ARTICLE IN PRESS

Journal of Comparative Economics xxx (xxxx) xxx

Contents lists available at ScienceDirect

Journal of Comparative Economics

journal homepage: www.elsevier.com/locate/jce

Geopolitical fragmentation and trade[☆]

Rodolfo G. Campos[a], Julia Estefania-Flores[b], Davide Furceri[b,*], Jacopo Timini[a]

[a] Banco de España, Spain
[b] University of Palermo, International Monetary Fund, Washington DC, USA

ARTICLE INFO

JEL Codes:
F13
F14
F15

Keywords:
Trade
Globalization
Structural gravity
Fragmentation

ABSTRACT

What are the economic consequences of geopolitical fragmentation on trade? We answer this question by using a canonical general equilibrium trade model to quantify the trade and welfare effects stemming from world trade fragmentation along geopolitical borders. To calibrate the size of the increase in trade costs, we use a new aggregate measure of trade restrictions that spans over the last 70 years and includes up to 157 countries and estimate the impact on trade of very broad trade policy restrictions in a theory-consistent structural gravity framework. We estimate that a fragmentation into three different trade blocs (Western, Eastern, Neutral)—defined according to how countries voted on the suspension of the rights of membership of the Russian Federation in the United Nations Human Rights Council because of the invasion of Ukraine— would have important effects on trade between them, reducing trade flows by 22%–57%, in the most extreme scenarios. Welfare losses would be the largest in the Eastern bloc, where the median country would experience a welfare loss of up to 3.4%.

1. Introduction

Since the end of World War II, the global economy has become increasingly integrated. This process, sustained by transportation, technological advances and liberalizing trade policy, has resulted in an increase of productivity and living standards, boosting economic growth and contributing to reduce poverty.

But trade integration has stalled since the Global Financial Crisis (Cabrillac et al., 2016; Campos et al., forthcoming) and trade policy restrictions—in the form of both tariff and non-tariff measures—have regained momentum. Recent examples are the trade tensions between US, China and other major economies (Fajgelbaum and Khandelwal, 2021), trade restrictions associated with the COVID-19 crisis, and economic sanctions imposed in response to the Russian invasion of Ukraine (Gourinchas, 2022). Related to the latter, about around 30 countries have restricted trade in food, energy, and other key commodities since the Russian invasion of Ukraine (Georgieva et al., 2022).

What are the economic consequences of imposing further trade restrictions? Trade restrictions may be very diverse (Egger et al. 2021), but most empirical contributions have focused only on a limited number of policy tools, such as tariffs and trade agreements (e. g., Baier and Bergstrand, 2007; Baier et al., 2018; Baier et al., 2019). This is because, despite recent remarkable advances (see Disdier

☆ The views expressed in this paper are those of the authors and do not necessarily represent the views of Banco de España or the Eurosystem, nor those of the International Monetary Fund (IMF). In writing this paper we have benefited from comments by Antoine Berthou, Yuriy Gorodnichenko, Michele Mancini, Pedro del Rio, two anonymous referees, and by participants at the Banco de España research seminar, and the NCB G4 International Economy Meeting that took place at the Bundesbank.

* Corresponding author.
E-mail address: dfuceri@imf.org (D. Furceri).

https://doi.org/10.1016/j.jce.2023.06.008
Received 8 June 2023; Accepted 12 June 2023

Please cite this article as: Rodolfo G. Campos et al., *Journal of Comparative Economics*, https://doi.org/10.1016/j.jce.2023.06.008

and Fugazza, 2020, for more details), data on non-tariff barriers are still limited in time and space, difficult to transform at the aggregate level, and need data-intensive procedures (e.g., Kee et al., 2009; Niu et al., 2018) to obtain ad-valorem equivalents (i.e., the tariff level that would have similar impact on trade).

To overcome these limitations, we exploit a new measure of aggregate trade restrictions called MATR (Estefania-Flores et al., 2022), that spans over the last 70 years and includes up to 157 countries. It covers tariffs, non-tariff barriers, and restrictions on requiring, obtaining, and using foreign exchange for current transactions. More precisely, MATR is based on binary variables from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) related to five different policy dimensions: a) exchange measures; b) arrangements for payments and receipts; c) imports and imports payments; d) exports and exports proceeds; and e) payment and proceeds from invisible transfers and current transfers.

We use MATR to examine how a fragmentation of the world into trade blocs would affect global trade flows.[1] We do this using a canonical general equilibrium trade model, in which trade and welfare effects stemming from a fragmentation of the world into blocs can be simulated by raising trade costs for flows crossing bloc boundaries. To calibrate the size of the increase in trade costs, we estimate the impact of MATR on bilateral trade flows using a theory-consistent structural gravity framework.

Our baseline results suggest that one standard deviation increase in MATR—as experienced for example by Venezuela in 2002—is associated with a reduction in international (with respect to domestic) trade by approximately 31%.[2] The effect is statistically significant and economically sizeable. Using the median estimate of the trade elasticity reported in a recent meta-analysis of the literature (Bajzik et al., 2020) as a comparison, we find that an increase of one standard deviation in the MATR indicator has the same effect as a 7.6 percentage points increase in tariff rates.

We use these estimates in a general equilibrium framework to simulate the effect of geopolitical fragmentation on trade. Of course, there are multiple possible scenarios of how the world could fragment. In this paper, we consider a hypothetical global economy divided into three trade blocs. We allocate countries to each of these blocs according to their vote on the 9th of April, 2021 in the United Nations (UN) General Assembly on the resolution concerning the suspension of the rights of membership of the Russian Federation in the Human Rights Council. Countries are part of a Western, Eastern, or a Neutral bloc, depending on whether they voted with Russia, against Russia, or abstained. We simulate trade fragmentation as an increase in MATR to its highest country-specific historical levels for trade between the Western and Eastern bloc and find that this fragmentation would reduce trade flows across bloc boundaries by more than 20%. If fragmentation is deeper, and comparable to also removing World Trade Organization (WTO) membership status for the Eastern bloc, trade flows between the Eastern and Western bloc could fall by up to 57%. Compared to drops in trade flows, welfare losses are smaller although still sizeable, and would be the largest in the Eastern bloc, where the median country would experience a welfare loss of up to 3.4%.

This paper contributes to three main strands of the trade literature. A first group of papers has estimated the effect of (removing) trade restrictions empirically. Most contributions, however, proxy trade restrictions using data on tariffs, trade agreements, and/or WTO membership (e.g., Baier and Bergstrand, 2007; Baier et al., 2018; Baier et al., 2019; Felbermayr et al., 2020). We contribute to this literature by explicitly analyzing the role of general trade restrictions (tariff and non-tariff barriers); and by covering a larger sample of countries over a longer time span. This allows us to go beyond "case-study results" derived from the analysis of single trade disintegration episodes (such as Brexit, see e.g., L'Hotellerie-Fallois et al., 2020; Felbermayr et al., 2022). A second strand of the literature has tried to quantify general equilibrium effects of (removing) trade policy restrictions on trade volumes and welfare (Mayer et al., 2019; Baier et al., 2019; Felbermayr et al., 2022; Campos and Timini, 2022; Timini and Viani, 2022). We contribute to this literature by using a very broad definition of trade restrictions, which is in line with the definition of trade costs in these models. A third strand of the literature has analyzed the trade effects stemming from the creation of trade blocs and the eruption of trade wars during the interwar period of 1919–1939 (Eichengreen and Irwin 1995; Wolf and Ritschl, 2011); Gowa and Hicks, 2013l Jacks and Novy 2020) and, more recently, regarding the US-China trade tensions (Cerdeiro et al., 2021) and risks of geoeconomics fragmentation (IMF 2022; Aiyar et al. 2023). We contribute to this literature by estimating the effect of MATR restrictions on trade flows and using these estimates for the calibration of the general equilibrium trade model.

The rest of the paper is structured as follows. We describe the data in Section 2. In Section 3, we review the empirical strategy. In Section 4, we discuss our partial equilibrium results for trade flows, and in Sections 5 and 6 the results derived in the general equilibrium setting for gains from trade. We conclude in Section 7.

2. Data

Data on trade flows (1949–2019) are taken from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) gravity database (Head et al., 2010; Head and Mayer, 2014), which collects and reports bilateral merchandise trade flows from the International Monetary Fund (IMF) Direction of Trade Statistics (DOTS) database. Trade flows are gross, reported in nominal terms, and expressed in the same currency (thousand US dollars). Following the standard practice in gravity models, we use nominal trade data for estimations, as the set of country-time fixed effects accounts for inflation differentials (Baldwin and Taglioni, 2007). We construct domestic trade flows as the difference between nominal Gross Domestic Product (GDP) and nominal total exports (the latter

[1] From an historical perspective, the literature analyzed the trade effects stemming from the creation of trade blocs and the eruption of trade wars during the interwar period (1919-1939). Eichengreen and Irwin (1995), Wolf and Ritschl (2011), Gowa and Hicks (2013), Jacks and Novy (2020) are prominent examples.

[2] Equivalent to an increase in the index of around five units.

constructed as the sum of bilateral exports; both GDP and trade data are from the same CEPII gravity database). Using gross production instead of GDP would be a more theory-consistent way of constructing domestic trade flows, but there are no good internationally-comparable sources for gross production for the period of our analysis. That said, we use a reduced sample (1995–2018), based on the OECD Trade in Value Added database, to check whether our results are sensitive to the use of gross production data.

MATR data are sourced from Estefania-Flores et al. (2022). This index is constructed combining information in the AREAER online database (available from 1999 onwards) with the narrative accounts of how restrictive official government policy is towards the international flow of goods and services, obtainable in printed versions of the AREAER country-year specific reports (from 1949 onwards). The index is constructed by tracking the changes in IMF's AREAER binary variables related to policies concerning: a) exchange measures; b) arrangements for payments and receipts; c) imports and imports payments; d) exports and exports proceeds; and e) payment and proceeds from invisible transfers and current transfers. The simplest version of MATR is the unweighted sum of up to twenty-two possible variables (see Table 1). As a result, the index (potentially) varies from 0 to 22 where a higher score indicates more restrictions (although in practice if varies from 2 and 21).

Compared to existing measures of trade restrictions, MATR has several desirable properties. This simple measure is based on sensible, plausible, trade policy inputs from a transparent and reliable source that is easily accessible. Each of the underlying fundamentals is quantitative, based on clear criteria, and the fundamentals include a host of non-tariff barriers as well as tariffs. Normalization issues are avoided since the measure is an aggregate of binary components. MATR is also strongly correlated with existing measures of openness and trade policy (see Table 2) but is more comprehensive in terms of country and time coverage.[3] In particular, MATR is available for a large, unbalanced panel of most economies from 1949 through 2019, and it is regularly updated. The coverage increases from about 30 economies in 1949 to more than 100 in 1973, and over 150 by 2000 (see Fig. 1). The main limitation of MATR compared to some of the existing measures of non-tariff barriers—such as the World Bank's Ad Valorem Equivalent (AVE) of Non-Tariff Measures (NTMs)—is that it is not bilateral and does not vary by sector.

Figs. 2–4 examine some the time-series characteristics of MATR. Fig. 2 shows the evolution of MATR for advanced economies (AEs) and emerging market and developing economies (EMDEs). Both groups began in comparable situations and started to liberalize in the early 1970s, but their liberalization has since stalled in the early 2000s. Overall, the degree of liberalization is more pronounced in AEs than in EMDEs. The evolution across regions (see Fig. 3) also reveals a general trend towards liberalization since the 1970s and 1980s, with little change in trade restrictions in recent years. Not surprisingly, European countries tend to have the lowest restrictions, while African countries tend to have the highest. While MATR effectively captures significant variations within its various subcomponents, it is insensitive to variations in the intensity of these measures. As a result, MATR moves little over a typical year for most countries.

Despite these general liberalization trends, there have been cases where countries have increased their trade barriers in recent years. Fig. 4 shows the evolution of MATR for Venezuela and China. Both these countries underwent a period of liberalization followed by a period of increased restrictions. The sudden rise in trade restrictions to highest historical levels in Venezuela since 2001 corresponds with a recession period caused by fluctuations in the global oil market and the introduction of several measures against free-market, including non-tariff measures. For China, MATR shows a significant decline during the WTO accession phase but started to increase since 2017 following China's initiative to shift its economic growth model from being less reliant on exports and foreign investment to be more driven by domestic demand along with the onset of increasing trade tensions with the United States.

