Economic Costs of Friend-shoring

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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 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 substantial cost.

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

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1 Introduction

The nature of 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).

The prevalence of global value chains has been underpinned by the well-functioning international trade rules enshrined in the GATT and later the WTO as well as regional agreements. However, the recent years have witnessed a number of disruptions to 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. Supply chain resilience could be achieved through further supply chain diversification: keeping old ties alive but adding more links globally. However, the public debate and political discourse have focused not only on securing access to inputs, but also on the potential for trade being weaponised by non-friendly countries. Thierry Breton, the EU Commissioner for Internal Market, for example, said in January 2023 that "...dependencies are used as weapons against us..." and that "...supply chains have become now geopolitical instruments..." (see Center for Strategic and International Studies, 2023).

Friend-shoring – a preference for sourcing inputs from economies that share similar values (such as democratic institutions or maintaining peace) – has thus 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] [2]

Trump administration's imposition of tariffs and other trade barriers on China starting in January 2018 could be viewed as a predecessor to friend-shoring; in June 2018, tariffs were imposed on 1,102 Chinese products, such as aerospace, information, and communication technology, robotics and industrial machinery (Office of the United States Trade Representative, 2018). In response, China announced a 25% tariff on US products (National Public Radio, 2018). The Biden administration did not withdraw the Trump-era tariffs on Chinese imports; rather, it introduced new export controls and US investment bans for Chinese companies to protect US economic and military interests. Since Yelen's April 2022 speech, 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). Moreover, Trump's plan for a possible second term as US President includes across-the-board 10% tariff on imports (The Economist, 2023).

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 benefits - related to security, insurance, or helping friends and hurting enemies - 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-shoring it is necessary to use a general equilibrium framework capturing such intricate

[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/.

[2] Moreover, the debate has extended to technology transfers and investments. EU Commissioner Breton, for example, said the following at an event organised by the Center for Strategic and International Studies on January 27, 2023: "... we need to develop stronger common ground on technology security. We cannot allow China to access the most advanced technologies via the – in semiconductors, quantum, cloud, edge, AI, connectivity and so on." (see Center for Strategic and International Studies, 2023).

linkages.

We quantify the economic costs of friend-shoring using an economic model from Baqaee and Farhi (Forthcoming) by applying shocks that reflect a polarized world. 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 - even though we do not have time in our model, this assumption implies that our model does not reflect developments in the short run. 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. The model does not allow for new trade partnerships at the industry or at the country level - this implies that it is not suitable for assessing the long run (where this would happen). Thus, despite having no time in our model, we consider it to be capturing the medium-run implications.

We model friend-shoring as a polarised world with the blocs defined based on the UN General Assembly Resolution ES-11/1 on "Aggression against Ukraine" from 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 the 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).

We start with a case of one bloc unilaterally imposing an increase in trade costs in all industries on the other bloc; this corresponds to, for example, Trump administration imposing tariffs on 1,102 Chinese products in June 2018 (Office of the United States Trade Representative, 2018). In the real world, this situation is unlikely to last long as the bloc on which this increase in trade costs is imposed is likely to retaliate; therefore, we also model an increase in trade costs across the blocs. Since the first two waves of the US tariffs on China implemented in July and August 2018 involved the average tariffs of 26-27%,while the third wave in September 2018 implemented an average tariff of approximately 13% (Fajgelbaum et al., 2020), we assume an overall trade cost increase of 20%.[3] In addition to an increase in trade costs in all industries, we also consider a scenario where the coke, refined petroleum, and nuclear fuel industry is not affected.[4] We run scenarios with and without the ability of countries to collect tariff revenues. The latter approach could be thought of as economic sanctions or other increases in non-tariff barriers. As discussed earlier, actual policy measures included both approaches.

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; Çakmaklı et al., 2021; di Giovanni et al., 2022; Baqaee and Farhi, Forthcoming). 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.

Our results indicate that while some countries may benefit from friend-shoring if their bloc unilaterally imposed an additional trade cost on the other bloc without it retaliating in kind (not a very likely scenario), friend-shoring is costly for most economies and generally 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

[3] We discuss the estimates for an overall increase of 5%, 10%, 50% and 100% in trade costs in Appendix C.

[4] 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).

are higher than the economic costs of export disruptions resulting from China's zero Covid policy (section 4.3.1) or from sanctions imposed on Russia after its full-scale invasion of Ukraine (section 4.3.2). 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. 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. (iv) We do not model FDI flows or account for technology transfers that may be happening through trade.[5] Despite these limitations, we believe that our exercise raises an important warning flag for the friend-shoring trend.

Our paper is an extension of Baqaee and Farhi (Forthcoming) 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), 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). Moreover, our paper is similar to Caliendo and Parro (2015), which builds on Eaton and Kortum (2002), in the sense that we model the equilibrium trade patterns with input-output linkages. The model we employ is more flexible as it allows different elasticities at each stage; however, it does not aim to explain the source of comparative advantage.

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 assuming unilateral and bilateral increase in trade costs and compare them to alterna-

[5] 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.

tive scenarios, such as export disruptions resulting from zero Covid policies in China and sanctions imposed on Russia following its invasion of Ukraine. We highlight the limitations of our model in Section 5 and conclude in Section 6.

2 Economic Model

Before formalising our economic model, we illustrate the dimensions that we capture through an example of Turkish automotive industry.[6] On the production side, this industry uses labour (or other factors)[7] 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 first allocate their income at the sectoral level, deciding on the share of their income to be spent on automotive industry and then deciding on the variety of cars that they buy from different countries including Turkey.

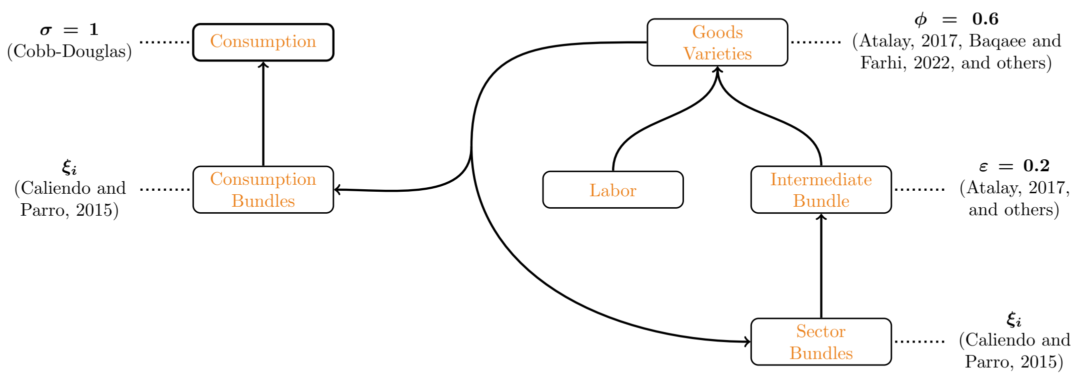
To capture this heterogeneity between varieties, industries, sector bundles and factors, we opt for using nested production and consumption utility functions as in Baqaee and Farhi (Forthcoming) and Çakmaklı et al. (2021). Specifically, we use constant elasticity of substitution (CES) functions at each step. Figure 1 shows the schematic of the model. Each country produces a different range of products within a given industry. The production process in a sector in a given country combines labour and other inputs from different industry bundles – which, in turn, are based on product varieties from different countries. Meanwhile, consumers in a country decide to spend their income on so-called consumption bundles, which again consist of different ranges of products from different countries.

Before defining the functions governing the production and consumption decisions, we discuss

[6] Throughout the model description, we will use the terms "industry" and "sector" interchangeably.

[7] 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.

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. We denote the set of all country-sector pairs with $\mathcal{CN}$.

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. We denote the set of all factors with $\mathcal{F}$ and index a generic factor with f.

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} in 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. Both are specific to an industry-country-pair combination. 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 producer's prices (Ω) and purchaser's prices ($\tilde{\Omega}$) – i.e., including the trade costs – with each element corresponding to:

$$\Omega_{jm}^{ic} \equiv \frac{p_{jm} x_{jm}^{ic}}{p_{ic} y_{ic}} \quad \text{and} \quad \tilde{\Omega}_{jm}^{ic} \equiv \frac{p_{jm}^{c} x_{jm}^{ic}}{p_{ic} y_{ic}} = \frac{t_{jm}^{c} \tau_{jm}^{c} p_{jm} x_{jm}^{ic}}{p_{ic} y_{ic}} = t_{jm}^{c} \tau_{jm}^{c} \Omega_{jm}^{0c}. \tag{1}$$

We distinguish between the producer and purchaser prices because the purchaser price affects the sourcing decision whereas the producer prices affect the revenue flows. We denote the consumption of country c with $0c$ and use same notation for the consumption goods as well and we define the consumption shares as:

$$\Omega_{jm}^{0c} \equiv \frac{p_{jm} x_{jm}^{0c}}{e_c} \quad \text{and} \quad \tilde{\Omega}_{jm}^{ic} \equiv \frac{p_{jm}^{c} x_{jm}^{0c}}{e_c} = t_{jm}^{c} \tau_{jm}^{c} \Omega_{jm}^{ic}.$$

where e_c denotes the total expenditure in country 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:

$$e_c \equiv wL_c + \sum_{i \in \mathcal{N} \bigcup \{0\}} \sum_{j \in \mathcal{N}} \sum_{m \in \mathcal{C} \setminus \{c\}} (t_{jm}^{c} - 1) p_{jm}^{c} x_{jm}^{ic}. \tag{2}$$

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 $\mathcal{N} \bigcup \{0\}$.[8]

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 functions are calibrated, i.e., the inputs are normalized such a way that the weights in the production function and the price indices are equal to each other, and pre-shock prices are equal to one. This allows us to directly calculate the changes in welfare after the shocks. With this choice, we can

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

write the price index of industry variety ic as:

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

p_M^{ic} 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_j^{ic}. Then the price index for the intermediate bundle can be written as:

$$p_M^{ic} = \left[\sum_{j \in \mathcal{N}} \frac{\sum_{m \in \mathcal{C}} \tilde{\Omega}_{jm}^{ic}}{\sum_{k \in \mathcal{N}} \sum_{v \in \mathcal{C}} \tilde{\Omega}_{kv}^{ic}} \left(p_j^{ic} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}, \tag{4}$$

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 of substitution ξ_i, the price index for the sectoral bundle can be written as:

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

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:

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

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 of substitution ξ_i', the price index for the sectoral bundle can be written as:

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

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:

$$y_{jm} = \sum_{i \in \mathcal{N} \bigcup \{0\}} \sum_{c \in \mathcal{C}} x_{jm}^{ic}. \tag{8}$$

And the labour markets clear, giving rise to full-employment:

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

Response to an iceberg trade cost shock or a tariff shock. Following Baqaee and Farhi (Forthcoming)'s differential hat algebra methodology, we solve for perturbations to the equilibrium induced by an iceberg trade cost or a tariff shock via log-linearising around the equilibrium. We quantify the changes in equilibrium wages, prices and labour allocations through solving the log-linear system. This methodology gives a very close approximation to exact hat algebra, which is heavily used in the trade literature (see Costinot and Rodríguez-Clare, 2014, for a review), but the computations become faster without sacrificing much on accuracy. The differential hat algebra is akin to Euler's method to solve for differential equations. To make the log-linearisation more accurate, we split our aggregate shock into smaller shocks and chain these shocks to solve the system. We modify the Matlab code provided by Baqaee and Farhi (Forthcoming) to solve for the equilibrium after introducing a variety of shocks.

The solution strategy relies on the fact that after a shock, prices adjust in such a way that all markets clear. We can write the market-clearing condition in terms of the Domar weights (Domar, 1961; Hulten, 1978), defined for a sector $jm \in \mathcal{CN}$ and a factor $f \in \mathcal{F}$ as:

$$\lambda_{jm} = \frac{p_{jm} y_{jm}}{E}, \qquad \Lambda_f \equiv \frac{p_f L_f}{E},$$

where E is the total world expenditure. We can also define $\chi_c \equiv e_c / E$ as the country c's expenditure share. With these definitions, we can write the goods market clearing condition in Equation 8 in terms of the Domar weights and expenditure shares as:

$$\lambda_{jm} = \sum_{ic \in \mathcal{CN}} \Omega_{jm}^{ic} \lambda_{ic} + \sum_{c \in \mathcal{C}} \Omega_{jm}^{0c} e_c.$$

The factor Domar weights can be obtained by:

$$\Lambda_f = \sum_{ic \in \mathcal{CN}} \Omega_f^{ic} \lambda_{ic}.$$

Note that we are using the input-output linkages defined with producer prices for the Domar weights, since the flow of revenue to sectors is given by these prices.

