the global recession," *IMF Economic Review*, 2010, *58* (2), 295–326.

**Boehm, Christoph E, Aaron Flaaen, and Nitya Pandalai-Nayar**, "Input linkages and the transmission of shocks: Firm-level evidence from the 2011 Tōhoku earthquake," *Review of Economics and Statistics*, 2019, *101* (1), 60–75.

**Bonadio, Barthélémy, Zhen Huo, Andrei A Levchenko, and Nitya Pandalai-Nayar**, "Global supply chains in the pandemic," *Journal of International Economics*, 2021, *133*, 103534.

**Çakmaklı, Cem, Selva Demiralp, Şebnem Kalemli-Özcan, Sevcan Yeşiltaş, and Muhammed Ali Yıldırım**, "COVID-19 and Emerging Markets: A SIR Model, Demand Shocks and Capital Flows," Working Paper 27191, National Bureau of Economic Research 2020.

**_ , _ , _ , _ , and _** , "The Economic Case for Global Vaccinations: An Epidemiological Model with International Production Networks," Working Paper 27191, National Bureau of Economic Research 2021.

**Caliendo, Lorenzo and Fernando Parro**, "Estimates of the Trade and Welfare Effects of NAFTA," *The Review of Economic Studies*, 2015, *82* (1), 1–44.

**Carvalho, Vasco M, Makoto Nirei, Yukiko U Saito, and Alireza Tahbaz-Salehi**, "Supply chain disruptions: Evidence from the great east japan earthquake," *The Quarterly Journal of Economics*, 2021, *136* (2), 1255–1321.

**Coelli, Francesca, Andreas Moxnes, and Karen Helene Ulltveit-Moe**, "Better, Faster, Stronger: Global Innovation and Trade Liberalization," *The Review of Economics and Statistics*, 2020, *104* (2), 205–216.

**Cohen, Jacob**, "A Coefficient of Agreement for Nominal Scales," *Educational and Psychological Measurement*, 1960, *20* (1), 37–46.

**Costinot, Arnaud and Andrés Rodríguez-Clare**, "Trade theory with numbers: Quantifying the consequences of globalization," in "Handbook of international economics," Vol. 4, Elsevier, 2014, pp. 197–261.

**di Giovanni, Julian, Şebnem Kalemli-Özcan, Alvaro Silva, and Muhammed Ali Yıldırım**, "Global Supply Chain Pressures, International Trade, and Inflation," Working Paper 30240, National Bureau of Economic Research 2022.

**Eppinger, Peter, Gabriel J Felbermayr, Oliver Krebs, and Bohdan Kukharskyy**, "Decoupling global value chains," Working Paper 9079, CESifo 2021.

**Felbermayr, Gabriel J, Hendrik Mahlkow, and Alexander-Nikolai Sandkamp**, "Cutting through the value chain: The long-run effects of decoupling the East from the West," EconPol Policy Brief 41, CESifo 2022.

**Grossman, Gene M, Elhanan Helpman, and Hugo Lhuillier**, "Supply Chain Resilience: Should Policy Promote Diversification or Reshoring?," Working Paper 29330, National Bureau of Economic Research 2021.

**Guriev, Sergei**, "The implications of sanctions on the Russian economy and financial system," March 2022. presentation at the PIIE event entitled "How Russia's war in Ukraine affects the financial sector" on 23 March 2022.

**Harput, Halit**, "What Policy Initiatives Advance Friend-Shoring?," Zeitgeist Briefing 2, Global Trade Alert 2022.

**Hausmann, Ricardo, Ulrich Schetter, and Muhammed A. Yıldırım**, "On the Design of Effective Sanctions: The Case of Bans on Exports to Russia," September 2022. HKS CID Working Paper Series.

**Head, Keith, Thierry Mayer, and John Ries**, "The erosion of colonial trade linkages after independence," *Journal of International Economics*, 2010, *81* (1), 1–14.

**International Monetary Fund**, "Geoeconomic Fragmentation and Foreign Direct Investment," in "World Economic Outlook: A Rocky Recovery," Washington, DC: International Monetary Fund, April 2023, chapter 4.

**Kleinman, Benny, Ernest Liu, and Stephen J. Redding**, "International Friends and Enemies," Working Paper 292, Griswold Center for Economic Policy Studies 2022.

**Mahlstein, Kornel, Christine McDaniel, Simon Schropp, and Marinos Tsigas**, "Estimating the economic effects of sanctions on Russia: an allied trade embargo," *The World Economy*, 2022.

**OECD**, "OECD Inter-Country Input-Output Database," 2021. http://oe.cd/icio.

**Scott, William A.**, "Reliability of Content Analysis: The Case of Nominal Scale Coding," *The Public Opinion Quarterly*, 1955, *19* (3), 321–325.

**Signorino, Curtis S. and Jeffrey M. Ritter**, "Tau-b or not tau-b: Measuring the similarity of foreign policy positions," *International Studies Quarterly*, 1999, *43* (1), 115–144.

**Voeten, Erik**, "Data and Analyses of Voting in the UN General Assembly," in Bob Reinalda, ed., *Routledge Handbook of International Organization*, 1st ed., London: Routledge, May 2013, chapter 4. https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/LEJUQZ.

**World Bank**, *World Development Report 2020: Trading for Development in the Age of Global Value Chains*, World Bank, 2020.

# APPENDIX

## A List of Countries and Industries

Table A.1: List of countries

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

NOTES: Blocs: 1 - "friends", 2 - "non-friends", 3 - "non-aligned". In Bloc definition A, blocs are based on the UN General Assembly Resolution ES-11/1 on "Aggression against Ukraine" on March 2, 2022. In Bloc definition B, blocs are based on the clusters visually emerging in heat maps of bilateral UN General Assembly voting similarity (using measures such as Signorino and Ritter, 1999; Scott, 1955; Cohen, 1960) between 2014 and 2021. In Bloc definition C, blocs are based on countries 'ideal points' on a unidimensional scale and Jenks natural breaks classification with two clusters (see Bailey et al., 2017) between 2014 and 2021. In Bloc definition D, blocs are the same as in definition B, the difference is that ROW is now included in bloc 3 rather than 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, and 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.