Table A.1 in Appendix A provides key descriptive statistics for the variables used in the analysis.

3. Empirical strategy

To assess the effect of trade restrictions on bilateral trade flows, we follow Anderson and van Wincoop (2003), Baier and Bergstrand (2007) and Yotov et al. (2016), and estimate a theory-consistent state-of-the-art structural gravity equation with the following specification (see Appendix B for further details on the theoretical model behind this empirical framework):

$$X_{ijt} = \exp\left(\beta_0 + \beta_1 MATR_{ijt} + \psi Z'_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij}\right) + \varepsilon_{ijt}. \quad (1)$$

The dependent variable X_{ijt} refers to gross bilateral trade flows between the exporter i and importer j, at time (year) t. To closely

[3] We consider five alternative measures to MATR. (1) Novy's (2012) trade costs is a measure used by the UN's ESCAP in conjunction with the World Bank, with export weights. The measure is constructed using macro-economic data based on micro-theory. It accounts for all costs involved in trading goods internationally relative to domestically including transport costs, tariffs or import and export procedures. The current measure covers 180 countries from 1995 to 2020. (2) The World Economic Forum's 2016 Index of Trade Enablement evaluates countries' capacity to facilitate the flow of goods in terms of domestic and foreign market access; border administration; transport and digital infrastructure; transport services; and operating environment. The index is available for 136 economies for 2016. (3) Trade Restrictiveness Index (TRI) produced by the World Bank (2009), using the methodology of Kee et al. (2009), calculates the uniform tariff that would maintain the level of imports in a country constant. The index is calculated annually and is available for 167 countries for 2009. (4) Quinn's measure of Current Account Financial Openness measures how well governments liberalize the proceeds from goods and services trade in complain with their IMF's Article VIII obligations. The index is available for 88 countries from 1973 to 2014. (5) The World Bank's Ad Valorem Equivalent (AVE) of Non-Tariff Measures (NTMs) is the uniform tariff that will result in the same trade impacts on the import of a product due to the presence of the NTMs. The database covers 40 importing countries, and 151 exporting countries and presents a cross-section at sectoral level (42 sectors) and is also available bilaterally. The information to construct the measures is compiled during the years 2012 to 2016 and presents two different measures: technical and non-technical.

Table 1
MATR components.

II. Exchange measures	II.A. Restrictions and/or multiple currency practices
	II.B. Exchange measures imposed for security reasons
IV. Restrictions to payments	IV.A. Prescription of currency requirements
	IV.B. Payments arrangements
	IV.C. Administration of control
	IV.D. Payment arrears
	IV.F. Controls on exports and imports of banknotes
VII. Import Restrictions	VII.A. Foreign exchange budget
	VII.B. Financing requirements for imports
	VII.C. Documentation requirements for release of forex for imports
	VII.D. Import licenses and other nontariff measures
	VII.E. Import taxes and/or tariffs
	VII.F. State Import Monopoly
VIII. Export Restrictions	VIII.A. Repatriation requirements
	VIII.B. Financing requirements
	VIII.C. Documentation requirements
	VIII.D. Export licenses
	VIII.E. Export taxes
IX. Payments and X. Proceeds for Invisibles Restrictions	IX.A. Payments for Invisibles, Transfers & Current Transfers
	X.A. Repatriation requirements on Proceeds
	X.A.1. Surrender Requirements on Proceeds
	X.B. Restrictions on use of funds

Source: Estefania-Flores et al. (2022)

Table 2
Correlation of MATR with trade costs, trade enablement, TRI, current account fin openness measure here.

Variables	(1)	(2)	(3)	(4)	(5)
(2) Trade Costs Novy (export-weighted)	0.192*				
(3) Trade Enablement, WEF		-0.695*			
(4) TRI, WB 2009			0.278*		
(5) Curr. Acc. Fin'l Openness, Quinn				-0.850*	
(6) Ad Valorem Equivalent (AVE) of NTMs					0.32*

Note: MATR correlations against four ad-hoc trade restriction existing measures: Novy's (2012) measure of trade costs; The World Economic Forum's 2016 Enabling Trade Index; Quinn's measure of current account financial openness; Trade Restriction Index (TRI) produced by the World Bank, using methodology from Kee et al. (2009). AVE of non-tariff measures (NTMs) by importing countries by the World Bank. The index is disaggregated at the sectoral level and provides two different measures: technology and non-technology. We first use the mean of all the sectors by countries and then the mean of the two measures, since both are included in MATR. AVE index is a cross-section calculated using 2012–2016 information, thus we restrict MATR to this range of years to calculate the correlation.

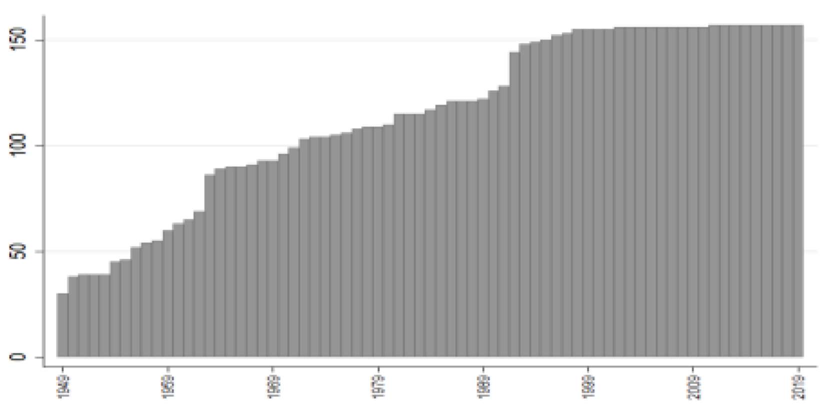

Fig. 1. MATR country coverage over time.

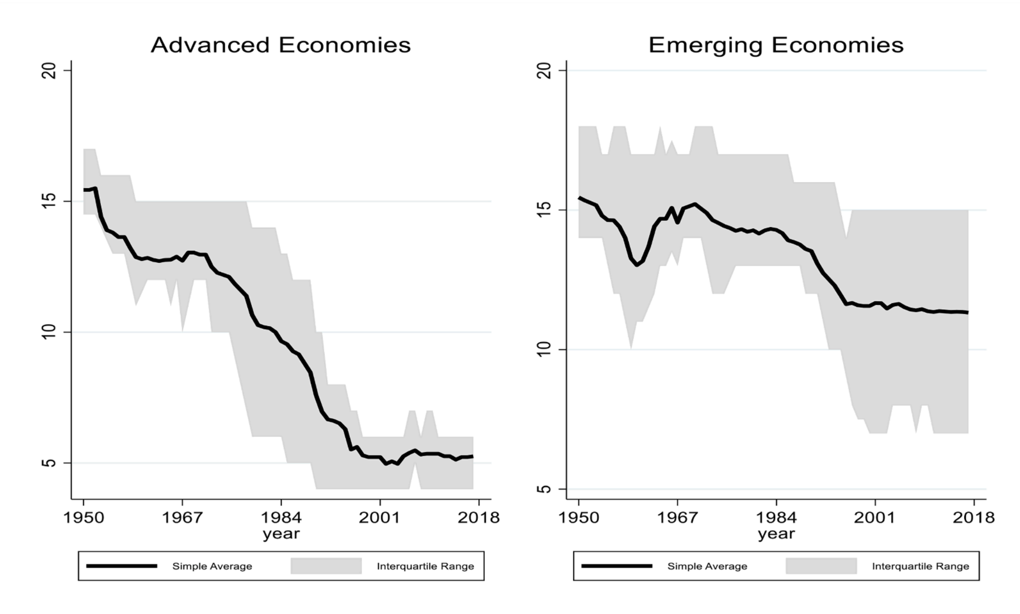

Fig. 2. Evolution of MATR over time, by income groups.
Note: Year-specific simple average and interquartile range of MATR for Advanced and Emerging Economies, classified following the IMF World Economic Outlook.

Fig. 3. Evolution of MATR over time, by region.
Note: Simple MATR average by region, classified following the IMF World Economic Outlook.

adhere to gravity theory, our dependent variable also includes the case $i = j$, i.e., domestic trade flows.[4] The variable $MATR_{ijt}$ is an index measuring the restrictions imposed by countries on international trade flows. We construct this variable as the interaction of $MATR_{it}$, which varies along the country-time dimension, with a dummy variable that indicates international trade (i.e., whether country $i \neq j$). For domestic trade flows, the variable $MATR_{ijt}$ equals zero, as restrictions impeding international trade do not apply to domestic transactions. The simultaneous use of observations on domestic and international trade flows not only aligns the empirical specification with gravity theory but is also essential to identify the effect non-discriminatory trade policies, such as those captured by the MATR index.[5]

[4] Yotov (2022) summarizes the many reasons why domestic trade should be used in estimation of structural gravity models.

[5] Structural gravity models include various sets of fixed effects, including exporter-time and importer-time fixed effects. Given that non-discriminatory trade policy variables vary along the exporter-time or importer-time dimension only, these are perfectly collinear with the above-mentioned fixed effects, if only international trade flows are considered (Head and Mayer, 2014). However, using observations both on domestic and international trade flows introduces variation in the non-discriminatory policy variable vector that survives after partialling out the exporter-time and importer-time dimension (the non-discriminatory trade policy variable is always equal to zero in the case of domestic trade flows because non-discriminatory trade policies do not apply for transactions occurring within country borders, but exporter and importer dummies are not).

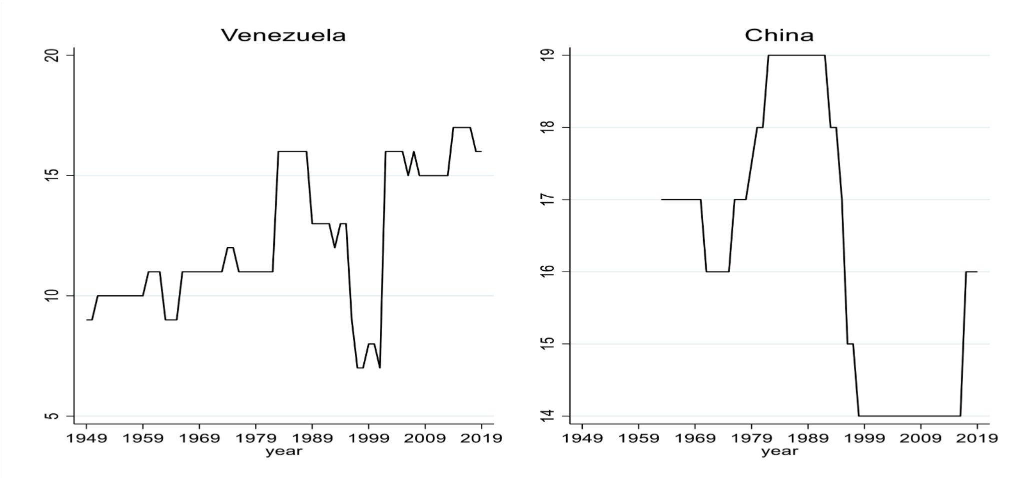

Fig. 4. Evolution of MATR for Venezuela and China.