These equations can be written in the matrix form. Let λ denote the row-vector of Domar weights for goods, Λ the row-vector of Domar weights for factors, and χ the row-vector of country expenditure shares. We can define $\Omega^{\mathcal{N}}$ matrix as the $CN \times CN$ matrix of input shares for goods, Ω^0 as consumption shares and $\Omega^{\mathcal{F}}$ as the factor shares. The Domar weights for goods satisfy:

$$\lambda = \lambda \, \Omega^{\mathcal{N}} + \chi \, \Omega^0.$$

Solving for this equation gives us:

$$\lambda = \chi \, \Omega^0 \, (I - \Omega^{\mathcal{N}})^{-1} = \chi \, \Omega^0 \, \Psi^{\mathcal{N}},$$

where $\Psi^{\mathcal{N}} \equiv (I - \Omega^{\mathcal{N}})^{-1}$ is the Leontief-inverse and I is CN dimensional identity matrix. Factor Domar weights are given by:

$$\Lambda = \lambda \, \Omega^{\mathcal{F}} = \chi \, \Omega^0 \, \underbrace{\Psi^{\mathcal{N}} \, \Omega^{\mathcal{F}}}_{\Psi^{\mathcal{F}}} = \chi \, \Omega^0 \, \Psi^{\mathcal{F}},$$

where $\Psi^{\mathcal{F}}$ captures the total direct and indirect impact of expenditures in different sectors on factor Domar weights. Any small shock in trade costs will result in changes in Domar weights for goods:

$$d\lambda = d\chi \, \Omega^0 \, \Psi^{\mathcal{N}} + \chi \, d\Omega^0 \, \Psi^{\mathcal{N}} + \chi \, \Omega^0 \, d\Psi^{\mathcal{N}},$$

and factor Domar weights:

$$d\Lambda = d\lambda\, \Omega^{\mathcal{F}} + \lambda\, d\Omega^{\mathcal{F}}$$

Changes in expenditure shares ($d\chi$) are related to the changes in factor Domar weights and trade costs. Changes in consumption shares ($d\Omega^0$), input shares (and, therefore, Leontief-Inverse matrix term $d\Psi^{\mathcal{N}}$),[9] and factor shares ($d\Omega^{\mathcal{F}}$) are all related to the price changes. Since we start from the equilibrium, by Shepard's Lemma, changes in prices of goods must satisfy:

$$\begin{aligned} d\log p_{ic} &= \sum_{jm\in\mathcal{CN}} \tilde{\Omega}^{ic}_{jm} d\log p^{c}_{jm} + \sum_{f\in\mathcal{F}} \Omega^{ic}_{f} d\log p_f \\ &= \sum_{jm\in\mathcal{CN}} \tilde{\Omega}^{ic}_{jm} d\log p_{jm} + \underbrace{\sum_{jm\in\mathcal{CN}} \tilde{\Omega}^{ic}_{jm} (d\log t^{c}_{jm} + d\log \tau^{c}_{jm})}_{\equiv d\log \tilde{t}_{jm}} + \sum_{f\in\mathcal{F}} \Omega^{ic}_{f} d\log p_f, \end{aligned}$$

where $d\log \tilde{t}_{jm}$ captures the direct impact of exogonous trade shocks. Let p () denote the row-vector of prices of goods, w the row-vector of factor prices, and $\tilde{t}$ the row vector of direct trade shock impact. In matrix notation:

$$d\log p' = \tilde{\Omega}^{\mathcal{N}}\, d\log p' + d\log \tilde{t}' + \Omega^{\mathcal{F}}\, d\log w'.$$

Solving this equation gives us:

$$\begin{aligned} d\log p' &= \tilde{\Psi}^{\mathcal{N}}\, d\log \tilde{t}' + \underbrace{\tilde{\Psi}^{\mathcal{N}}\, \Omega^{\mathcal{F}}}_{\equiv \tilde{\Psi}^{\mathcal{F}}}\, d\log w' = \tilde{\Psi}^{\mathcal{N}}\, d\log \tilde{t}' + \tilde{\Psi}^{\mathcal{F}}\, d\log w' \\ d\log p &= d\log \tilde{t}\, \tilde{\Psi}^{\mathcal{N}'} + d\log w\, \tilde{\Psi}^{\mathcal{F}'}. \end{aligned}$$

Hence, all the price changes can be related to factor price changes and exogenous trade shocks. Lastly, assuming the world nominal expenditure, E, is normalized, we can write:

$$d\log \Lambda_f = d\log w_f + d\log L_f = d\log w_f,$$

[9]It is easy to show that

$$d\Psi^{\mathcal{N}} = \Psi^{\mathcal{N}} d\Omega^{\mathcal{N}} \Psi^{\mathcal{N}}.$$

since we assume full employment. Consequently, we can solve for wages that clear out the goods and factor markets by combining the Domar weight equations and price changes, resulting in a linear equation for wages that can be easily solved. We refer the reader to the Appendix of Baqaee and Farhi (Forthcoming) for the details of the calculations.

3 Data

3.1 Input-Output Data

We calibrate our model using the 2018 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).[10] 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

[10] These elasticities are listed in Table A.2.

sectors. This elasticity is also similar to the ones used in the literature (see, for instance, Atalay, 2017; Bonadio et al., 2021; Çakmaklı et al., 2021; Baqaee and Farhi, Forthcoming). 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 tariff data from 2018 and the effectively applied tariff rates calculated by WITS as the lowest available tariff.[11]

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.

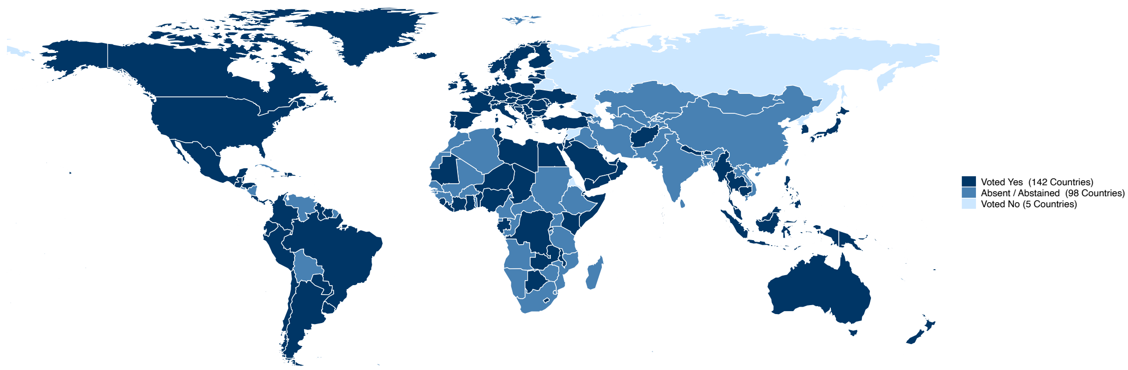
In Bloc definition A, we differentiate between two blocs of economies based on the UN General Assembly vote on "Aggression against Ukraine": (i) the 141 countries that voted in favour of the UN General Assembly resolution condemning the aggression against Ukraine on 2 March 2022 (friends) and (ii) the 40 countries that voted against it, abstained or were absent from the voting (non-friends).[12] Figure 2 shows the countries based on their vote. Note that two of the country

[11]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. 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).

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

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.

Figure 2: UN Vote on "Aggression against Ukraine"



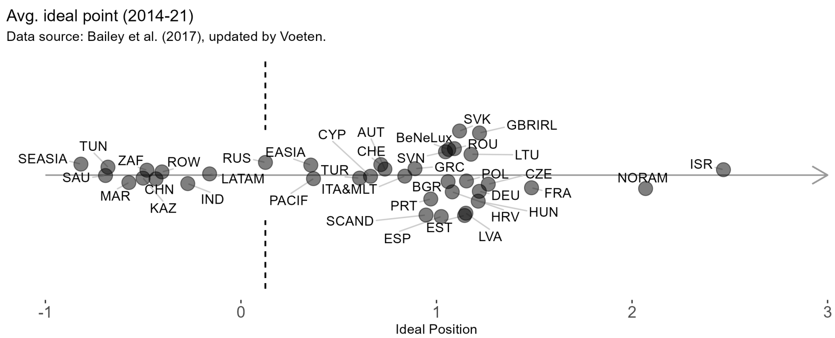
SOURCE: UN General Assembly Resolution ES-11/1.
NOTES: This figure summarises the vote on UN General Assembly Resolution ES-11/1. The dark blue countries are the ones that voted "Yes". Blue countries are either abstained or were absent from the voting. Light blue colored countries voted "No".

In the other three bloc definitions, we use data on UN General Assembly voting between 2014 and 2021 from a dataset maintained by Voeten (2013) 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, 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 3).

In Bloc definition C, we define three blocs – friends, non-friends, and non-aligned – based on the clusters visually emerging in heat maps of bilateral vote similarity using three similarity measures: S-score (Signorino and Ritter, 1999, Figure 4a), π-score (Scott, 1955, Figure 4b), and κ-score (Cohen, 1960, Figure 4c).[13] These figures produce the same country groupings. Rest of the World is assigned to the non-friends bloc (Bloc 2), while Bloc 3 is the non-aligned bloc. In Bloc definition D, we use the same bloc definition as in Bloc definition C, but assign the Rest of the World to the non-aligned bloc (Bloc 3).

[13] See Appendix B for a brief description of these measures.

Figure 3: Bloc definition B: 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.

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 and thus increase trade barriers vis-à-vis countries in Bloc 2. We assume that Bloc 2 countries employ similar measures vis-à-vis Bloc 1 countries. In the medium run, this results in a polarised world. Bloc 3 countries in definitions C and D remain neutral.

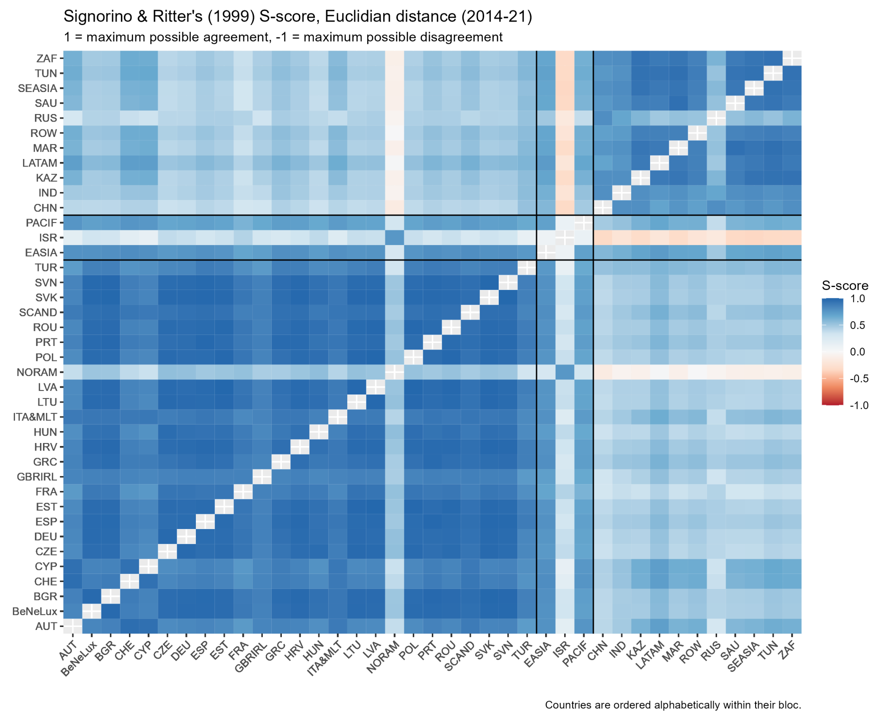
3.4.1 Trade and tariffs between blocs

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 accounted for 6.1% of Bloc 1's total exports, and exports from Bloc 2 to Bloc 1 countries represented around a tenth of Bloc 2's 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%.