The symbol Z'_{ijt} identifies a vector of control variables that capture other bilateral and multilateral trade policies, among other variables. In our main specification, this vector includes dummies identifying memberships in trade agreements (TAs) and the GATT/WTO. The estimated coefficients for MATR, TAs and GATT/WTO obtained in the baseline specification are used to calibrate the general equilibrium model. As robustness checks, we further modify and expand the vector Z'_{ijt} by considering, for example, most favored nation (MFN) tariffs or allowing the effect of bilateral distance to vary over time. The latter allows capturing effects of policy and non-policy variables, such as, for example, the construction of a road or railway infrastructure connecting (or improving the connection between) two countries. The terms δ_{it} and γ_{jt} are exporter-time and importer-time fixed effects. Apart from absorbing all features with country-time variation (such as GDP, GDP per capita, population, etc.), they represent the theory-consistent way of controlling for "multilateral trade resistances" (Anderson and van Wincoop, 2003), i.e., the exporter's and importer's overall 'market thickness' (Fally, 2015). The term ω_{ij} indicates exporter-importer fixed effects, a standard way in the gravity literature of accounting for trade imbalances and asymmetric trade costs (Waugh, 2010). This term absorbs all features with (directional) pair variation (such as the standard gravity variables: distance, contiguity, common language, colonial relationship, etc.). The inclusion of this large set of fixed effects is key to control for many potentially confounding factors associated with MATR, allowing to identify the causal effect of trade restrictions on international trade flows.

We estimate Eq. (1) using a Poisson Pseudo-Maximum-Likelihood (PPML) procedure (Santos Silva and Tenreyro, 2006) and compute standard errors by clustering on exporter, importer and year.[6] The period of analysis is 1949–2019, and the country sample size is determined by the availability of MATR data both for the exporter and the importer.

4. Partial equilibirum results

4.1. Baseline results

Table 3 reports the partial equilibrium effects of trade restrictions on trade flows, derived from the baseline estimation framework. The main coefficient of interest corresponds to $MATR_{ijt}$ (β_1 in Eq. 1). Given the inclusion of country-pair and country-time fixed effects, this coefficient captures the marginal (partial equilibrium) effect of trade restrictions on trade flows.

In Column 1, Table 3, we run a naïve specification that includes only MATR. In this first regression, the estimated effect of introducing one additional trade-restrictive measure leads to a 7% reduction in international trade flows, approximately.[7] This implies that a one standard deviation increase in MATR—such as the increase observed for Venezuela in 2002—is associated with a reduction in international trade by approximately 31%. Given our identification strategy, which relies on the fact that trade restrictions do not apply to domestic trade, these effects should be interpreted as relative to domestic trade flows.

In Colum 2 and 3 of Table 3, we expand the set of explanatory variables to include TAs and a GATT/WTO membership indicator. Reassuringly, the coefficient of MATR remains economically and statistically significant with these additional controls, confirming that the index captures additional important aspects of trade restrictions different from those associated with TAs and GATT/WTO memberships, which are the ones typically considered in the literature. At the same time, as expected, the point estimate of MATR coefficient declines (to about 6%), as MATR already incorporates changes associated with TAs memberships and GATT/WTO

[6] Egger and Tarlea (2015) show that as trade data are multidimensional, computing standard errors that are clustered at the country-pair level leads to misleading inference on the impact of preferential trade agreements.

[7] The effect is computed as $100 * [e^{\beta_{MATR}} - 1]$).

Table 3
MATR trade effects – Main estimates.

	MATR (1)	MATR and TA (2)	MATR, TA, and GATT/WTO (3)
$MATR_{ijt}$	-0.0767***	-0.0695***	-0.0627***
	(0.015)	(0.015)	(0.013)
TA_{ijt}		0.262***	0.216***
		(0.062)	(0.061)
$GATT/WTO_{ijt}$			0.365***
			(0.112)
Observations	624,444	624,444	624,444
δ_{it}	YES	YES	YES
γ_{jt}	YES	YES	YES
ω_{ij}	YES	YES	YES

Note: PPML regressions. Fixed effects and constant not reported for the sake of simplicity. Standard errors (in parentheses) are clustered at the exporter, importer and time level. ***p < 0.01, **p < 0.05, *p < 0.1.

memberships.

The estimated effects of TAs and GATT/WTO memberships are also statistically significant and suggest that the entry into force of a trade agreement along with joining the GATT/WTO increase trade between members by approximately 24% and 44%, respectively.[8]

4.2. Robustness checks

We perform several sensitivity checks to validate the robustness of our results. As a first robustness check, we modify the set of controls Z'_{ijt}(Table 4). In Column 1, we separate the GATT from the WTO dummy variable. GATT and WTO effects on trade flows seem to be very similar in size. In Column 2, we substitute the GATT/WTO dummy with the MFN tariff, using the logarithm of (1+) the MFN tariff rate. This is an alternative way to account for multilateral tariff changes. If anything, the point estimate of MATR increases. In Column 3, we separate the European Union (EU) from the rest of trade agreements, to check whether the EU has different trade effects than other trade agreements. In line with expectations, given the higher degree of economic integration within the EU, the estimated EU trade effect is considerably larger than that of the rest of trade agreements. In Column 4, we use an alternative MATR aggregation, which excludes taxes and tariffs. The little variation in the MATR coefficient further confirms that MATR trade effect goes beyond taxes and tariffs.

In a second exercise, we follow Bergstrand et al. (2015) and adopt a more conservative approach by including additional interaction terms that serve as additional controls for the variation in the evolution of domestic versus international trade (Column 5 and Column 6). These include the interaction between an international border dummy (a dummy equal to 1 if $i \neq j$) and a time dummy, and the interaction between the logarithm of the bilateral distance between the exporter and the importer—a proxy measure of bilateral trade costs—and a time dummy, respectively. The former set of interaction terms capture any common trend in the evolution of international trade with respect to domestic trade. Bergstrand et al. (2015) suggest that this indicator can be interpreted as a measure of a general globalization trend. The latter set of interaction terms also control for trade effects stemming from policy and non-policy changes that modify bilateral trade costs, such as, for example, the construction of a road or railway infrastructure connecting (or improving the connection between) two countries. In Column 7, we use both sets of interaction terms together.

Next, we examine the sensitivity of our baseline specification to alternative time and country samples. We start by splitting the sample in pre-Bretton Woods era (1949–1973) and post-Bretton Woods era (1974–2019). The results reported in the first two rows of column 1 of Table A.2 (Appendix A) show that the effect of MATR was larger in the second period. Next, since MATR varies considerably across regions (see Estefania-Flores et al. 2022), we check whether the baseline results are driven by any specific regions. The results reported in rows 3–7 do not point to any statistically significant differences. Successively, we examine whether the effect of MATR varies between advanced and emerging economies. The results (rows 8 and 9) suggest that the effect of reducing trade restrictions is statistically significant in both advanced and emerging economies, albeit larger in the second group. This finding is consistent with the evidence reported by Estefania-Flores et al. (2022), that MATR has larger effects on GDP for emerging economies than for advanced ones.

As an additional exercise, we check the robustness of our results to the use of alternative data sources, such as IMF, COMTRADE, and BACI. The coefficient of MATR changes little (due to sample compositions) and remains highly statistically significant (rows 10–13). Similarly, the effect of MATR remains statistically significant when alternative ways of aggregating the sub-indicators of MATR are considered (e.g., principal factors, principal component) or different components of MATR are considered (rows 14–25).[9]

A potential concern with our results is that trade liberalization (or restrictions) occurs in tandem with other regulatory changes. While the set of country-time fixed effects effectively controls for these, it could be possible that these regulatory changes affect in-

[8] The effect is computed as $100 * [e^{\psi_{TA}} - 1]$ and $100 * [e^{\psi_{GATT/WTO}} - 1]$ respectively.

[9] In some of these exercises, the magnitude of the coefficient varies from the baseline as the standard deviation of the alternative MATR index considered is different than that of the baseline.

Table 4
MATR trade effects – Robustness tests.

	Separating GATT from WTO (1)	MFN tariffs (2)	Separating EU from the rest of TAs (3)	MATR without taxes and tariffs (4)	Adding border*year interactions (5)	Adding distance*year interactions (6)	Adding border*year and distance*year interactions (7)
$MATR_{ijt}$	-0.0432***	-0.0759***	-0.0519***		-0.0447***	-0.0614***	-0.0462***
	(0.012)	(0.019)	(0.012)		(0.014)	(0.0137)	(0.0153)
$MATR\_nt_{ijt}$				-0.0594***			
				(0.013)			
TA_{ijt}	0.169***	0.0320		0.207***	0.152***	0.197***	0.123**
	(0.049)	(0.042)		(0.061)	(0.053)	(0.0555)	(0.0561)
EU_{ijt}			0.836***				
			(0.181)				
$Other\_TAs_{ijt}$			0.190***				
			(0.061)				
$GATT/WTO_{ijt}$			0.377***	0.362***	0.279**	0.324***	0.298**
			(0.112)	(0.110)	(0.112)	(0.124)	(0.121)
$GATT_{ijt}$	0.254*						
	(0.139)						
WTO_{ijt}	0.231***						
	(0.063)						
$\ln(1+t_{MFN})_{ijt}$		-5.388***					
		(1.053)					
Observations	624,444	354,634	624,444	624,444	624,444	624,444	624,444
δ_{it}	YES	YES	YES	YES	YES	YES	YES
γ_{jt}	YES	YES	YES	YES	YES	YES	YES
ω_{ij}	YES	YES	YES	YES	YES	YES	YES

Note: PPML regressions. Fixed effects, distance*year interactions, border*year interactions, and constant not reported for the sake of simplicity. Standard errors (in parentheses) are clustered at the exporter, importer and time level. ***p < 0.01, **p < 0.05, *p < 0.1.

ternational trade differently than domestic trade. To address this issue, we expand Eq. (1) to control for regulatory changes in domestic finance, capital account, product and labor markets (Alesina et al., 2020). In particular,

$$X_{ijt} = \exp\left(\beta_0 + \beta_1 MATR_{ijt} + \psi Z'_{ijt} + \vartheta_1 S_{ijt} + \delta_{it} + \gamma_{jt} + \omega_{ij}\right) + \varepsilon_{ijt}. \quad (2)$$

The variable S_{ijt} is an index measuring regulatory changes in capital account, labor, domestic finance, or product market regulations implemented by countries. For domestic trade flows, the variable S_{ijt} equals zero: in this way, our measure is not collinear with country-time fixed effects (Heid et al., 2021) and captures the differential effect of regulatory changes on international trade (with respect to domestic trade). The results (rows 26–29) show that MATR coefficient remains statistically significant when these additional controls are included.

In a similar fashion, we also test the robustness of MATR to other control variables. First, we relax the implicit assumption of linearity made in our main regression, allowing MATR to have nonlinear effects. We do this by including a quadratic term of our main variable of interest (row 30). The regression results hint towards a non-linear effect, suggesting a stronger marginal effect when MATR is already high. In this sense, the assumption made in our main regression and its use for calibration purposes in general equilibrium should be interpreted as conservative. Second, we address the potential concern that trade liberalization (restrictions) occurs as a response to crises, such as currency, banking, or inflation crises (Reinhart and Rogoff, 2009), and that those crises affect domestic and international trade differently. Therefore, we expand Eq. (1) accordingly and, similarly to what we did for structural reforms (see Eq. (2) above), by adding a dummy variable that identifies the years in which one (or any) of these crises occur in a country and setting this dummy variable to zero for domestic trade flows. The results (rows 31–34) show that MATR coefficient remains statistically significant when these additional controls are included.

Finally, as further robustness tests, we tackle three issues related to the structure of our database. First, given the unbalanced nature of our database, we run a regression keeping—both as exporters and as importers—only those countries that are present in the database since the beginning of our sample, i.e., 1949. Second, we inflate the database with zeros, by considering all missing data as indicating the inexistence of trade relationships. Third, we use a reduced sample (1995–2018), based on the OECD Trade in Value Added database, to check whether our results are sensitive to the use of gross production data (instead of GDP data used in our baseline specification) to construct domestic trade. Again, the MATR coefficient remains negative and significant (row 35–37). In the latter case, our findings are in line with Campos et al., (2021), indicating that the presence of country and time fixed effects in gravity equations makes the distinction between GDP and gross output less relevant in practical applications.