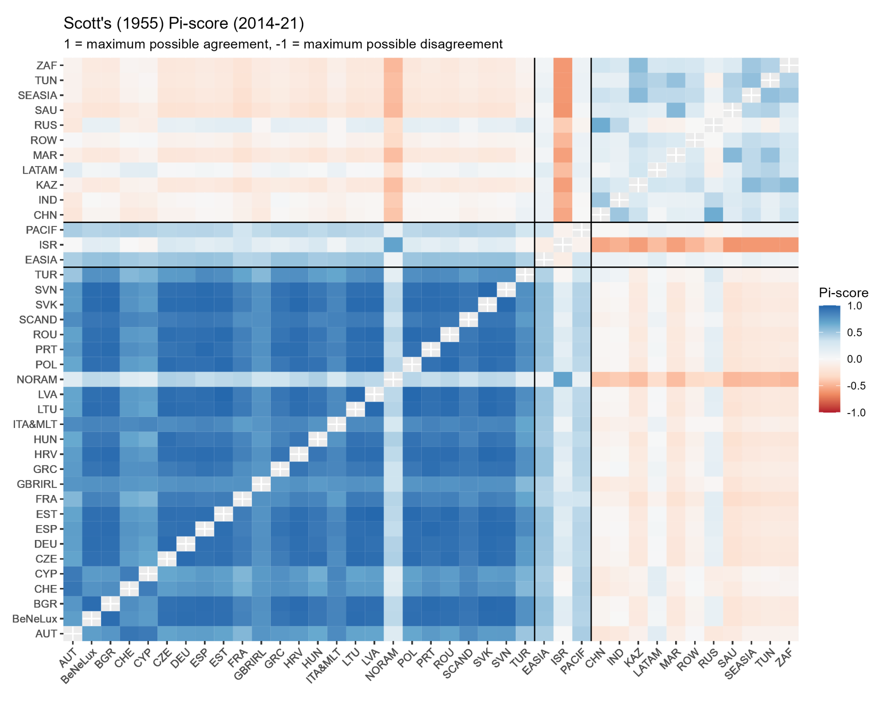
Which final goods and intermediate inputs are traded the most between Bloc 1 and Bloc 2? We

Figure 4: Bloc definition C

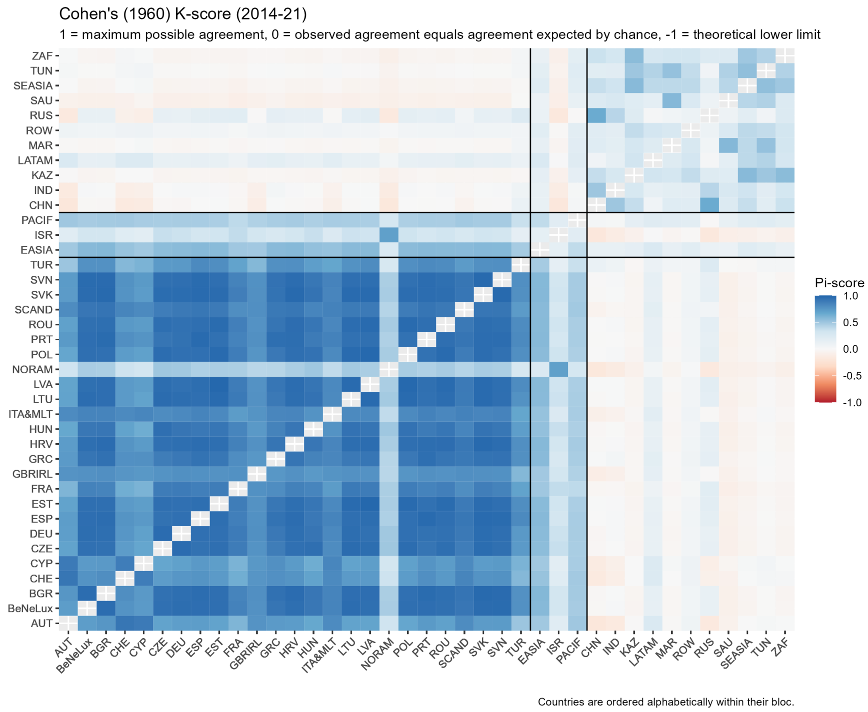
(a) S-score (Signorino and Ritter, 1999)



(b) π-score (Scott, 1955)



(c) κ-score (Cohen, 1960)

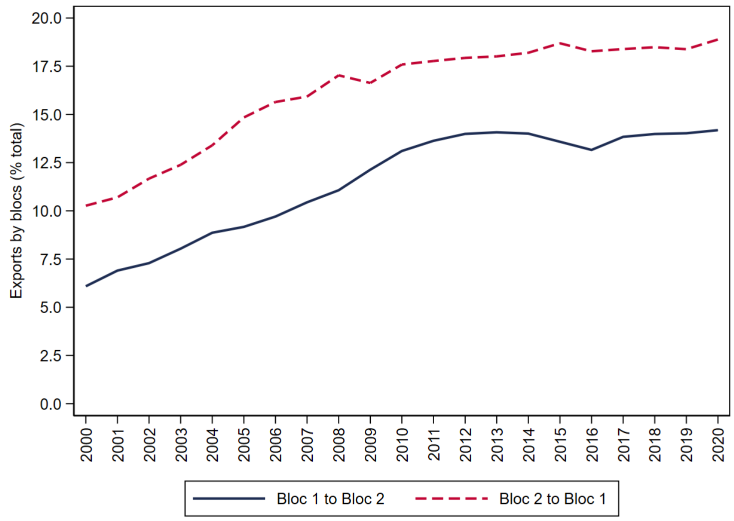


SOURCE: Authors' calculations based on UN General Assembly voting between 2014 and 2021 (Voeten, 2013).
NOTES: Panel 4a shows the S-score of Signorino and Ritter (1999), using Euclidean distance. 1 - maximum possible agreement, -1 - maximum possible disagreement. Panel 4b shows the π-score of Scott (1955). 1 - maximum possible agreement, -1 - maximum possible disagreement. Panel 4c shows the κ-score of Cohen (1960). 1 - maximum possible agreement, 0 - observed agreement equals agreement expected by chance, -1 - theoretical lower limit. Black lines indicate our country blocs. Economies are ordered alphabetically within their bloc (see Table A.1).

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 (n.e.c.) (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

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

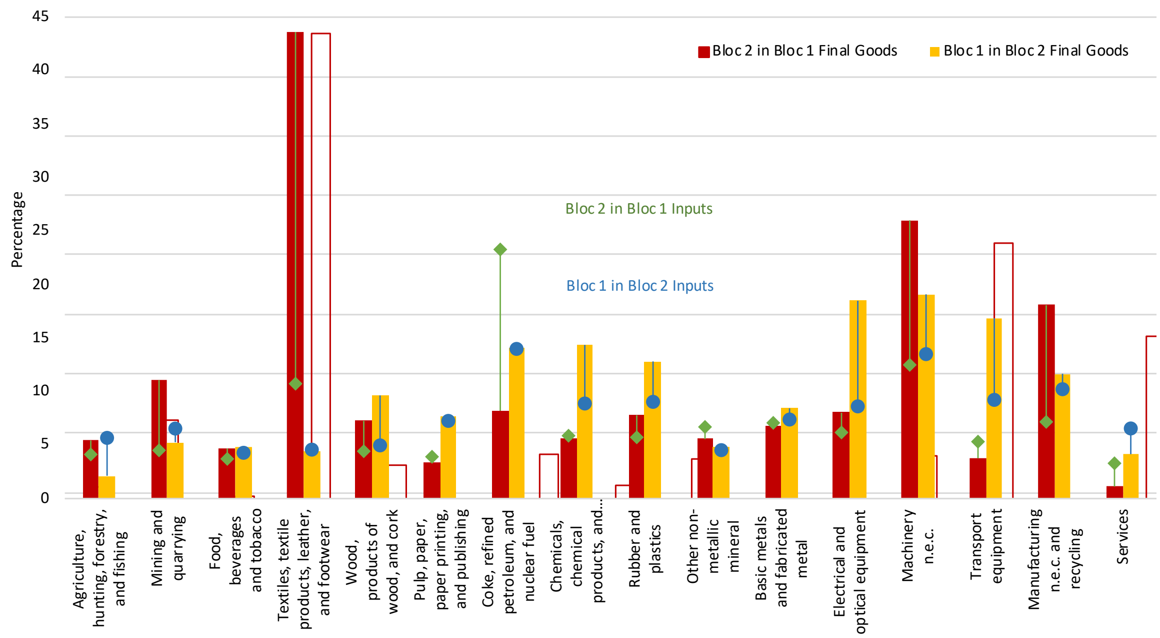


SOURCE: UN Comtrade, UN General Assembly Resolution ES-11/1 and authors' calculations.
NOTES: This figure shows the share of exports from Bloc 1 countries to Bloc 2 countries (under Bloc definition A) and vice versa. Since exports are reported on an FOB (free on board) basis, while imports are reported on a CIF (cost, insurance and freight) basis, the mean difference between the two values across the dataset is used to adjust the value of exports where no imports are reported (roughly in line with the approach adopted by 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.

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 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.

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



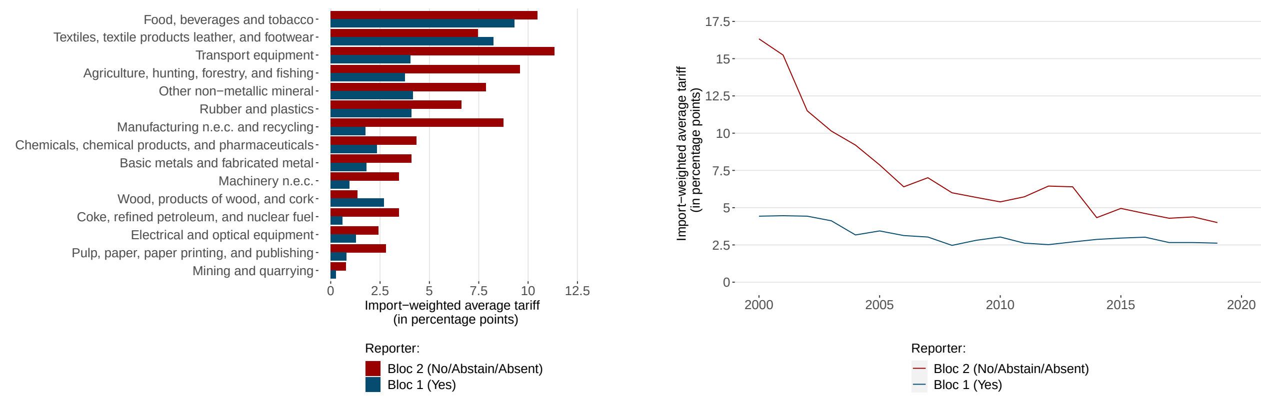
SOURCE: OECD Inter-Country Input-Output Database (OECD, 2021), UN General Assembly Resolution ES-11/1 and authors' calculations.
NOTES: To distinguish between final goods and intermediate input trade, we use OECD Inter-Country Input-Output Database (OECD, 2021). Sectoral aggregations in terms of ISIC 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.

Bloc 2 countries have been lowering their tariff rates with Bloc 1 countries. Friend-shoring would be undoing this rapprochement process between these two blocs.

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

(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

We model the impact of friend-shoring by assuming either a 20% increase in tariffs or an additional iceberg trade cost of 20%.[14] Iceberg trade cost does not generate any revenues for the involved in trade and could be used to model sanctions or other non-tariff barriers. An increase in tariffs results in tariff revenues for importing countries, thus leading to lower losses than iceberg trade costs.

In the analysis, 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. To compare the economic costs of friend-shoring with economic costs of other policies, we consider the alternative scenarios of zero-covid policy in China and sanctions imposed on Russia owing to its invasion of Ukraine. The former is isomorphic to one country weaponising trade.

[14]This is in line with the US tariffs on China implemented during 2018 (see Fajgelbaum et al., 2020). We discuss the estimates for an overall increase of 5%, 10%, 50% and 100% in trade costs in Appendix C.

4.1 Unilateral measures

The "easiest" way to hurt the "enemies" is to increase tariffs, and in the first instance, this is introduced unilaterally by one of the Blocs (unilateral tariffs). This of course hurts the other Bloc, which will typically retaliate in kind. In the second instance, one of the Blocs introduces non-tariff measures, such as, for example, local content requirements, domestic subsidies, or licensing, packaging, and labelling requirements. We approximate such measures with an additional 20% iceberg trade cost.

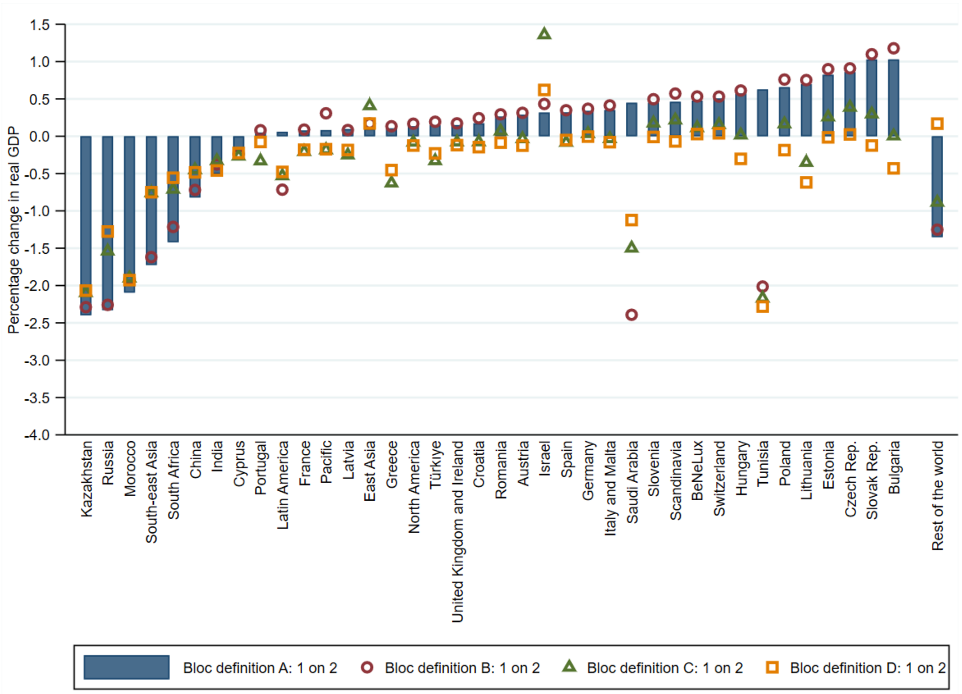
4.1.1 Unilateral tariffs

In the first scenario, one of the blocs unilaterally imposes a 20% increase in tariffs on the other bloc of countries in all industries, without the latter bloc responding in kind. Figure 8 shows the results of this approach for each of the four bloc definitions.

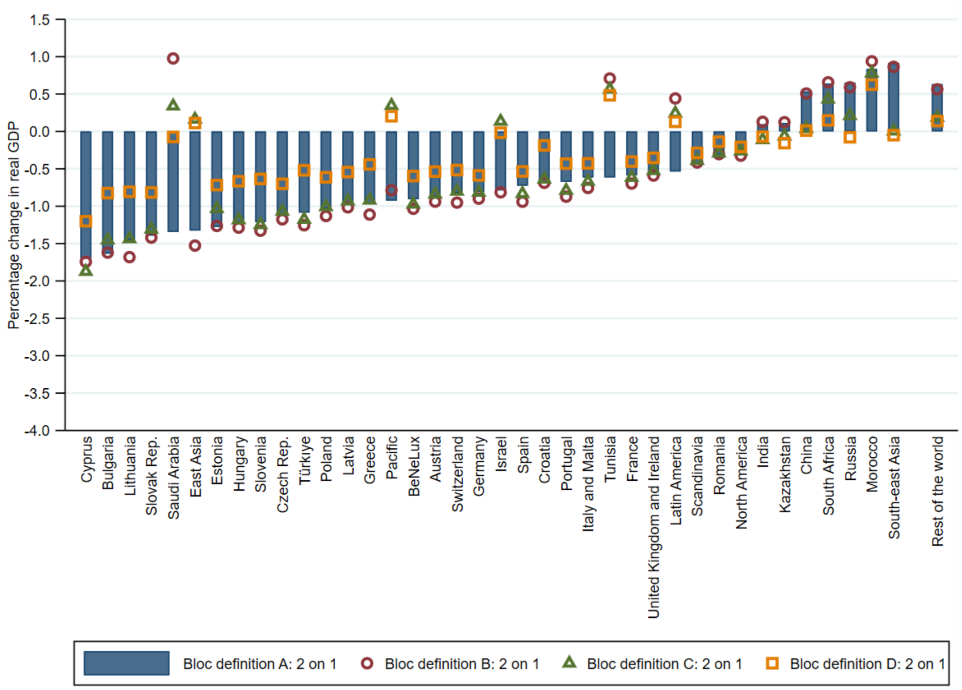
If Bloc 1 unilaterally imposes a 20% increase in tariffs on Bloc 2, we observe that under all bloc definitions (see Figure 8, panel 8a), Block 1 countries are generally the winners in terms of GDP gain and Bloc 2 countries the losers. For most economies, GDP losses and gains are similar regardless of the bloc definition used. However, since some economies - Saudi Arabia, Tunisia and Latin America - voted in favour of the UN General Assembly resolution condemning the aggression against Ukraine on 2 March 2022 and were thus in the "friends" bloc, but their entire bilateral voting record between 2014 and 2021 puts them into the group of less politically aligned economies - "non-friends" bloc, they experience a loss in GDP rather than a gain under Bloc definitions B, C and D. Moreover, while Kazakhstan is the biggest loser under Bloc definition A, Saudi Arabia takes its place under Bloc definition B. The biggest winners under bloc definitions A and B are Czech Republic, Slovak Republic and Bulgaria. Under bloc definitions C and D, they are replaced by Israel and East Asia – both of these are non-aligned; Russia's loss is lower under these two definitions. Interestingly, despite being in Bloc 1 and imposing a tariff increase, Cyprus loses 0.20-0.27% of GDP. More broadly, the gains of most of Bloc 1 countries are smaller or even turn to losses under Bloc definitions C and D.

Figure 8: Relative decline in GDP after unilateral 20% tariff increase (% GDP)

(a) Imposed by Bloc 1 on Bloc 2



(b) Imposed by Bloc 2 on Bloc 1



NOTES: The economic costs of friend-shoring are calculated by Bloc 1 imposing a 20% additional tariff on Bloc 2 (Panel 8a) and by Bloc 2 imposing a 20% additional tariff on Bloc 1 (Panel 8b) in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

If, instead, Bloc 2 is the one unilaterally imposing a 20% increase in tariffs on Bloc 1 (see Figure 8, panel 8b), the losers are generally Bloc 1 economies and winners are Bloc 2 economies. Cyprus, Bulgaria and Lithuania are the biggest losers, with losses around 1.5% of GDP under Bloc definitions A, B and C; their losses are lower under Bloc definitions D, since they do quite a bit of trade with the non-aligned rest of the world. As above, Saudi Arabia, Tunisia and Latin America change from losers when using bloc definition A to winners when using bloc definitions B, C and D, in line with their bloc assignment. Non-aligned countries record small gains - smaller than in panel 8b, since they do more trade with Bloc 1 than Bloc 2 economies.

Unilaterally increasing tariffs on "non-friends" ends up hurting them in the form of loss of GDP, but any potential gains depend on the trading patterns with "non-friends". Despite the fact that tariffs generate revenues, these revenues might not be enough to offset the losses. Moreover, the situation where one bloc is able to impose a tariff increase on the other without that other bloc retaliating in kind or with non-tariff measures is unlikely to last.

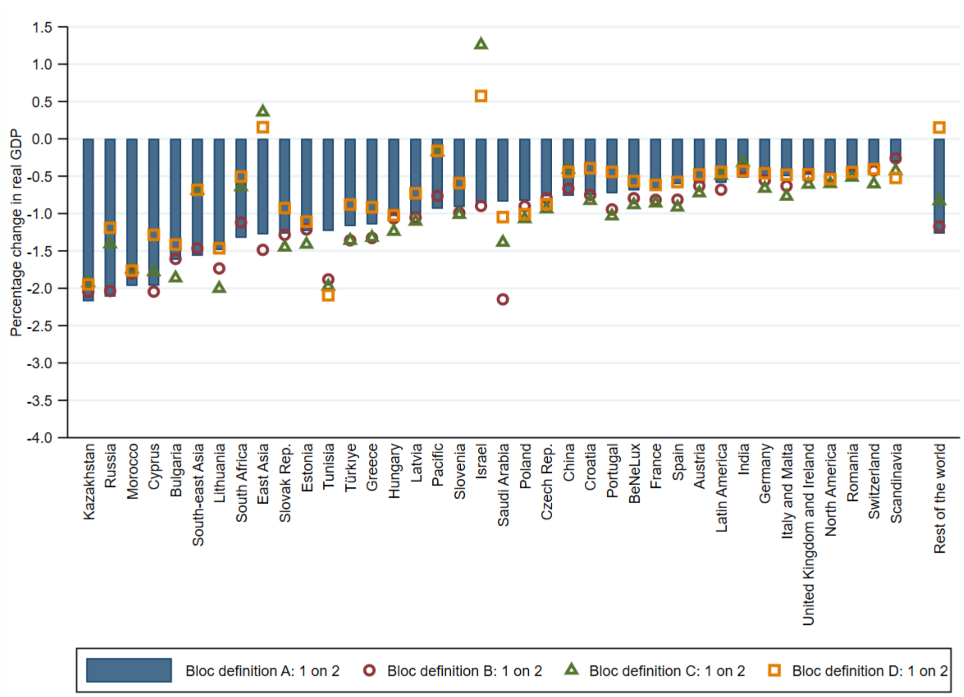
4.1.2 Unilateral iceberg costs

In the second scenario, one of the blocs unilaterally increases iceberg trade cost on the other bloc of countries in all industries by 20%, without the latter bloc responding in kind, at least not immediately. Examples include export restrictions introduced by the USA and Western allies on exports of cutting-edge technologies, such as high-performing chips and lithography machine. Our scenario is more extreme since it affects all industries equally, but it is useful for general lessons.

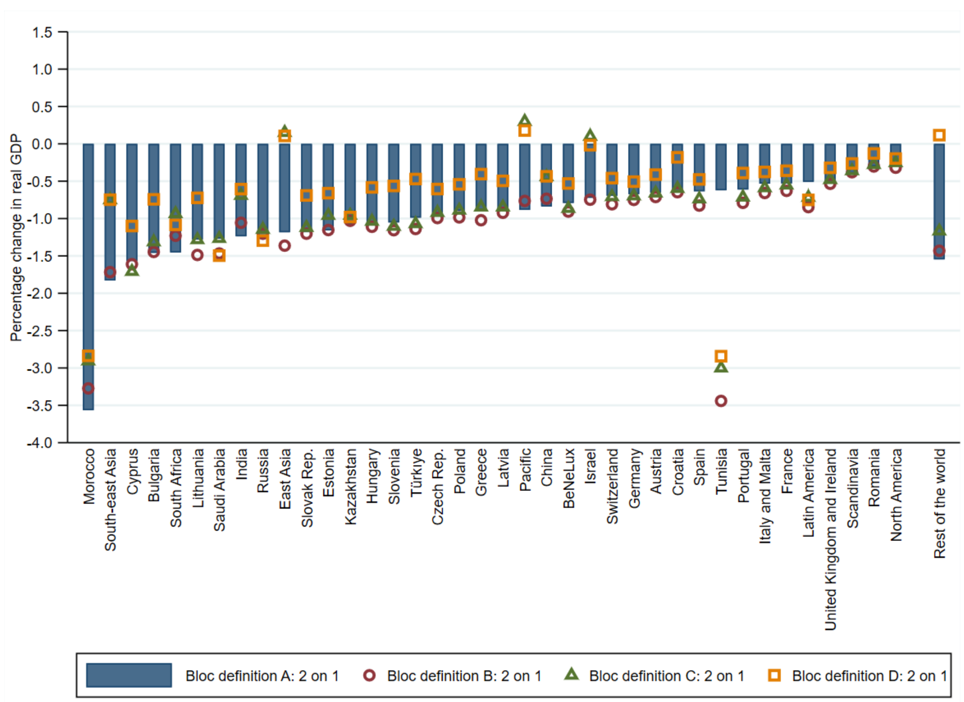
If Bloc 1 unilaterally imposes an additional 20% iceberg trade cost on Bloc 2 (or vice-versa), Figure 9 shows that there are no winners under bloc definition A and B – with all the countries losing between 0.3 and 2.17% of GDP under bloc definition A and between 0.26 and 2.14% of GDP under bloc definition B.