5. General equilibrium model

To draw conclusions that are not altered by specific model details, we employ a static theory-consistent general equilibrium structural gravity model that has been shown to be isomorphic to many of the well-known theoretical models that deliver an aggregate gravity relation for trade flows (Head and Mayer, 2014; Allen et al, 2020). The model is an Armington model (Armington, 1969) in which consumers value goods produced in different locations according to a utility function with a constant elasticity of substitution $\sigma > 1$. Each country produces a single good. The production function has constant returns to scale and combines labor and an aggregate of internationally-traded goods in a Cobb-Douglas specification, as in the benchmark model of Allen et al (2020), with labor share parameter ζ. Labor is country-specific and consumers supply labor inelastically. Transporting goods from one country to another incurs in bilateral trade costs that are modeled as iceberg trade costs. The model implies a system of equations that implicitly determines the endogenous change in equilibrium prices in response to a change in trade costs. For any given change in trade costs, we solve for the endogenous change in prices, wages, and quantities numerically. The equilibrium trade flows from this specific model are consistent with a large set of alternative theoretical trade models.[10] Using "exact hat algebra" à la Dekle et al. (2007), we map changes in the vector of trade costs $(\widehat{\tau}_{ij})$ faced by goods shipped from exporter i to importer j to changes in trade flows $\widehat{X}_{ij}$, changes in real output $\widehat{Q}_i$, and changes in welfare $\widehat{W}_i$ (see Appendix B for a full specification of the model and further details). Welfare measures the change in consumption by a representative worker and, unlike other models, in this model the change in welfare does not equal the change in output because labor is not the only factor of production.[11]

The solution of the model requires specifying two elasticities that are tied to the model's structural parameters. The first of these elasticities is the trade elasticity. It governs the sensitivity of trade flows to changes in trade costs. In our model, this trade elasticity is determined by the constant elasticity of substitution between varieties and equals $\theta = \sigma - 1$. The other elasticity that is important for the model is the supply elasticity. It determines the reaction of a country's output to changes in (relative) export prices. This elasticity is tied to the relative importance of intermediate goods in the production function and is equal to $\psi = (1 - \zeta)/\zeta$.

In our simulations, we set the trade elasticity θ to 3.8; this is the median value of the Armington trade elasticity reported by the meta-analysis by Bajzik et al. (2020). There is no similar meta-analysis fir the value of the supply elasticity. To calibrate ψ, we therefore rely on recent research by Huo et al (2019), who calculate the share of intermediates in the KLEMS database for various industries and countries. In their data, the 10th and 90th percentiles of this distribution are 0.31 and 0.67, respectively, which in turn correspond to supply elasticities of 0.45 and 2.03. We use the mid-point of this range and set the supply elasticity ψ to 1.24 in our simulations.

The way we conduct our general equilibrium simulations is standard practice in the applied trade literature to obtain "benchmark trade and welfare estimates" stemming from changes in trade policy (Yotov et al., 2016). For example, using a similar approach, but (implicitly) setting the supply elasticity to zero, Mayer et al. (2019) study the trade and welfare gains of being a member of the EU, Felbermayr et al. (2020) the gains of being part of the GATT/WTO, and Baier et al. (2019) those deriving from a trade agreement between the EU and the US. Our model does not include different sectors, nor their interlinkages (i.e., input-output linkages; global value chains), or the possibility of accumulating assets or capital (because it is a static model). For these reasons, our results should be interpreted as lower bounds, given that the inclusion of these features in the model tend to increase the trade and welfare effects associated to the trade policy change (see, e.g., Caliendo and Parro, 2015).[12]

As it is well known in the literature on structural gravity models (e.g., Head and Mayer, 2014), in the context of the general equilibrium model used, the estimates from Eq. (1) can be given a structural interpretation in terms of the vector of bilateral trade costs. In particular, the change in trade costs between any two scenarios can be computed as

$$\widehat{\tau}_{ij}^{-\theta} = \exp\left(\widetilde{\beta}_1 \Delta MATR_{ij} + \widetilde{\psi} \Delta Z'_{ij}\right) \ \forall i, j,$$

where $\widetilde{\beta}_1$ and $\widetilde{\psi}$ are the estimated values of the parameters in Eq. (1) and $\Delta MATR_{ij}$ and $\Delta Z'_{ij}$ are differences posited for the value of MATR and other covariates in an alternative scenario relative to the value in the baseline scenario.

Because the model is a general equilibrium model, trade flows will vary also for countries that are not directly hit by changes in their trade costs, giving rise to so-called trade diversion effects. In the context of the Armington model used, part of these general equilibrium effects operates through changes in country-level prices and wage rates. They adjust in response to a change in trade costs and affect the relative costs of producing in all countries, including those that did not experience a change in trade costs. In addition, even for fixed prices and wages, a rise in bilateral trade costs for any given partner makes other producers more competitive in relative terms and leads to increased imports from these other sources. All of these effects are taken into account in the general equilibrium model.

[10] Our results on trade flows fit into the universal gravity framework of Allen et al. (2020) and are valid for any trade model that delivers the same trade elasticity and supply elasticity.

[11] As shown in Appendix B, the change in welfare in the model always exceeds the change in output unless labor is the only factor of production and, in that case, they coincide.

[12] In our case, the use of a model and estimation that distinguishes between sectors would not be advisable for three reasons. First, because MATR does not vary at the sectoral level, and therefore it cannot be used to inform the counterfactuals. Second, sectoral data including domestic trade flows covers only the recent period, which leaves out the period in which MATR was highest. Third, there is less consensus on the value of sectoral trade elasticities, and results are very dependent on their values.

6. Scenarios

6.1. Autarky benchmark for Russia

Before describing a scenario of world trade fragmentation, we first study what would happen if Russia were forced into complete autarky, presumably the worst possible outcome for Russia. In a first pass, we can determine the impact on Russia's welfare directly from the well-known sufficient-statistics ACR formula by Arkolakis et al (2012), which requires knowing only the initial trade openness of Russia and assuming a value for the trade elasticity, without the need to solve for the full general equilibrium. Russia's share of expenditure on domestic goods in our data is 0.845. By applying the ACR formula with a trade elasticity of 3.8 we find that a move to complete autarky would lead to a change in welfare of $(0.845)^{1/3.8}$ -1 = -4,3%.[13] However, in our model with roundabout production presented in the previous section, welfare costs are larger, as activity is also affected by a positive supply elasticity. In this case, Russia's welfare losses would be -9.4%.[14] We discuss in the appendix how to calculate welfare for all countries for this scenario.[15] With Russia becoming autarkic, both imports and exports of all countries to and from Russia drop to zero. Therefore, countries with strong trade ties to Russia, which happen to be all geographically close to Russia, would be the ones most affected. Among them, the country most negatively affected is Belarus, whose total trade is predicted to drop by 42%, leading to a welfare loss of -16%, larger than that of Russia given its larger reliance on trade.[16] The five next most affected countries are Mongolia (-5.8%), Armenia (-4.7%), Kyrgyzstan (-4.1%), Kazakhstan (-4.0%), and Tajikistan (-3.6%), all of them contiguous or close to Russia. In contrast, for countries that are not geographically close to Russia, and, therefore, trade less with Russia, welfare losses are relatively muted, and the majority of countries in the world will be almost unaffected (Fig. 5).[17]

6.2. Scenario: fragmentation of world trade

We next consider two scenarios in which trade becomes fragmented. In the first scenario, called the fragmentation scenario, we simulate the effect of a world fragmented into two antagonizing blocs, the Western and the Eastern bloc, who raise barriers to trade between them. A third bloc, called the Neutral bloc, includes countries that do not belong to either bloc. We categorize individual countries as belonging to any of these three blocs according to how they voted in the United Nations (UN) General Assembly on the resolution adopted on 7 April 2022 concerning the suspension of the rights of membership of the Russian Federation in the Human Rights Council.[18] We codify the members who voted in favor of suspension (voted "yes") as part of the Western bloc, those against the suspension (voted "no") as part of the Eastern bloc, and those who abstained or did not participate in the vote ("abstention" or "non-voting") as part of the Neutral bloc (Fig. 6). Table A.3 in the Appendix A reports the votes cast by each UN member.

We construct the fragmentation scenario by raising bilateral trading costs for trade between countries belonging to opposing blocs. To do so, we search for the highest MATR for each country in the Western and Eastern blocs throughout history and then raise trade costs between any given country and members of the opposing bloc bilaterally to this maximum level.[19] We use the year 2019 as the baseline level, because it is the most recent year of trade (and trade restrictions) data. Trade costs between the Neutral bloc and the other two blocs remain constant in this scenario.

We report the maximum of MATR by country in Table A.3 in the Appendix. Most peaks in MATR index corresponds to the Cold War era, a period also characterized by limited trade across blocs. By setting each country's MATR to its own maximum for cross-bloc trade we ensure that the scenario takes into account idiosyncratic reasons for why individual countries may differ in their tolerance to restricting trade. Moreover, because countries have had these high values of MATR in the past, it is not unreasonable to assume that they are capable to enact the legal framework to instate and enforce them again.

Following the steps described in the prior section, we first calculate

[13] This calculation is sensitive to the level of domestic trade in the data. As explained in section 2, we construct domestic trade as GDP minus total exports instead of using gross production, in order to obtain data for a large number of countries. Doing the welfare calculation using domestic trade from the TiVA dataset leads to a somewhat larger welfare loss. The change in welfare for Russia of moving to complete autarky would be $(0.809)^{1/3.8}$ -1 = -5,4%.

[14] Using data from TiVA, the variation in welfare would be -11.7%.

[15] In practice, the model can be solved numerically by assuming that trade costs between Russia and the rest of the world increase to a very large number. We simulate an increase of trade costs of one billion (10^9) and verify that the welfare loss for Russia in the numerical solution is numerically identical to the solution obtained in closed form.

[16] in detail, the reason for this is that Belarus simultaneously has very strong trade ties with Russia and is relatively small compared to Russia. This implies that, after losing Russia as a trade partner, the gap between export prices and import prices, which determines the welfare change, rises more sharply for Belarus than for Russia.

[17] In the numerical solution there are also seven small countries (ATG, LBR, BLZ, LSO, VUT, BHS, KIR) with welfare gains. However, their predicted increase of trade is less than 2% in all cases, and their welfare gains are at most 0.1%.

[18] See the UN Digital Library for the text of the resolution and the vote records, respectively available at: https://digitallibrary.un.org/record/3968037 and https://digitallibrary.un.org/record/3967778.

[19] The recent experience of Venezuela in increasing non-tariff barriers to historically high levels suggests that the scenario considered in the analysis, while highly hypothetical, is a possible one.

Fig. 5. Welfare if Russia becomes fully autarkic.
Note: The figure shows the change in welfare that would result if Russia were to become autarkic. Countries shown in blue experience an improvement in welfare, and those in red a worsening. Units are percentage points. Welfare can be interpreted as the change in the real wage of workers in a country. The scales are different for positive and negative values, and the negative scale is capped at -15.

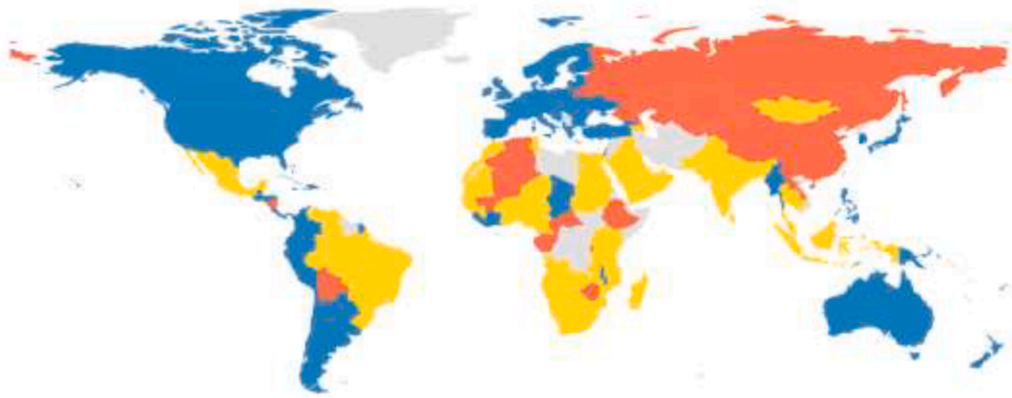

Fig. 6. Definition of trade blocs.
Note: The figure shows three trade blocs according to how countries voted in the United Nations (UN) General Assembly on the resolution adopted on 7 April 2022 concerning the suspension of the rights of membership of the Russian Federation in the Human Rights Council. Countries shown in blue voted "Yes" and belong to the "Western" bloc. Countries in red voted "No" and belong to the "Eastern" bloc. Countries in yellow either abstained or did not vote and belong to the "Neutral" bloc. Countries shown in grey are countries without MATR or trade data, and they are excluded from the simulations regardless of their vote.

$$\Delta MATR_{ij} = \begin{cases} MATR_{ij}^{MAX} - MATR_{ij}^{2019} & \textit{if } i \textit{ and } j \textit{ belong to antagonizing blocs} \\ 0 & \textit{otherwise} \end{cases}$$

and then modify trade bilateral trade costs by scaling the change in MATR by the point estimate of β_1 reported in column 3 of Table 3:

$$\widehat{\tau}_{ij}^{-\theta} = \exp\left(-0.0627 \times \Delta MATR_{ij}\right) \forall i, j.$$

The model is solved by using these changes in trade costs and trade flow data for the year 2019 as inputs for the algorithm of the extended model described in Appendix B.

6.3. A more severe fragmentation scenario

In a second scenario, in addition to the increase in MATR for members of opposing blocs, we simulate a unilateral exit of the Eastern bloc from the WTO. This compromises the ability to trade between the Eastern and the Neutral bloc, because trade between these two regions would not benefit from the trade-creation benefits inherent to WTO. At the same time, we also assume that all trade agreements between the Eastern and Western bloc are canceled, which will further increase the restrictions between the Western and Eastern bloc. In this exercise, we assume that entering and exiting a trade agreement and the WTO have symmetric effects—this is a common approach in the literature (see Mayer et al., 2019; Campos and Timini, 2022).[20]

To calculate the increase in bilateral trade costs due to the Eastern bloc's exit of WTO, we "switch off" the WTO dummy for trade flows involving a country in the Eastern bloc and a country in any of the other two blocs:

$$\Delta WTO_{ij} = \begin{cases} -1 & \textit{if i and j are in WTO and exactly one is in the Eastern bloc} \\ 0 & \textit{otherwise} \end{cases}$$

To calculate the impact of eliminating free trade treaties, we define

$$\Delta TA_{ij} = \begin{cases} -1 & \textit{if i and j have a TA and they are in antagonizing blocs} \\ 0 & \textit{otherwise} \end{cases}$$

In this scenario, the change in trade costs is modeled as

$$\widehat{\tau}_{ij}^{-\theta} = \exp\left(-0.0627 \times \Delta MATR_{ij} + 0.216 \times \Delta WTO_{ij} + 0.365 \times \Delta TA_{ij}\right) \forall i, j.$$

where the point estimates are again taken from column 3 of Table 3.

As before, the model is solved by using these changes in trade costs and trade flow data for the year 2019 as inputs for the algorithm of the extended model described in Appendix B.

6.4. Trade between blocs

The main results from these two scenarios are illustrated in Table 5, which aggregates bilateral trade flows at the bloc level. In the first scenario, exports from the Eastern to the Western bloc are estimated to fall by 22% and exports from the Western to the Eastern bloc by roughly 33%. The neutral bloc benefits by attracting some of the trade volume reduction between the antagonizing blocs due to trade diversion. This bloc is predicted to increase its exports to the Eastern bloc by 6%, but its imports from the Eastern and Western blocs are reduced because of the drop in output in those regions. The typical country in the Eastern bloc suffers a larger welfare drop compared to the typical Western country, although this differs by country, as we will discuss later.[21]

In the second scenario, the withdrawal of the Eastern bloc from WTO implies that trade between the Neutral and Eastern bloc also falls sharply (dropping by 24%–25%). As a result, the Neutral bloc increases trade with the Western bloc due to the trade diversion effect. Notably, the increased costs of trading with the Eastern bloc, also raise trade by partners within the Neutral bloc. The welfare loss for the median Eastern bloc country increases by 1 percentage point relative to the first scenario. For the typical Western bloc country, welfare losses also increase, but only at 0.3 percentage points. In this scenario, the typical neutral country experiences a welfare loss that is only slightly below that of the typical Western country.

6.5. Trade at the country level

The results presented in the previous section mask significant heterogeneity across countries (see Tables A.4 and A.5 in the Appendix A for the full set of country-level results). In general, countries that were more open to begin with are more affected by a fragmentation between blocs, as are countries with strong trade relationships with countries belonging to the opposite bloc. South Korea, Chile and Peru are examples of this phenomenon, as their strong trade relationship with China is hampered by the fact that China belongs to the Eastern bloc while they are part of the Western bloc.[22] As a result, the effect on their trade flows and welfare is among the largest in the Western bloc. In the Eastern bloc, Hong Kong is in an analogous situation.

Geography also plays an important role, as countries that are in a region that aligns primarily with the opposing bloc experience a sharp increase in the average distance of their trade. Nicaragua and Bolivia are two examples. They belong to the Eastern bloc whereas virtually their neighbors on the American continent align with the Western bloc. Consequently, Nicaragua and Bolivia are placed,

[20] Glick and Rose (2016) show that this is the case for entering and exiting currency unions. In case of the WTO, the symmetry assumption translates in interpreting the WTO exit as the reestablishment of all tariffs and non-tariff measures eliminated with the entry in the WTO system.

[21] As described in detail in the Appendix B, by setting the supply elasticity $\psi = 0$, the model boils down to a standard trade model – in the spirit of Head and Mayer (2014). In this case, given that labor is the only factor of production, i.e., production will not depend on foreign inputs, welfare changes are more limited in size. This is a typical feature of these types of models that is further reinforced by the absence of features such as multiple factors of production, industries, elasticities of substitution; interlinkages among sectors of the economies or production steps (i.e., input-output linkages, global value chains); dynamic features (e.g., capital accumulation). This simpler version, however, is a standard approach in the literature, that interprets reported welfare losses as lower bound effects. However, welfare numbers obtained in our scenarios are large for these models. Indeed, to put our results in context, welfare losses deriving from trade fragmentation are up to approximately ten times - for the typical country in the Eastern bloc – and three times – for the typical country in the Western bloc – the size of the US and China welfare losses stemming from the 2018 trade war (Caliendo and Parro, 2022). These numbers correspond to approximately three times – for the typical country in the Eastern bloc – the size of Mexico's welfare gains from joining the North American Free Trade Agreement (NAFTA; Caliendo and Parro, 2015).

[22] In the case of South Korea, because it is part of value chains that process goods imported from China to be exported to the Western bloc, the effect might be even larger in the short term, as these value chains cannot be rebuilt that quickly. On the other hand, it is common to interpret the results from general equilibrium trade models with flexible prices and full employment of production factors –as the one we use- as indicative of long-term effects.

Table 5
Change in trade volumes between trade blocs.

Exports from/to	Western bloc	Eastern bloc	Neutral bloc	Welfare (median)
Scenario: Fragmentation into trade blocs				
Western bloc	0,9	-33,4	2,3	-0,5
Eastern bloc	-22,2	4,6	-1,9	-2,3
Neutral bloc	-0,8	5,8	0,2	0,0
Scenario: Fragmentation + WTO exit of the Eastern bloc				
Western bloc	2,5	-57,5	3,1	-0,8
Eastern bloc	-42,8	12,0	-25,2	-3,4
Neutral bloc	1,9	-24,2	3,2	-0,5

Note: Trade refers to international trade only. General equilibrium results assume a trade elasticity of 3.80 and a supply elasticity of 1.24. Welfare is reported for the median country in each trade bloc.

respectively, in the first and fourth position in the ranking of countries with the largest welfare drop in the Eastern bloc.

In the Neutral bloc, there are several countries that are hit hard in the more severe fragmentation scenario. The country most affected is Mongolia, which is landlocked between Russia and China. It is expected to suffer a welfare loss equivalent to 6.9% of annual per-capita consumption. Other countries that are affected in a special way in this scenario are Cambodia, Malaysia, Thailand, and Singapore, who are very reliant on trade with China, as well as a number of African and Middle Eastern countries who have strong trade links with China (Fig. 7).

6.6. Robustness checks

An important caveat that we addressed in the estimation of the impact of MATR is that we use GDP instead of gross production to construct domestic trade. We showed that the coefficient of our estimation is not significantly different from the one obtained from replicating our estimation with data from the OECD Trade in Value Added (TiVA) database, a database in which domestic trade can be constructed in a theory-consistent way, using gross production data. Despite of these prior empirical results, domestic trade might still be measured with error, bias the measure of initial domestic trade shares, and potentially affect our counterfactual exercises. To address this possibility, we replicate our counterfactual simulation exercises using the TiVA dataset. In Figs. A.1 and A.2 (in the appendix), we compare the results obtained for the intersection of 60 countries that are present in both datasets in the more severe scenario. The drop in trade flows is very similar when using both datasets. If anything, the fall in trade is predicted to be slightly more pronounced for Russia and China than in our baseline results. On the other hand, for welfare there are more cases for which results do not align perfectly, which implies that the measure of domestic trade does have an impact on the results for welfare. There does not seem to be a systematic bias, however, as there are some countries for whom the results in the TiVA dataset are larger and some for whom they are smaller. Specifically, Russia is expected to suffer a greater welfare loss when using TiVA data and China is expected to suffer a greater loss in our baseline results.

7. Conclusions

At least since the end of World War II, countries employed a mix of very diverse policies to restrict trade, including tariffs, quotas, import and export restrictions (such as import and export licenses, financing and foreign exchange requirements, etc.), as well as restrictions in the making of international payments and transfers (whose aim is often to support international trade and finance). Recent developments have reignited the interest in quantifying the effects of trade policy restrictions.

Our paper contributes to the literature by exploiting a new aggregate measure of trade restrictions (Estefania-Flores et al., 2022), that spans over the last 70 years and includes up to 157 countries. We use this new measure to estimate—in a theory-consistent structural gravity framework—the potential impact of a hypothetical scenario of trade fragmentation into three different trade blocs (Western, Eastern, Neutral). These blocs are defined according to how countries voted on the suspension of the rights of membership of the Russian Federation in the United Nations Human Rights Council on 7 April 2022.

In our preferred specification, we find that a one standard deviation increase in MATR implies the reduction of international (with respect to domestic) trade by approximately 31%. A fragmentation into three trade blocs (Western, Eastern, and Neutral) and the return of trade restrictions could have large effects on trade flows between trade blocs, reducing them between 22% and 57%, in the most extreme scenarios. Countries in the Eastern bloc would suffer the largest drop in welfare although, in the most extreme scenarios, individual countries in the Western and Neutral bloc are expected to suffer large welfare drops as well.

The focus of our analysis, however, is on the *between*-country trade and welfare effects of trade restrictions. This means that it does not shed light on the *within*-country effects, i.e., the distribution of these effects across sectors, firms, and households. Changes in trade costs are known to generate winners and losers and may modify the welfare calculations. For example, Antràs et al (2017) study an episode in which increases in inequality may remove around 20% of the gains from trade. More recently, Galle et al (2023) studied the "China shock" for the United States and found that although some groups may experience welfare changes that are of the opposite sign and up to four times as large as average welfare gains or losses, using a social welfare function with reasonable values for the inequality aversion parameter results in inequality-adjusted gains from trade not very different from those with no inequality aversion. In our scenarios, it is uncertain whether trade fragmentation would lead to more or less inequality, and the outcome could also be

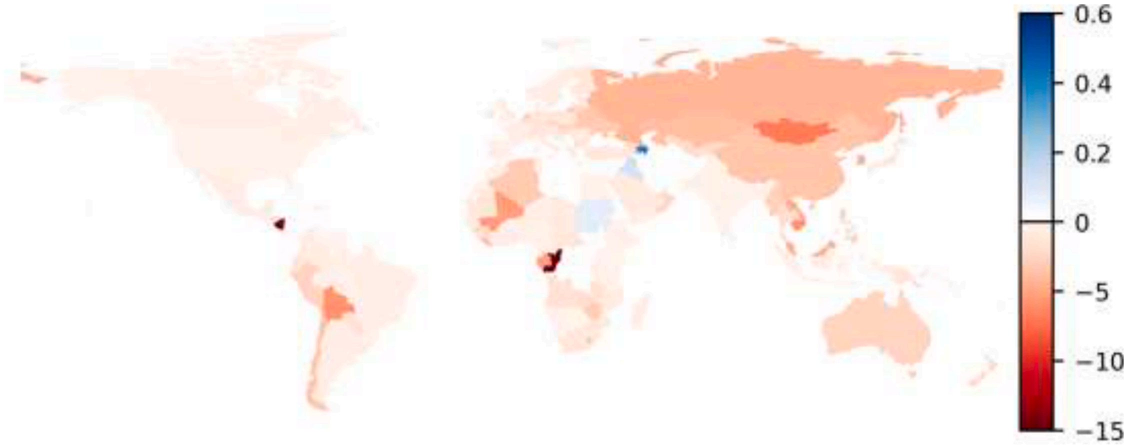

Fig. 7. Welfare in the more severe scenario.
Note: The figure shows the change in welfare in the scenario in which the world fragments into trade blocs and Eastern bloc exits the WTO. Countries shown in blue experience an improvement in welfare, and those in red a worsening. Units are percentage points. Welfare can be interpreted as the change in the real wage of workers in a country. The scales are different for positive and negative values, and the negative scale is capped at -15. The full set of results is available in Appendix A.5.

country-dependent, so it is difficult to determine the direction in which welfare change should be adjusted.