Figure 9: Relative decline in GDP after unilateral additional 20% iceberg trade cost (% GDP)

(a) Imposed by Bloc 1 on Bloc 2



(b) Imposed by Bloc 2 on Bloc 1



NOTES: The economic costs of friend-shoring are calculated by Bloc 1 imposing additional 20% iceberg trade cost on Bloc 2 (Panel 9a) and by Bloc 2 imposing a 20% additional tariff on Bloc 1 (Panel 9b) in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

Using bloc definition A, the largest losses are experienced by Kazakhstan (2.17% of GDP), Russia (2.11% of GDP) and Cyprus (1.96% of GDP). Cyprus is not the only Bloc 1 country with relatively large GDP losses - Bulgaria (1.61% of GDP), Lithuania (1.48% of GDP) and Slovak Republic (1.27% of GDP) are also among the top 10 losers (Figure 9, panel 9a). What they have in common is that Bloc 2 is an important trade partner for them - more important than for Romania, Switzerland and Scandinavia, which experience lower GDP losses. Morocco suffers a similar fate when Bloc 2 unilaterally imposes an additional 20% iceberg trade cost on Bloc 1 (Figure 9, panel 9b), its important trading partner: Morocco's losses amount to 2.84-3.57% of GDP.

As with tariffs, when using Bloc definitions B, C and D, Saudi Arabia and Tunisia experience larger losses than when using bloc definition A. Saudi Arabia experiences much larger losses when the additional iceberg cost is imposed by Bloc 1 (up to 2.15% of GDP compared with up to 1.47% of GDP when such costs are imposed by Bloc 2), while Tunisia experiences much larger loses when Bloc 2 unilaterally imposes such cost (up to 3.44% of GDP). In Bloc definitions C and D, some countries that remain non-affiliated, such as East Asian countries, Israel, Pacific countries have slight benefits due to their independent position. In Bloc definition D, Rest of the World also becomes independent, and receives a slight positive gain.

4.2 Bilateral measures

In the real world, unilateral imposition of additional trade costs, either in the form of iceberg trade cost or tariffs, is unlikely to last long - the Bloc on which such costs are imposed is likely to respond in similar fashion. For example, when the US CHIPS and Science Act of 2022, which provides subsidies for the construction of semiconductor manufacturing plants, prohibited recipients of such subsidies from expanding semiconductor manufacturing in China or other countries that pose a threat to US national security, China retaliated by imposing restrictions on exports of gallium and germanium.

In this section, we assume that either an additional iceberg trade cost of 20% or a 20% increase in tariffs is applied by Bloc 1 countries on Bloc 2 countries and vice versa. 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.

4.2.1 All industries affected in the same way

In the first approach, we increase the iceberg trade cost by 20% in each industry. Figure 10a 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.

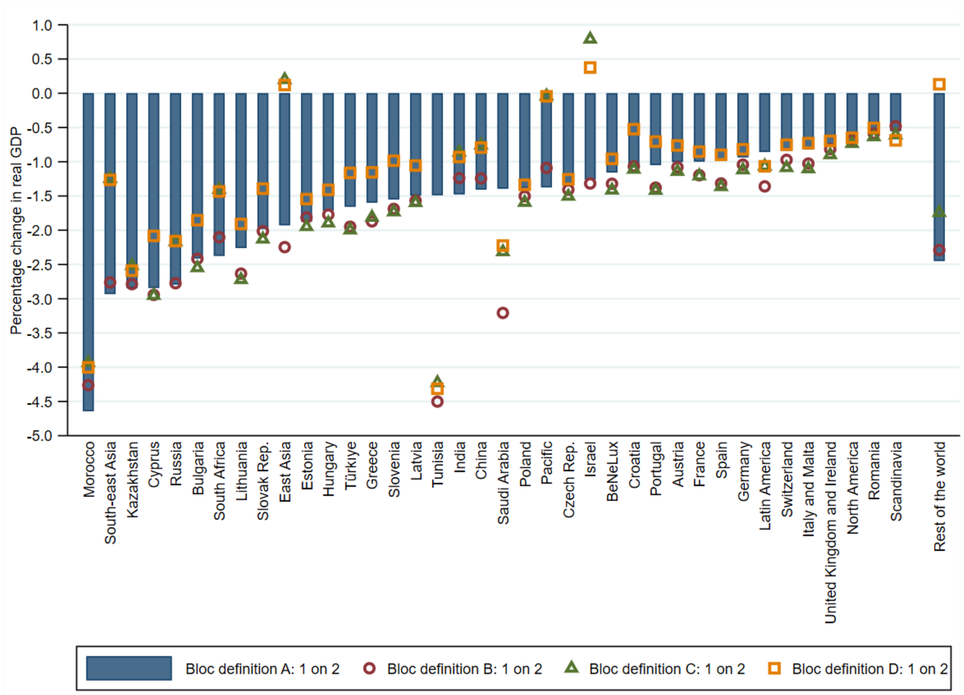
When using Bloc definitions B, C or D, on the other hand, Tunisia experiences the largest losses (4.2 to 4.5% of GDP), followed by Morocco (3.9 to 4.2% of GDP). The reason Tunisia is not among the top losers under Bloc definition A is that it voted in favour of the UN General Assembly resolution condemning 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 trade with both blocs.

There are also a few economies that experience gains in real GDP when we allow some countries to remain non-aligned (Bloc definitions C 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.

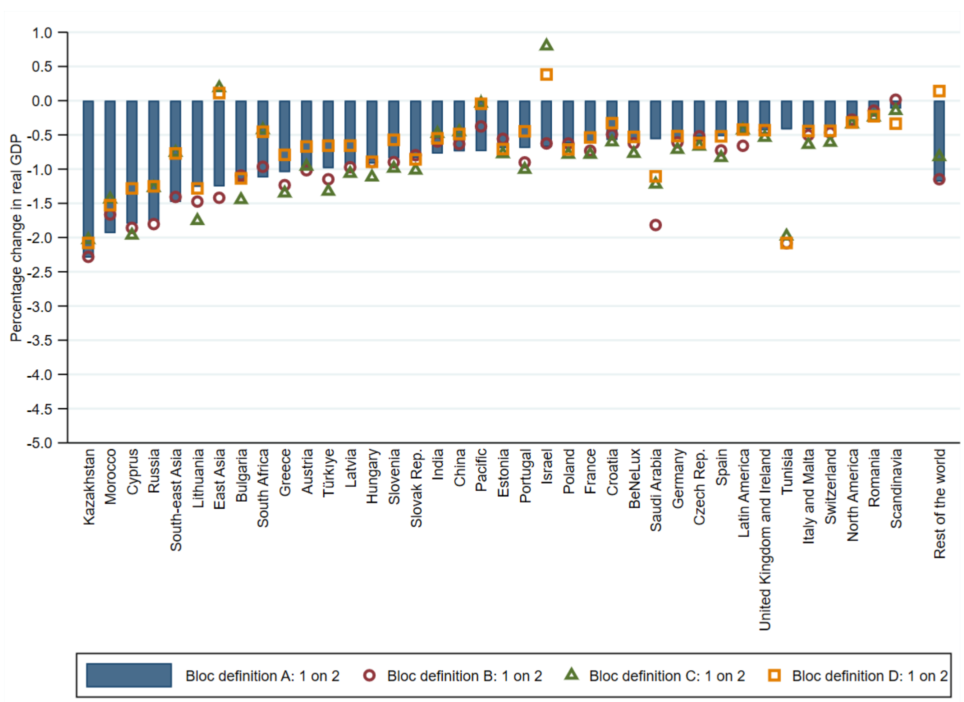
In the second approach, we instead impose a 20% increase in tariffs. We choose this increase to be above the observed tariffs reported in Figure 7. This increase results in tariff revenues for countries, so the losses are lower than with the iceberg trade cost, but again there are no winners under Bloc definition A - all countries lose between 0.1 and 2.3% of GDP (see Figure 10b). The biggest cost is

Figure 10: 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 10a) or a 20% additional tariff (Panel 10b) in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

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 C and D remains roughly the same.

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

In the third approach, we increase the iceberg trade cost by 20% in all industries except the coke, refined petroleum, and nuclear fuel industry, and in the fourth approach, we do the same with a 20% increase in tariffs. Figure 11 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 losses are on average 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 declines in magnitude by about a third to 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) bears 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, Tunisia again experiences the largest losses (4.1 to 4.4% of GDP), followed by Morocco (4.0 to 4.4% of GDP). The economies that remain non-aligned in Bloc definitions C and D again experience gains in real GDP, 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 instead impose a 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 11b). 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.

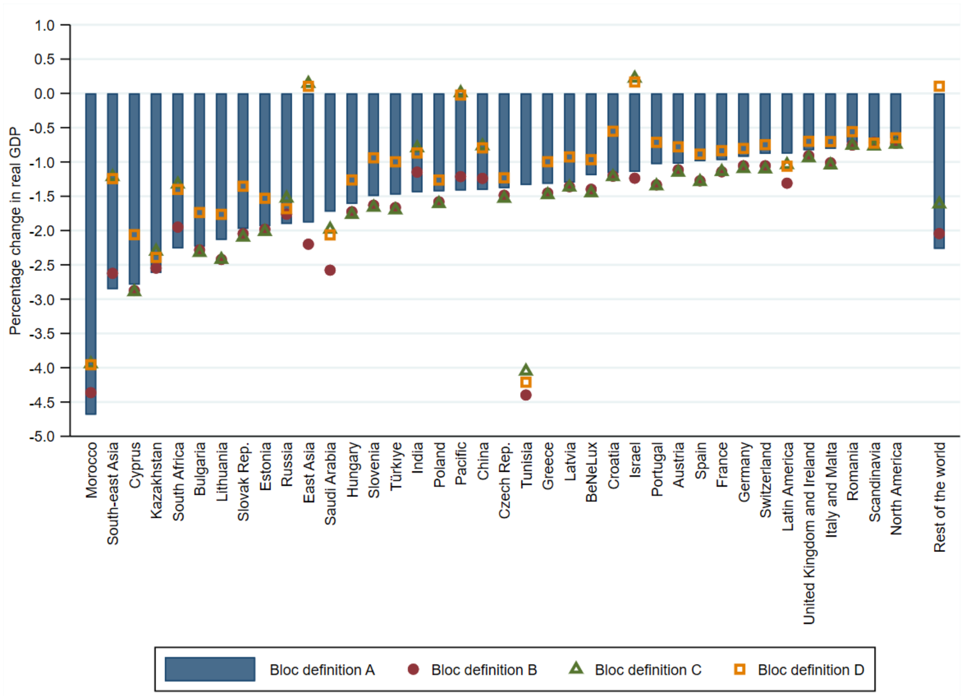
The estimates obtained by all four approaches make it clear that friend-shoring results in real GDP losses for most economies, though the exact costs depend on which industries are targeted. Some economies may be better off if they manage to remain non-aligned, but non-alignment does not necessarily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

4.3 Alternative scenarios

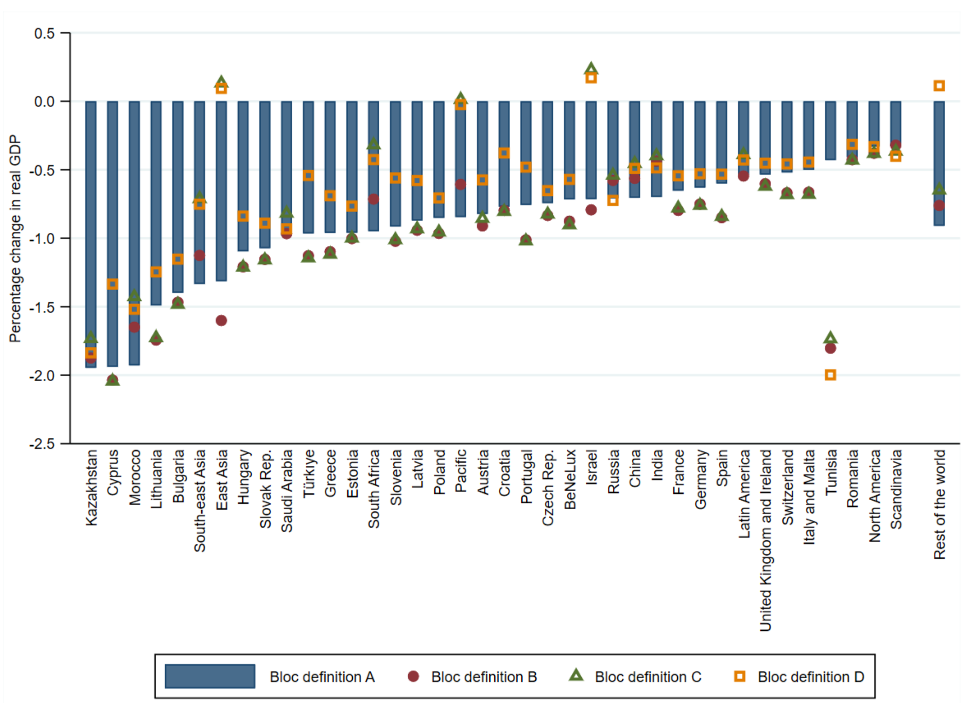
How do the economic costs of friend-shoring compare with economic costs of other policies? We consider two alternative scenarios under Bloc definition A: (1) zero-Covid policy pursued by China, and (2) sanctions imposed on Russia owing to its invasion of Ukraine. For both scenarios, we assume a 20% hike in iceberg trade cost 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 isomorphic to imposing trade barriers individually on China and Russia instead of applying sanctions to whole Bloc 2, or to each of these countries instigating unilateral export frictions. Hence, the results change considerably for other countries in Bloc 2.