Moreover, because the model we use is static, and our simulations compare two steady-state equilibria with different trade costs, it does not shed light on the transition dynamics, or the economic costs that could accrue when moving from one equilibrium to the other. A point made by Costinot and Rodríguez-Clare (2018) is that various frictions in the reallocation of factors would lead to a slow adjustment to changes in trade costs, implying a lower trade elasticity in the short run and a higher trade elasticity in the long run. Losses from reallocation would then decline over time, so that the present value of losses would exceed losses calculated from the steady state.

An additional concern about using a static model is that it does not take into account so-called “dynamic gains from trade” accruing from capital accumulation or innovation. Ravikumar et al (2019) show that increased capital accumulation adds to the gains from

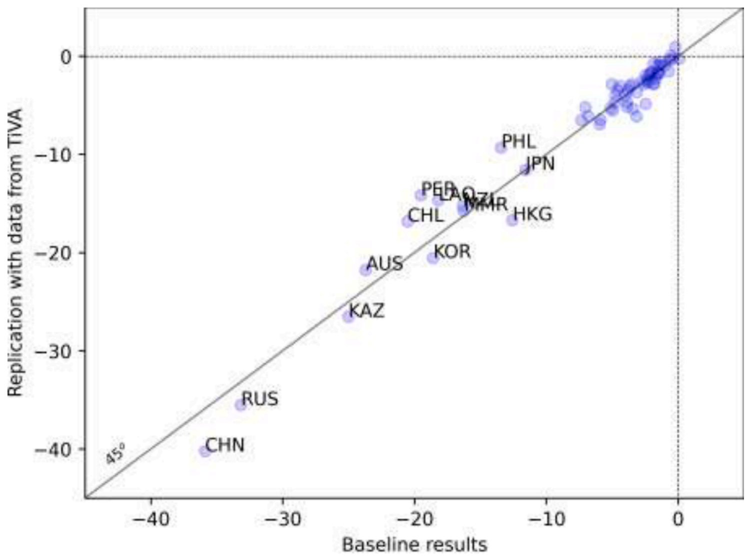

Fig. A.1. Impact on international trade in the severe scenario in a replication with data from TiVA.
Note: The figure compares our baseline results for the change in international trade flows in the severe fragmentation scenario with a replication that uses data from TiVA. The TiVA dataset contains data for only 66 countries, but has the advantage that domestic trade flows can be constructed from gross production instead of GDP. We show results for the set of 60 countries that appear in both datasets. Each point corresponds to a country. The horizontal dimension refers our baseline results and the vertical dimension to the results obtained with data from TiVA. The units on both axes are percentage points. Observations above the 45-degree line indicate that the drop in international trade is larger in our baseline results than in the replication using data from TiVA. Observations below the 45-degree line indicate that the drop in international trade is larger when using the TiVA database.

trade from liberalization. Also, based on recent work by Perla et al (2021) and Buera and Oberfield (2020), it can be argued that trade liberalization leads to more innovation. If trade policy becomes more restrictive, as in our fragmentation scenarios, the underlying forces that lead to more capital accumulation and more innovation would work in reverse, which would imply that the welfare losses calculated from a static model are underestimated.

Finally, our analysis considers exclusively the trade channel of increasing fragmentation. Other channels, such as the financial and banking channels, may strengthen the trade effects of trade restrictions. All these issues deserve further research and consideration.

Declaration of Competing Interest

None.

Appendix A: Tables and figures

Fig. A1, Fig. A2, Table A1, Table A2, Table A3, Table A4, Table A5

Appendix B

Our model is the benchmark Armington model with roundabout production described by Allen et al (2020). We first present a simpler model, without a positive supply elasticity, along the lines of the workhorse model of Head and Mayer (2014), and then introduce intermediate goods into the production function and indicate the differences with the simpler model.

Theoretical model without roundabout production

Consumers in country j consume $q_{ij} \geq 0$ units of the product produced in country i. Utility exhibits a constant elasticity of substitution (CES), $\sigma > 1$:

$$U_j = \left(\sum_i \alpha_{ij}^{\frac{1}{\sigma}} q_{ij}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

The coefficient $\alpha_{ij} \geq 0$ is a utility shifter that captures tastes for varieties. The price paid for good q_{ij} is p_{ij}. Total expenditure by consumers in country j is denoted by E_j. Utility maximization leads to the usual CES demand function:

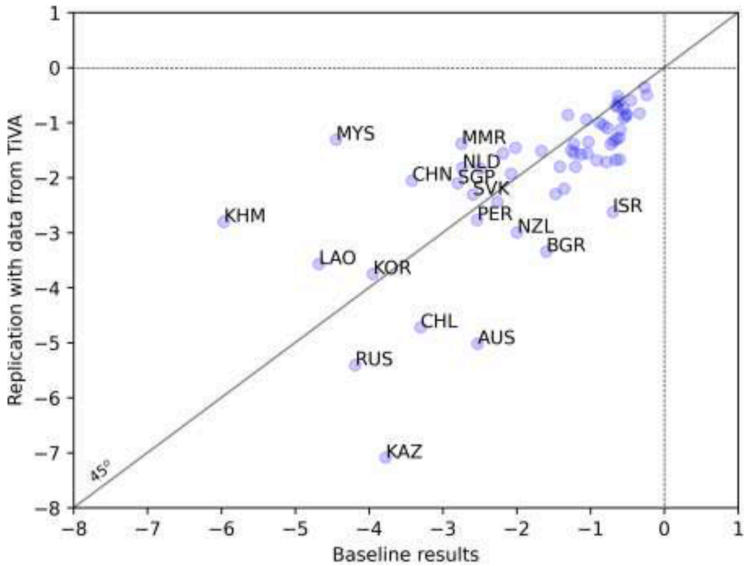

Fig. A.2. Impact on welfare in the severe scenario in a replication with data from TiVA.
Note: The figure compares our baseline results for the change in welfare in the severe fragmentation scenario with a replication that uses data from TiVA. The TiVA dataset contains data for only 66 countries, but has the advantage that domestic trade flows can be constructed from gross production instead of GDP. We show results for the set of 60 countries that appear in both datasets. Each point corresponds to a country. The horizontal dimension refers our baseline results and the vertical dimension to the results obtained with data from TiVA. The units on both axes are percentage points. Observations above the 45-degree line indicate that the welfare loss is larger in our baseline results than in the replication using data from TiVA. Observations below the 45-degree line indicate that the welfare loss is larger when using the TiVA database.

Table A.1
Descriptive statistics on main variables.

Variable	Source	Obs.	Mean	Std. dev.	Min.	Max.
Measure of Aggregate Trade Restrictions (MATR)	Estefania-Flores et. al. (2022)	8132	11.92	4.83	2	21
Bilateral Trade	CEPII gravity database	625,676	2,678,563	1.04E+08	0.00	1.99E+10
GATT dummy	CEPII gravity database	13,458	0.40	0.49	0	1
WTO dummy	CEPII gravity database	11,284	0.28	0.45	0	1
RTA dummy	CEPII gravity database	13,834	0.41	0.49	0	1
Distance (log)	CEPII gravity database	1036,438	8.75	0.82	2.26	9.89
Most Favored Nation Tariffs	World Bank WDI	359,438	8.07	11.01	0	421.5

Table A.2
MATR trade effects – Further robustness tests.

	Robustness test	$MATR_{ijt}$	Observations		Robustness test	$MATR_{ijt}$	Observations
1	Bretton Woods era (1949–1973)	-0.0450*** (0.0135)	61,246	20	MATR component: Payment Restrictions	-0.120*** (0.0380)	624,432
2	Post-Bretton Woods era (1974-)	-0.0657*** (0.0136)	562,378	21	MATR component: Import Restrictions	-0.121*** (0.0413)	624,432
3	Excluding Africa	-0.0648*** (0.0129)	595,346	22	MATR component: Export Restrictions	-0.200*** (0.0374)	624,073
4	Excluding Asia and Pacific	-0.0558*** (0.0131)	594,934	23	MATR component: Payment for Invisibles Restrictions	-0.106*** (0.0294)	621,593
5	Excluding Europe	-0.0547*** (0.0158)	578,887	24	MATR component: Exchange Measures and Multiple Currency Practices	-0.0758 (0.0894)	621,741
6	Excluding Middle East and Central Asia	-0.0655*** (0.0131)	608,274	25	MATR component: Prescription of Currency Req. and Restr. to Banknotes Imports and Exports	-0.155*** (0.0497)	624,432
7	Excluding Americas	-0.0680*** (0.0151)	592,288	26	Additional control: Normalized Financial Reform Index	-0.0305** (0.0133)	221,033
8	Only Advanced Economies	-0.0478*** (0.0125)	330,014	27	Additional control: Normalized Product Market Aggregate Index	-0.0654*** (0.0130)	221,033
9	Only Emerging Economies	-0.0945*** (0.0204)	577,263	28	Additional control: Normalized Capital Account Index	-0.0507*** (0.0137)	221,033
10	Using IMF (origin country) trade data	-0.0673*** (0.0133)	582,819	29	Additional control: Normalized Labor Market Index	-0.0614*** (0.0124)	202,401
11	Using COMTRADE (origin country) trade data	-0.0684*** (0.0116)	528,594	30	Additional control: quadratic form	-0.0758*** (#)	624,444
12	Using COMTRADE (destination country) trade data	-0.0560*** (0.0106)	573,598	31	Additional control: banking crises	-0.0638*** (0.0124)	299,629
13	Using BACI - CEPII trade data	-0.0439*** (0.0164)	386,296	32	Additional control: currency crises	-0.0622*** (0.0130)	331,454
14	Principal Factor from MATRV5	-0.307*** (0.0626)	555,123	33	Additional control: inflation crises	-0.0565*** (0.0126)	326,486
15	Principal Component from MATRV5	-0.121*** (0.0246)	555,123	34	Additional control: crises (banking, currency, or inflation)	-0.0638*** (0.0128)	299,396
16	Sum of coVII_A coVII_B coVII_C coVII_D coVII_E coVII_F	-0.102*** (0.0217)	624,432	35	Balanced panel	-0.0465*** (0.0147)	46,980
17	Sum of coII_* coIV_* coVII_* coIX_A_*	-0.0669*** (0.0125)	624,432	36	Zero-inflated	-0.0883*** (0.0229)	979,851
18	Sum of coIV_* coVII_* coIX_A_*	-0.0499*** (0.00810)	624,432	37	Domestic trade based on gross output data (1995–2018)	-0.0622*** (0.0189)	89,256
19	Sum of AREAER. All subcomponents	-0.0350*** (0.00667)	624,432				

Note: PPML regressions. The results reported in this table are derived from equations that are identical to our main specification (Column 3, Table 3), inclusive of the fixed effects considered (δ_{it}; γ_{jt}; ω_{ij}), apart from the changes indicated in each column title. Fixed effects and constant not reported for the sake of simplicity. Standard errors (in parentheses) are clustered at the exporter, importer and time level. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. # marginal effect calculated at the mean. Significance obtained by testing the difference from zero of the sum of the coefficients.