Figure 11: 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 11a) or a 20% additional tariff (Panel 11b) 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.

4.3.1 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 cost between China and Bloc 1 countries (Bloc definition A). Figure 12 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, the 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, the losses from zero-Covid policy in China are lower than the losses under the friend-shoring scenario using iceberg trade cost.

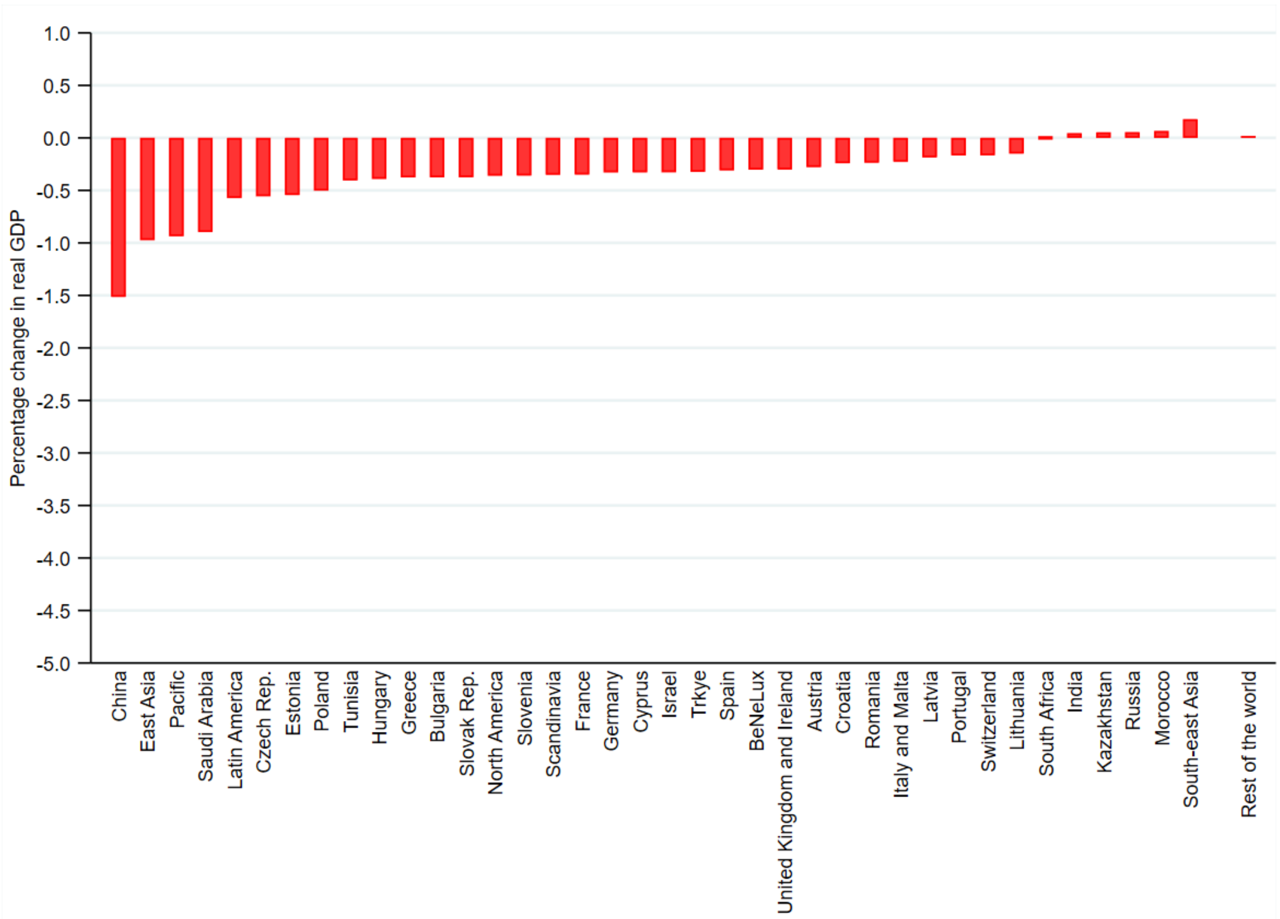
4.3.2 Sanctions imposed on Russia owing to its invasion of Ukraine

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).[15] In this scenario, an increase in the cost of trade leads to a decline of nearly 3% of Russia's real GDP (see Figure 13).[16] 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.

[15] These costs could be related to price caps on Russian commodity exports, restricted access to the SWIFT payment system, costs of additional due dilligence or simply costs of evading sanctions.

[16] Russia's GDP contracted by 2.1% in 2022, less than suggested by our model or estimates by forecasters in 2022 (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 12: Relative decline in GDP after 20% increase in iceberg trade cost between Bloc 1 countries and China (% GDP)

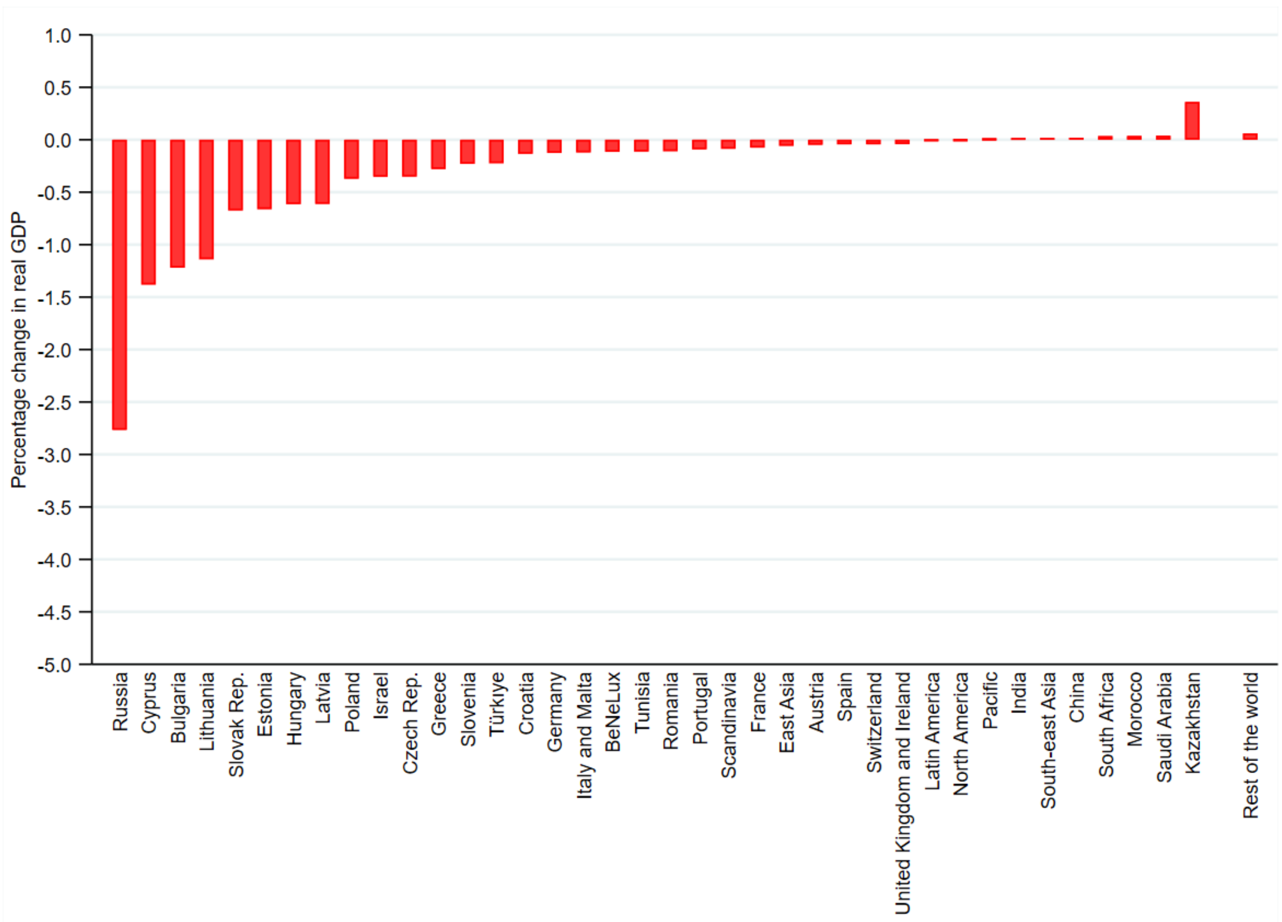


NOTES:This figure shows the economic costs resulting from extreme lockdowns resulting from China's zero-Covid policy using a non-revenue generating trade cost of 20% by Bloc 1. This scenario also corresponds to imposing an additional trade cost to China instead of whole Bloc 2. The list of country aggregations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

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 13: Relative decline in GDP after 20% increase in iceberg trade cost between Bloc 1 countries and Russia (% GDP)

Figure 14: 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

As is the case with most economic models, our analysis is subject to some limitations.

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

Second, 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.

Third, 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.

Fourth, friend-shoring might imply movement of production coupled with knowledge transfer, which may affect the costs of friend-shoring. Our model does not incorporate knowledge transfers or FDI flows.

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.

6 Conclusions

Due to recent political climate and geopolitical tensions, many countries are considering adopting friend-shoring to minimise the social cost of supply chain disruptions 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 while some countries may benefit from friend-shoring if their Bloc unilaterally imposed an additional trade cost on the other Bloc without facing retaliation (not a very likely scenario), most countries do not benefit from friend-shoring in the medium run. Our results indicate that the countries that trade with both blocs are the ones that bear the largest costs. 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; it may merely reduce the losses.

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APPENDIX

A List of Countries and Industries

Table A.1: List of countries

ID	ISO3/Abb.	Bloc definition A	B	C	D	ID	ISO3/Abb.	Bloc definition 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	1	3	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	1	3	3
16	ITA&MLT	1	1	1	1	36	CHN	2	2	2	2
17	KAZ	2	2	2	2	37	EASIA	1	1	3	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 (ξ_i)
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	10.60
12	D28	Machinery n.e.c.	1.52
14	D29-30	Transport equipment	0.37
15	D31-33	Manufacturing n.e.c. and recycling	5.00
16	D35-99	Services	5.00

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

B Measures of the similarity of countries' bilateral attitudes

Following the approach in Kleinman et al. (2022), we use four different measures of the similarity of countries' bilateral attitudes in our paper: Signorino and Ritter (1999)'s S-score, Scott (1955)'s π-score, Cohen (1960)'s κ-score) and Bailey et al. (2017)'s average ideal points.

Signorino and Ritter (1999)'s S-score is the most widely used measure of dyadic similarity of vote choices. S-score is a Euclidean distance measure between every dyad in the UN. It equals 1 minus the sum of the squared actual deviation between a pair of countries' votes scaled by the sum of the squared maximum possible deviations between their votes. It is by construction bounded between -1 (maximum disagreement) and 1 (maximum agreement), but it does not control for properties of the empirical distribution function of country votes. The latter may align by chance, such that the frequency with which any two countries agree on a "yes" depends on the frequency with which each country individually votes "yes".

Scott (1955)'s π-score and Cohen (1960)'s κ-score each control for properties of the empirical distribution of votes in their own way. The π-score (Scott, 1955) adjusts the observed variability of the countries' voting similarity using the variability of each country's own votes around the average vote for the *two countries taken together*. The κ-score (Cohen, 1960), on the other hand, adjusts the same around the country's *own* average vote.

Neither of these three similarity measures accounts for heterogeneity in the resolutions being voted on. Bailey et al. (2017) address this concern by using the observed UN votes to estimate a time-varying measure of each country's political preferences or "ideal points". We use this approach to calculate a measure of bilateral distance between countries' political attitudes by taking the absolute difference between the ideal points of countries i and j in each year between 2014 and 2021. We use the Jenks natural breaks classification with two clusters to define the two country blocs in Bloc definition B.

C Robustness checks

In the main text, we model the impact of friend-shoring by assuming a 20% increase in trade cost. Figures C.1-C.6 show how the results differ if we operationalize friend-shoring by assuming a 5%, 10%, 50% or 100% increase in trade cost instead. We summarise the main findings below.

As expected, the exact amount of GDP losses (or gains) changes, but the fact that most countries do not benefit from friend-shoring in the medium run (when unilateral trade cost increases by one of the blocs are likely to be matched by the other bloc) does not change.

While there is a positive correlation between the trade cost and change in GDP, the relationship is not linear - doubling the trade cost increase does not result in double the GDP losses (or gains).

For some Bloc 1 countries, the largest GDP gain (or smallest loss) occurs at a relatively low increase in tariffs they impose unilaterally on Bloc 2 countries (Figure C.2). For Austria, Bulgaria, BeNeLux, Spain, Estonia, Hungary, Italy and Malta, North America, Poland, Romania, Slovak Republic, and Slovenia, this happens at 20% increase in tariffs. Somewhat counter-intuitively, imposing a higher increase in tariffs can result in GDP losses even for countries imposing such tariff increases. On the flip side, Bloc 2 countries do not necessarily experience the largest GDP losses when Bloc 1 countries unilaterally impose a 100% increase in tariffs - China and India actually experience a GDP gain at that point, while South-east Asia sees the largest drop in GDP at a 50% increase in tariffs.

Some Bloc 2 countries - those for which Bloc 1 countries are an important trading partner - also experience the largest GDP gain at a relatively low increase in tariffs they unilaterally impose on Bloc 1 countries (Figure C.2). For China, South-east Asia and South Africa, this happens at a 20% increase in tariffs. Kazakhstan and Russia see the largest GDP gain with 100% increase in tariffs under Bloc definitions A and B. Morocco's and Tunisia's GDP losses increase in a linear fashion with higher tariffs, even if they are in the Bloc of countries that impose them unilaterally[17]. Among the Bloc 1 countries, France, Greece, Croatia, North America, Portugal, and Romania experience largest GDP losses when they face a 50% increase in tariffs imposed by Bloc 2 countries.

Almost all of the anomalies discussed above disappear when we introduce non-aligned countries in Bloc definitions C and D, or when tariff increases are imposed by both Blocs (Figure C.5). Non-aligned countries typically see GDP gains of up to 2.33% when tariff increase is imposed unilaterally by Bloc 1 countries, up to 0.54% when it is imposed unilaterally by Bloc 2 countries, and up to 1.03% when both Blocs introduce them.

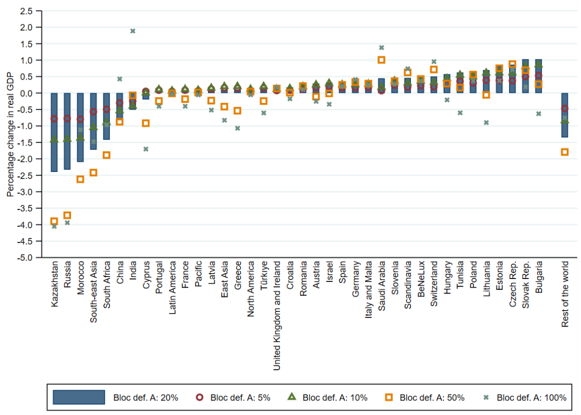
Higher iceberg trade costs typically result in higher absolute GDP losses at least up to and including a 50% additional iceberg trade cost when iceberg trade costs are imposed unilaterally by Bloc 1 countries (Figure C.3), regardless of the Bloc definition used. For some of the countries, the exceptions occur under a 100% additional trade costs. With the exception of India (Bloc definitions A and B), all still experience GDP losses. Non-aligned countries (except Pacific) record GDP gains the higher the additional iceberg trade costs (Bloc definitions C and D).

Once the additional trade costs are imposed bilaterally, however, higher tariff (Figure C.5) and iceberg (Figure C.6) costs result in higher absolute GDP losses in most cases, with any losses under 100% increases only marginally lower than under 50% increases in some of the countries.

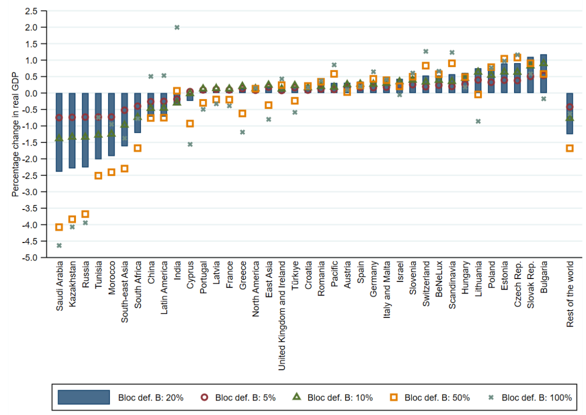
[17] For Tunisia, this is the case in Bloc definitions B, c and D.

Figure C.1: Relative decline in GDP after unilateral tariff increase imposed by Bloc 1 on Bloc 2 (% GDP)

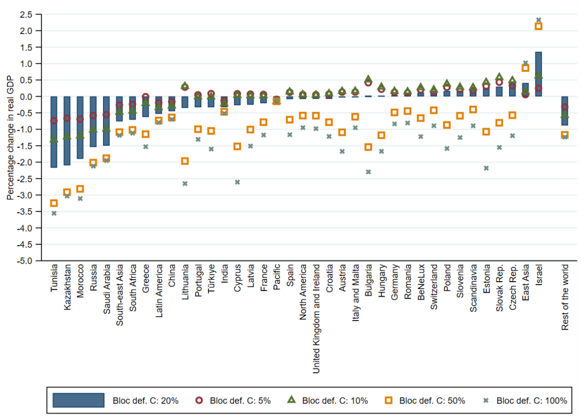
(a) Bloc definition A



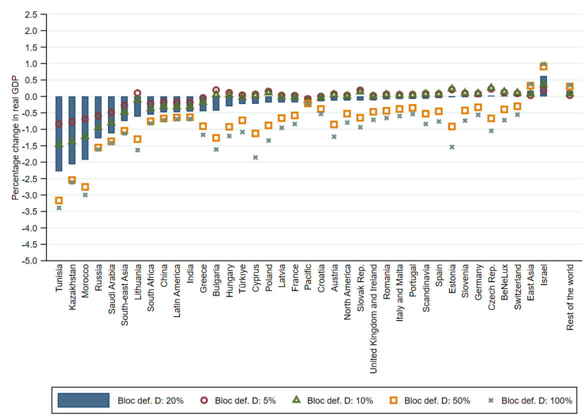
(b) Bloc definition B



(c) Bloc definition C



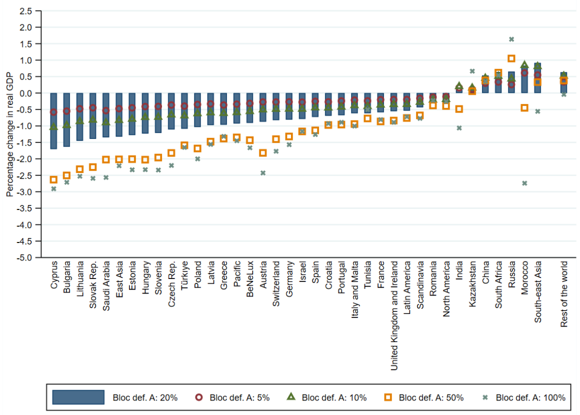
(d) Bloc definition D



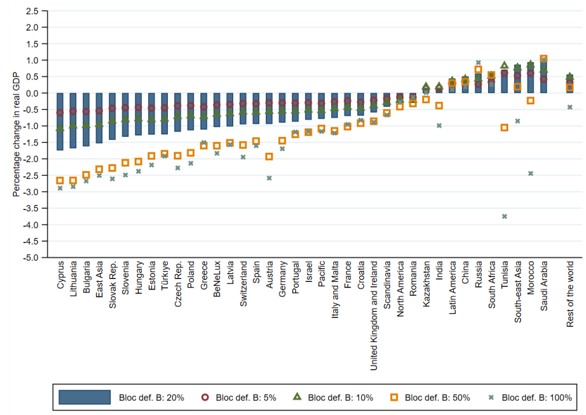
NOTES: The economic costs of friend-shoring are calculated by Bloc 1 imposing an additional tariff on Bloc 2 in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

Figure C.2: Relative decline in GDP after unilateral tariff increase imposed by Bloc 2 on Bloc 1 (% GDP)

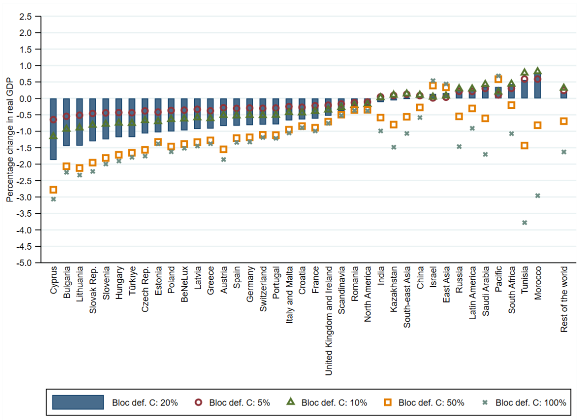
(a) Bloc definition A



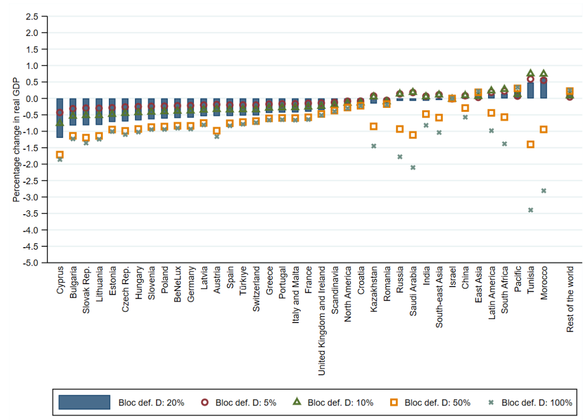
(b) Bloc definition B



(c) Bloc definition C



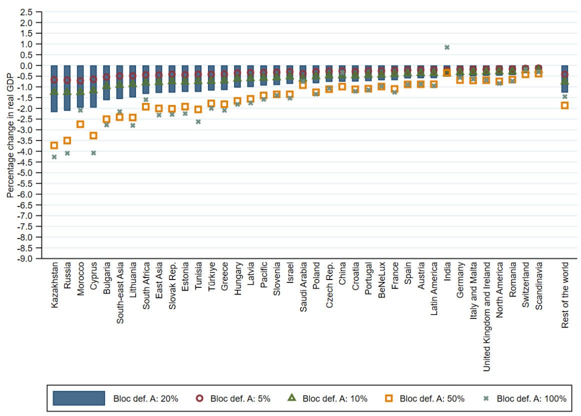
(d) Bloc definition D



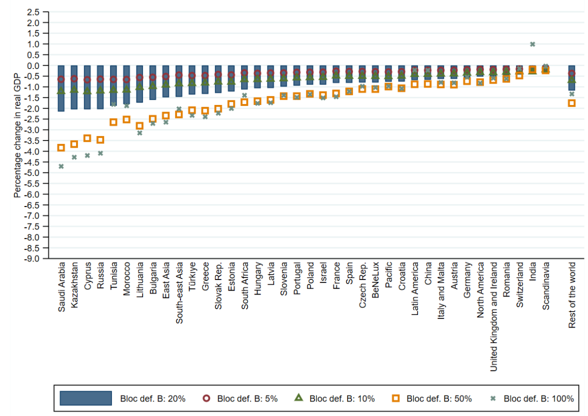
NOTES: The economic costs of friend-shoring are calculated by Bloc 2 imposing an additional tariff on Bloc 1 in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

Figure C.3: Relative decline in GDP after unilateral iceberg trade cost increase imposed by Bloc 1 on Bloc 2 (% GDP)