Table A.3
UN General Assembly resolution votes on the suspension of the rights of membership of the Russian Federation and MATR maximum values by country.

Advanced economies

Country	Vote	Max MATR	Date max. MATR	Country	Vote	Max MATR	Date max. MATR
AUS	Yes	17	1949–1958	ISR	Yes	18	1954–1961
AUT	Yes	16	1950–1952	ITA	Yes	17	1973–1975 | 1949–1960
BEL	Yes	16	1954	JPN	Yes	13	1950–1957
CAN	Yes	7	2005–2020	KOR	Yes	16	1968–1972 | 1955–1959
CHE	Yes	14	1950–1957 | 1965–1974	LVA	Yes	7	2006–2011
CZE	Yes	12	1991–1992	NLD	Yes	18	1952
DEU	Yes	18	1949–1952	NOR	Yes	15	1949–1972
DNK	Yes	13	1950–1952 | 1971–1972	NZL	Yes	13	1961–1971 | 1976–1978
ESP	Yes	17	1967–1978 | 1950–1959	PRT	Yes	16	1971–1976
EST	Yes	11	1993	SGP	Abstention	10	1965–1975
FIN	Yes	16	1961–1969 | 1955–1956	SVK	Yes	17	1981–1986
FRA	Yes	16	1957–1958	SVN	Yes	12	1993–1994
GBR	Yes	15	1949–1957 | 1965–1978	SWE	Yes	12	1956–1957 | 1966–1972
GRC	Yes	17	1949–1952	USA	Yes	5	1994–2013 | 1954–1968
IRL	Yes	17	1965				

Emerging economies

Country	Vote	Max MATR	Date Max. MATR	Country	Vote	Max MATR	Date Max. MATR
AGO	Abstention	18	2000 | 2013–2017 | 1989–1990	LBN	Non-voting	8	2015–2020 | 2001
ALB	Yes	13	2006–2008	LBR	Yes	13	1989–1990
ARE	Abstention	5	2004–2020	LKA	Abstention	20	1968–1976 | 1966
ARG	Yes	18	1971–1976 | 1964–1966	LSO	Abstention	16	2016–2020
ARM	Non-voting	10	1994 | 1992	MAR	Non-voting	18	1978–1987
ATG	Yes	13	2001–2020	MDA	Yes	16	1992
AZE	Non-voting	15	2008–2019	MDG	Abstention	18	1971–1972
BDI	No	17	1998	MDV	Abstention	9	1979
BEN	Non-voting	16	1987–1989	MEX	Abstention	14	1990
BFA	Non-voting	17	2005–2016	MLI	No	17	1963–1967 | 1971–1973
BGD	Abstention	19	2020	MMR	Yes	21	1990
BGR	Yes	15	1997–2000	MNG	Abstention	12	1991
BHR	Abstention	10	1972–1975	MOZ	Abstention	17	1984
BHS	Yes	14	2006–2020	MRT	Non-voting	18	1991–1992
BIH	Yes	16	2019	MWI	Yes	17	2002 | 1982–1987 | 2005 | 1968–1975
BLR	No	19	1998	MYS	Abstention	17	1957–1972
BLZ	Abstention	16	2002–2003 | 2005–2016	NAM	Abstention	16	1990–1994 | 2002–2016
BOL	No	16	1949–1955	NER	Abstention	19	1982–1984 | 1968–1977
BRA	Abstention	20	1949–1964	NGA	Abstention	16	2002–2004 | 1982
BRB	Abstention	16	1970–1993	NIC	No	15	1978–1985
BRN	Abstention	8	2009–2012	NPL	Abstention	18	2017–2020
BTN	Abstention	17	2012–2020	OMN	Abstention	7	1971–1972
BWA	Abstention	13	1996–1998 | 1970–1980	PAK	Abstention	19	1965–1991
CAF	No	17	1971–1973	PAN	Yes	6	1968–1996
CHL	Yes	18	1966–1968 | 1970–1972	PER	Yes	20	1974–1977
CHN	No	19	1982–1992	PHL	Yes	16	1949–1951
CIV	Yes	17	1994 | 2006–2016	PLW	Yes	6	2013–2020
CMR	Abstention	19	1968–1970 | 1963–1966	PNG	Yes	17	2001–2003
COG	No	19	1971–1973	POL	Yes	14	1989
COL	Yes	16	1949–1950	PRY	Yes	17	1950
CRI	Yes	19	1976–1979	QAT	Abstention	6	2004–2007 | 1972
DMA	Yes	17	1978–1985 | 1987–1996	ROU	Yes	18	1972–1988
DOM	Yes	18	1982–1986	RUS	No	19	1998–1999 | 2001
DZA	No	18	1963–1964	RWA	Non-voting	18	1973
ECU	Yes	17	1966–1984	SAU	Abstention	8	1957–1958
EGY	Abstention	19	1986–1989	SDN	Abstention	18	1969–1984
ETH	No	17	1997–2002	SEN	Abstention	17	1971–1973
FJI	Yes	17	1971–1978	SLB	Non-voting	15	2020
GAB	No	17	1968–1973 | 1963–1966	SLE	Yes	18	1962–1982
GEO	Yes	11	1992 | 2001–2003 | 2010–2011	SLV	Abstention	17	1981–1986
GHA	Abstention	20	1973–1974	TCD	Yes	18	1971–1973 | 1978–1988

(*continued on next page*)

Table A.3 (*continued*)

Emerging economies							
Country	Vote	Max MATR	Date Max. MATR	Country	Vote	Max MATR	Date Max. MATR
GIN	Non-voting	19	1975–1983	TGO	Abstention	17	2006
GMB	Abstention	14	1981–1984	THA	Abstention	16	1949–1955
GNB	Abstention	18	2006–2009	TJK	No	15	1993–1994 | 2015–2017 | 2000–2001 | 2020
GTM	Yes	18	1963–1972	TLS	Yes	4	2002 | 2011–2020
HND	Yes	16	1985–1987	TON	Yes	12	2018–2020
HRV	Yes	14	2001–2002 | 1992–1993	TUN	Abstention	21	1959–1969
HTI	Yes	13	1981–1983	TUR	Yes	17	1967–1979
HUN	Yes	15	1990	TUV	Yes	2	2011–2020
IDN	Abstention	19	1949–1961	TZA	Abstention	19	1964–1970
IND	Abstention	19	1950–1995 | 1998–2012	UGA	Abstention	18	1982–1983 | 1991
IRQ	Abstention	16	1998–2002 | 1994	UKR	Yes	18	2010–2017
JAM	Yes	18	1962–1966	URY	Yes	9	2007–2020
KAZ	No	18	1992	UZB	No	19	2001–2002
KEN	Abstention	17	1963–1972	VEN	Non-voting	17	2014–2017
KGZ	No	11	2011–2015	VUT	Abstention	6	2007–2020
KHM	Abstention	13	1963–1970 | 1993–2002 | 2010–2012 | 1960–1961	YEM	Abstention	14	1991–1993
KIR	Yes	3	2001–2020	ZAF	Abstention	16	2007–2008 | 2013–2020
KWT	Abstention	10	1963–1969	ZMB	Non-voting	17	1967–1972
LAO	No	17	1962–1974 | 1977–1987	ZWE	No	19	2002–2007

$$q_{ij} = \alpha_{ij} p_{ij}^{-\sigma} E_j P_j^{\sigma-1}, \tag{A.1}$$

where

$$P_j = \left(\sum_j \alpha_{ij} p_{ij}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

is the Dixit-Stiglitz price aggregator.

Each country i produces a single differentiated good using labor L_i, which is immobile across countries. Labor is inelastically supplied and commands the wage rate w_i. The production technology has constant returns to scale: $f(L_i) = A_i L_i$, where $A_i > 0$ is a country-specific productivity parameter. Under the assumption of perfect competition, factory prices equal the marginal costs:

$$p_i = \frac{w_i}{A_i}$$

Trade costs $\tau_{ij} \geq 1$ are specific to each country pair. By arbitrage in international markets, the price paid for the good of country i country j is

$$p_{ij} = \tau_{ij} p_i = \tau_{ij} \frac{w_i}{A_i}. \tag{A.2}$$

A country's total income equals the value of output and also total factor payments:

$$Y_i = p_i A_i L_i = w_i L_i$$

The trade deficit of a country equals the value of its imports minus the value of its exports, or the difference between its income and expenditure:

$$D_l \equiv \sum_{i \neq l} p_{il} q_{il} - \sum_{i \neq l} p_{lj} q_{lj} = (E_l - p_{ll} q_{ll}) - (Y_l - p_{ll} q_{ll}) \ = E_l - Y_l$$

The sum of trade deficits over all countries is zero in equilibrium:

$$\sum_i D_i = \sum_i (E_i - Y_i) = 0$$

Finally, market clearing in the goods market implies that the supply of a country's good is equal to total demand, including the resource cost of transporting goods to different destinations:

$$A_i L_i = \sum_j \tau_{ij} q_{ij}. \tag{A.3}$$

Table A.4
General equilibrium country-level results in the first scenario (fragmentation into three blocs).

Country	Eastern bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
NIC	-1,2	-27,5	3,1	-20,2	-4,7	-8,3
COG	3,1	-31,9	0,0	-5,1	-4,1	-7,2
HKG	6,0	-31,2	5,4	-6,2	-1,9	-3,4
BLR	3,4	-31,9	2,0	-8,4	-1,8	-3,2
BOL	-3,5	-39,8	1,9	-22,2	-1,7	-3,1
GAB	-0,5	-27,1	0,4	-9,2	-1,6	-2,8
RUS	3,3	-32,5	2,4	-19,3	-1,4	-2,5
DZA	-2,1	-32,1	1,2	-19,9	-1,4	-2,5
KAZ	2,8	-35,0	2,5	-15,5	-1,4	-2,4
UZB	4,6	-31,2	3,2	-11,9	-1,3	-2,3
MLI	3,4	-25,6	0,9	-8,0	-0,9	-1,6
CHN	4,8	-25,4	1,3	-14,8	-0,8	-1,5
KGZ	2,6	-17,6	1,9	-2,8	-0,5	-0,9
CAF	12,9	-20,9	28,5	-2,5	-0,4	-0,7
BDI	6,5	-35,0	6,8	-3,2	-0,3	-0,5
ZWE	5,3	-32,7	0,1	-4,1	-0,3	-0,5
LAO	2,3	-24,5	1,0	-1,1	-0,2	-0,4
ETH	10,4	-25,2	12,7	-2,5	-0,2	-0,3
TJK	4,1	-19,7	1,2	-1,2	-0,2	-0,3