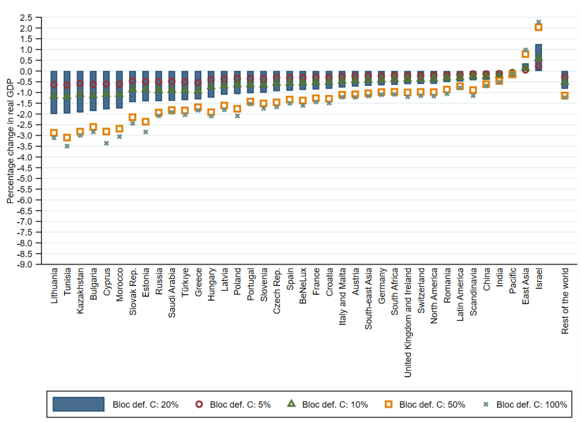
(a) Bloc definition A



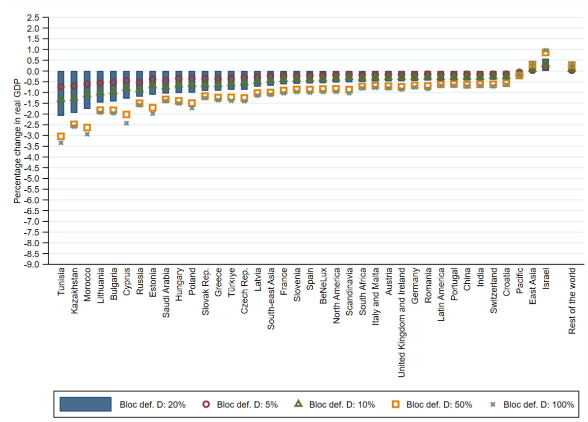
(b) Bloc definition B



(c) Bloc definition C



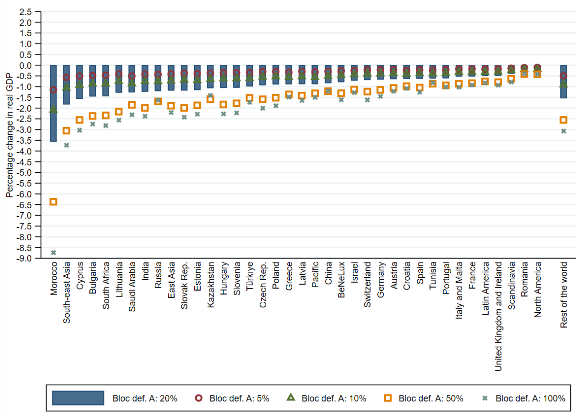
(d) Bloc definition D



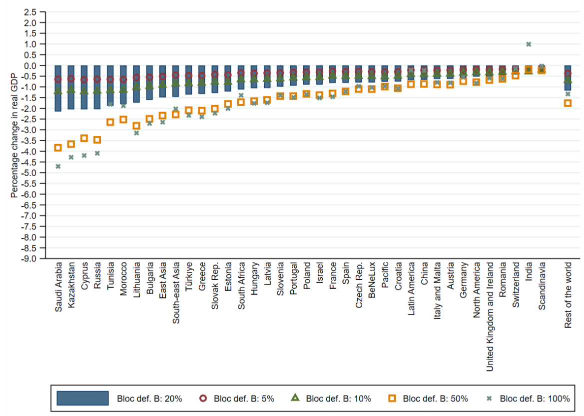
NOTES: The economic costs of friend-shoring are calculated by Bloc 1 imposing an additional iceberg trade cost on Bloc 2 in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

Figure C.4: Relative decline in GDP after unilateral iceberg trade cost increase imposed by Bloc 2 on Bloc 1 (% GDP)

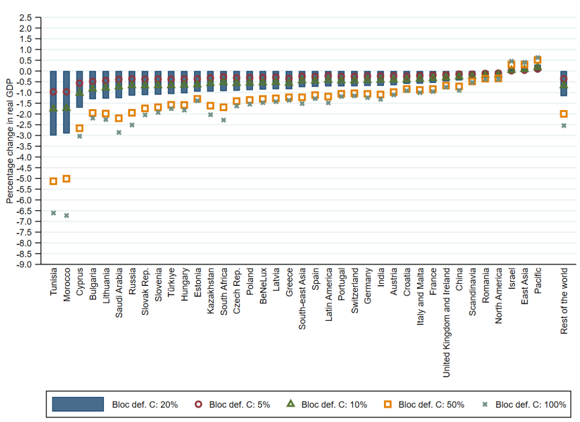
(a) Bloc definition A



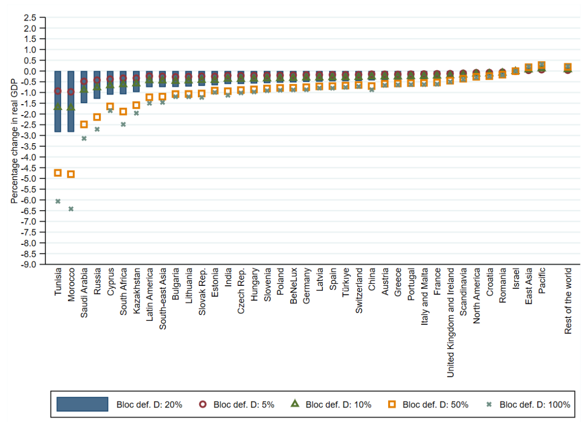
(b) Bloc definition B



(c) Bloc definition C



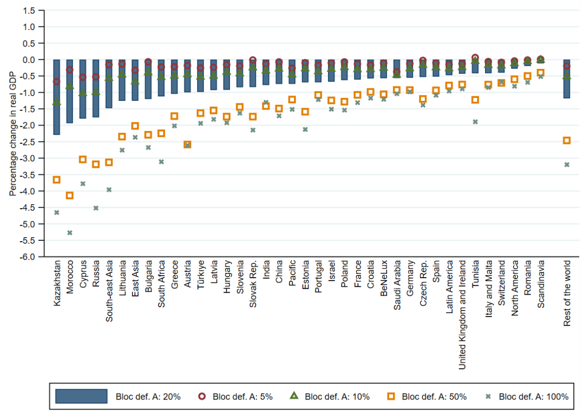
(d) Bloc definition D



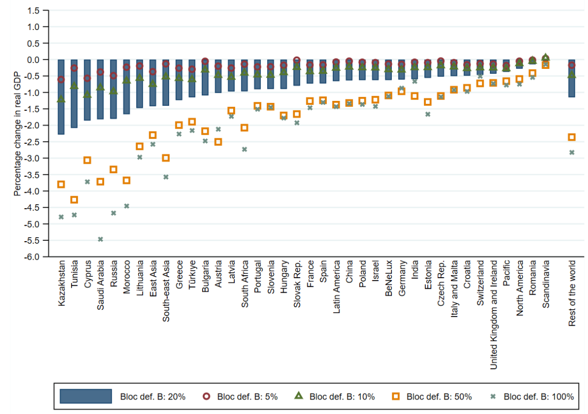
NOTES: The economic costs of friend-shoring are calculated by Bloc 2 imposing an additional iceberg trade cost on Bloc 1 in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

Figure C.5: Relative decline in GDP after bilateral tariff increase (% GDP)

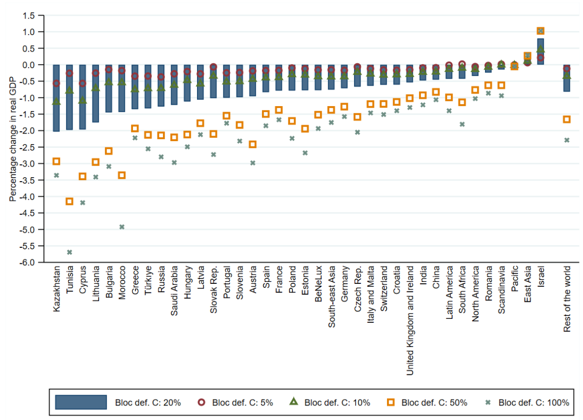
(a) Bloc definition A



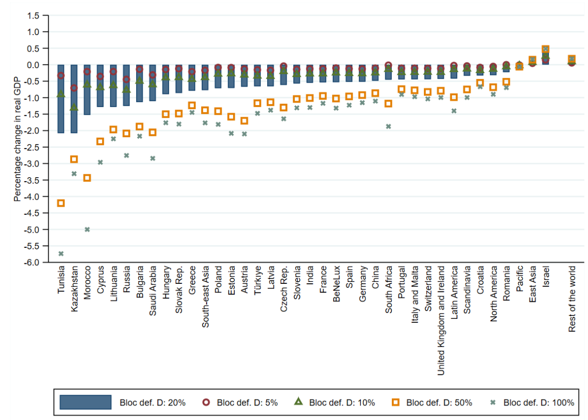
(b) Bloc definition B



(c) Bloc definition C



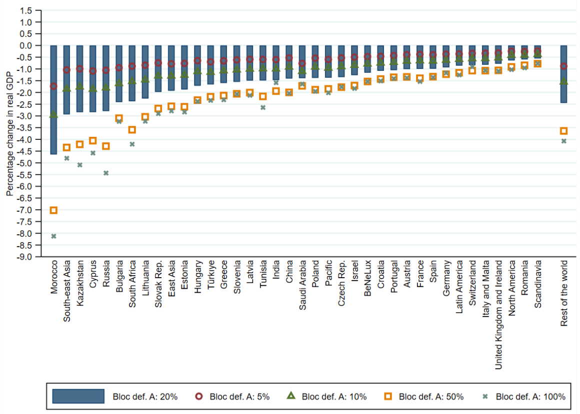
(d) Bloc definition D



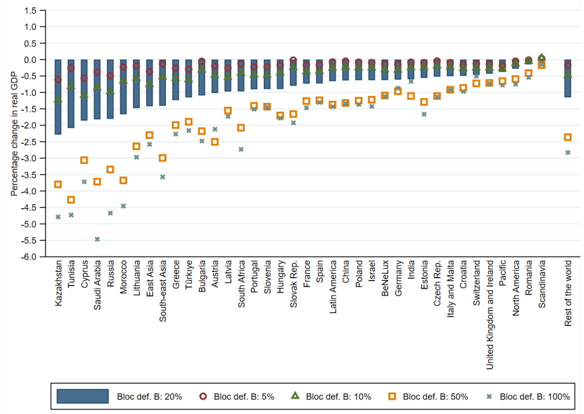
NOTES: The economic costs of friend-shoring are calculated by Bloc 1 imposing an additional tariff on Bloc 2 and vice versa in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.

Figure C.6: Relative decline in GDP after bilateral iceberg trade cost increase (% GDP)

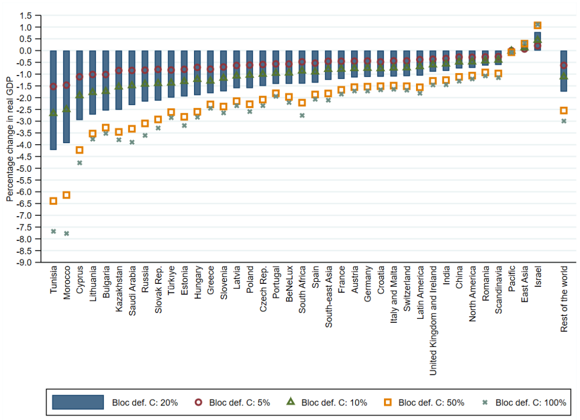
(a) Bloc definition A



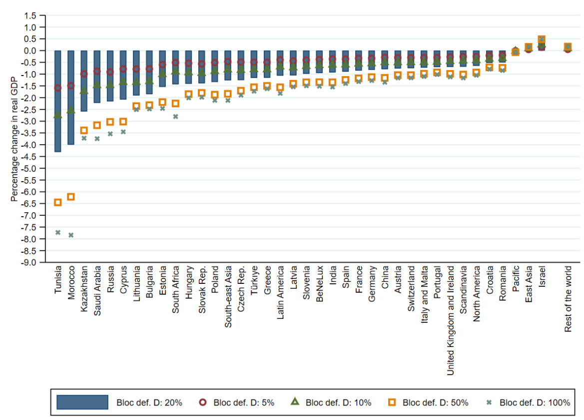
(b) Bloc definition B



(c) Bloc definition C



(d) Bloc definition D



NOTES: The economic costs of friend-shoring are calculated by Bloc 1 imposing an additional iceberg trade cost on Bloc 2 and vice versa in each industry using our economic model. The list of country aggregations and bloc allocations can be found in Table A.1.