Country	Neutral bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
KHM	-0,6	0,4	0,6	0,2	-0,2	-0,4
BRN	1,4	-2,2	0,1	-0,9	-0,2	-0,3
BLZ	0,1	0,2	0,4	0,2	0,0	-0,1
BGD	-1,7	0,3	0,1	-0,2	0,0	0,0
QAT	4,0	-1,5	0,9	0,0	0,0	0,0
LSO	-0,2	0,3	0,4	0,3	0,0	0,0
MDG	-0,9	0,3	0,3	0,1	0,0	0,0
NPL	-2,2	1,3	0,6	0,2	0,0	0,0
ARE	0,3	0,2	0,3	0,3	0,0	0,0
LBN	0,0	0,0	0,1	0,0	0,0	0,0
UGA	-1,3	1,1	0,3	0,2	0,0	0,0
PAK	-1,2	0,6	0,5	0,2	0,0	0,0
TUN	-0,3	0,0	-0,2	0,0	0,0	0,0
NGA	-0,8	0,2	0,5	0,1	0,0	0,0
BTN	-2,3	2,1	0,3	0,3	0,0	0,0
MDV	-1,9	2,3	0,2	0,3	0,0	0,0
RWA	-1,4	1,8	0,4	0,3	0,0	0,0
LKA	-1,0	1,1	0,1	0,3	0,0	0,0
MOZ	1,5	0,1	0,3	0,4	0,0	0,0
BFA	3,0	-0,3	0,2	0,0	0,0	0,0
TZA	-1,1	1,7	0,3	0,4	0,0	0,0
KEN	-1,3	1,4	0,3	0,4	0,0	0,0
VEN	3,5	0,5	-0,3	0,8	0,0	0,0
BWA	3,8	0,3	0,2	0,5	0,0	0,0
MAR	-0,6	0,4	0,2	0,2	0,0	0,0
BRB	-0,4	0,8	0,3	0,7	0,0	0,0
EGY	-0,6	1,1	0,1	0,5	0,0	0,0
NER	0,1	2,1	0,3	0,8	0,0	0,0
GHA	2,5	0,2	0,2	0,7	0,0	0,0
GNB	-1,0	0,9	0,3	0,5	0,0	0,0
IND	0,2	1,5	0,2	0,7	0,0	0,0
IDN	1,3	0,8	0,2	0,7	0,0	0,0
SAU	3,4	-0,6	0,3	0,6	0,0	0,0
BEN	1,7	1,4	0,3	0,8	0,0	0,0
IRQ	3,3	-0,4	0,0	0,7	0,0	0,0
GMB	2,6	0,4	0,5	0,9	0,0	0,0
CMR	3,0	0,6	0,4	1,1	0,0	0,0
TGO	1,7	0,6	0,3	0,6	0,0	0,1
BRA	3,1	0,7	0,3	1,4	0,0	0,1
AZE	1,4	0,1	0,0	0,4	0,0	0,1
SDN	4,3	1,2	0,3	0,9	0,0	0,1
YEM	3,2	1,0	0,7	1,4	0,0	0,1
KWT	1,5	0,2	0,2	0,5	0,0	0,1

(*continued on next page*)

Table A.4 (*continued*)

Country	Neutral bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
SLV	0,6	1,1	0,4	0,9	0,0	0,1
MEX	-0,5	1,1	0,5	0,9	0,0	0,1
ZAF	2,5	0,4	0,3	0,9	0,1	0,1
NAM	3,9	1,0	0,2	0,7	0,1	0,1
SEN	2,8	1,0	0,2	1,2	0,1	0,1
BHR	-1,4	1,4	0,3	0,7	0,1	0,1
ARM	1,5	0,7	0,1	1,0	0,1	0,1
THA	2,1	0,4	0,3	0,8	0,1	0,1
ZMB	2,7	1,4	0,4	1,4	0,1	0,2
GIN	3,7	0,3	-0,4	1,2	0,1	0,2
AGO	3,7	1,1	-0,7	2,0	0,2	0,3
OMN	4,7	-1,2	0,4	1,5	0,2	0,4
VUT	-1,6	3,1	1,0	1,8	0,2	0,4
SGP	3,1	1,0	0,1	1,2	0,3	0,5
MYS	3,2	0,3	0,1	1,0	0,3	0,6
MRT	5,1	1,0	0,1	1,7	0,3	0,6
SLB	3,8	4,0	-0,3	3,1	0,5	0,8
MNG	3,2	2,3	0,9	3,0	0,5	0,9

Country	Western bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
KOR	-34,2	1,6	0,5	-11,1	-1,2	-2,2
CHL	-40,7	0,0	-0,6	-13,3	-1,1	-2,0
SVK	-36,7	1,3	1,7	-2,0	-1,0	-1,7
LBR	-17,8	0,5	2,6	-2,9	-0,9	-1,7
NLD	-25,1	0,9	1,0	-2,2	-0,9	-1,7
PER	-44,9	0,8	-0,6	-13,5	-0,9	-1,6
AUS	-39,1	-0,2	0,1	-14,8	-0,8	-1,5
UKR	-17,0	2,2	-0,3	-3,8	-0,7	-1,3
LTU	-21,2	1,9	0,5	-1,8	-0,7	-1,3
HUN	-30,2	1,1	1,1	-1,7	-0,7	-1,2
CZE	-24,3	0,9	1,1	-1,3	-0,6	-1,2
GEO	-26,9	2,4	1,8	-4,7	-0,6	-1,0
NZL	-31,4	-0,4	-0,6	-9,0	-0,6	-1,0
PHL	-19,7	1,9	0,8	-5,3	-0,6	-1,0
MDA	-21,1	2,0	0,8	-3,1	-0,5	-1,0
PRY	-22,4	0,7	1,5	-5,5	-0,5	-1,0
MMR	-15,1	0,1	0,9	-5,1	-0,5	-0,9
CHE	-33,8	1,0	0,7	-2,9	-0,5	-0,9
FIN	-38,1	0,8	1,9	-4,7	-0,5	-0,9
SLE	-24,0	0,4	-0,5	-6,1	-0,5	-0,9
BEL	-31,7	0,8	0,4	-1,1	-0,5	-0,9
BGR	-24,9	1,1	0,7	-1,8	-0,5	-0,9
ECU	-30,1	0,4	-0,6	-6,1	-0,5	-0,8
EST	-23,7	1,2	0,6	-1,5	-0,5	-0,8
DEU	-40,9	0,8	1,4	-3,4	-0,5	-0,8
POL	-26,3	0,9	0,6	-2,0	-0,4	-0,7
HND	-27,2	1,1	0,9	-1,9	-0,4	-0,7
SVN	-23,7	0,7	0,2	-0,9	-0,3	-0,6
TUR	-23,6	1,1	0,6	-3,1	-0,3	-0,6
CRI	-29,9	0,9	0,5	-3,2	-0,3	-0,6
ROU	-32,9	0,7	0,9	-2,3	-0,3	-0,6
IRL	-46,3	1,5	1,9	-1,8	-0,3	-0,5
ITA	-35,3	0,7	0,6	-3,2	-0,3	-0,5
JPN	-23,2	1,5	0,3	-6,0	-0,3	-0,5
LVA	-18,2	1,4	-0,1	-0,7	-0,3	-0,5
ISR	-41,5	0,9	0,7	-5,0	-0,3	-0,5
AUT	-36,4	0,5	1,6	-1,7	-0,2	-0,4
TCD	-19,5	0,8	0,5	-6,0	-0,2	-0,4
GRC	-25,9	1,9	0,8	-2,3	-0,2	-0,4
MWI	-20,7	1,7	1,6	-1,9	-0,2	-0,4
COL	-21,4	0,8	0,6	-3,6	-0,2	-0,4
GTM	-28,6	1,1	0,8	-2,3	-0,2	-0,4
FRA	-33,5	0,4	0,6	-2,6	-0,2	-0,4
GBR	-29,1	0,8	0,3	-2,8	-0,2	-0,4
DNK	-29,9	0,6	0,9	-1,8	-0,2	-0,4

(*continued on next page*)

Table A.4 (*continued*)

Country	Western bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
SWE	-24,7	0,6	1,0	-1,5	-0,2	-0,3
ESP	-30,0	0,5	0,0	-1,9	-0,2	-0,3
BIH	-17,9	0,8	0,3	-0,8	-0,2	-0,3
NOR	-25,8	0,6	0,4	-1,6	-0,2	-0,3
DOM	-22,4	1,6	1,4	-1,8	-0,2	-0,3
PRT	-32,0	0,5	0,4	-1,4	-0,2	-0,3
PNG	-3,7	-0,6	-1,4	-1,5	-0,2	-0,3
ARG	-14,6	-0,3	0,4	-2,9	-0,2	-0,3
ALB	-20,2	1,0	0,6	-1,1	-0,1	-0,3
JAM	-26,4	1,0	0,7	-1,5	-0,1	-0,3
CIV	-13,5	0,6	0,8	-1,4	-0,1	-0,3
PLW	-18,1	2,7	1,9	-0,5	-0,1	-0,3
TLS	-21,9	7,1	5,8	0,1	-0,1	-0,2
HTI	-16,6	1,4	3,8	-1,3	-0,1	-0,2
CAN	-10,2	1,2	1,0	0,0	-0,1	-0,2
ATG	-18,2	0,9	0,3	-0,3	-0,1	-0,2
URY	-3,5	0,6	1,0	-0,4	-0,1	-0,1
FJI	-22,5	3,6	-1,1	-0,6	-0,1	-0,1
PAN	-16,1	0,5	0,4	-1,1	-0,1	-0,1
USA	-14,5	1,4	0,8	-1,5	-0,1	-0,1
HRV	-24,0	0,6	0,0	-0,4	-0,1	-0,1
DMA	-21,6	0,9	0,4	0,3	0,0	-0,1
TON	-21,3	3,5	-1,2	-0,2	0,0	-0,1
BHS	-8,2	0,7	1,0	0,4	0,0	0,0
TUV	-26,1	3,6	-1,2	0,4	0,1	0,1
KIR	-21,5	3,2	0,8	0,7	0,2	0,3

Note: Changes of trade flows with each of the three blocs and total trade flows are expressed in percentage points. Output and welfare changes are also expressed in percentage points. Countries in each bloc are ordered according to their welfare loss in the scenario. Calculations assume a trade elasticity of 3.8 and a supply elasticity of 1.24.

Definition of an equilibrium

Given preference parameters $\{\alpha_{ij}\}$ and σ, productivities $\{A_i\}$, labor endowments $\{L_i\}$, exogenous trade deficits $\{D_i\}$ that sum to zero, and trade costs $\{\tau_{ij}\}$, an equilibrium is defined as collection of allocations $\{q_{ij}\}$, goods prices in the destination country $\{p_{ij}\}$, and local wages $\{w_i\}$, such that

1 consumer demands are optimal (A.1),
2 prices satisfy the no-arbitrage condition (A.2),
3 and goods markets clear (A.3).

Comparative statics

Comparative statics across equilibria are obtained numerically by solving a system of equations that depends only on the elasticity of substitution σ, the exogenous change assumed for trade deficits, and on observed trade flows. Variables with hats indicate the ratio of the value of a variable in a counterfactual equilibrium and the baseline equilibrium.

Algorithm for comparative statics

The inputs for the comparative statics exercise are the matrix of baseline trade flows $\{X_{ij}\}$, the value taken by the parameter σ, and a matrix of exogenous changes in trade costs $\{\widehat{\tau}_{ij}\}$. The comparative statics exercise consists of the following well-known steps (Head and Mayer, 2014; Baier et al, 2019):

1 Calculate $Y_i = \sum_j X_{ij}$ for all i and $E_j = \sum_i X_{ij}$ for all j.
2 Calculate trade shares $\lambda_{ij} = \frac{X_{ij}}{E_j}$ for all combinations of i and j.
3 Solve for wage changes $\widehat{w}_i$ in the system of equations

$$\widehat{w}_i = \frac{1}{Y_i} \sum_j \frac{\lambda_{ij} \left(\widehat{w}_i \widehat{\tau}_{ij}\right)^{1-\sigma}}{\sum_k \lambda_{kj} \left(\widehat{w}_k \widehat{\tau}_{kj}\right)^{1-\sigma}} \widehat{w}_j E_j, \ \forall i$$

Table A.5
General equilibrium country-level results in the second scenario (fragmentation + WTO exit of the Eastern bloc).

Country	Eastern bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
NIC	10,6	-55,8	-23,5	-45,2	-10,4	-18,0
COG	5,6	-49,2	-24,3	-15,3	-9,6	-16,7
HKG	18,9	-50,5	-21,5	-12,6	-3,7	-6,5
BOL	0,5	-61,7	-27,2	-42,4	-3,3	-5,8
MLI	9,1	-49,2	-26,6	-30,2	-3,0	-5,4
GAB	-0,5	-48,9	-28,0	-20,4	-3,0	-5,3
LAO	5,2	-49,4	-26,8	-18,2	-2,6	-4,7
RUS	4,5	-51,4	-22,0	-33,2	-2,3	-4,2
KAZ	3,5	-52,9	-22,5	-25,0	-2,1	-3,8
CHN	13,2	-48,9	-26,0	-35,9	-1,9	-3,4
BLR	3,6	-35,9	4,6	-9,4	-1,8	-3,3
DZA	0,1	-39,7	2,1	-24,2	-1,7	-3,1
ZWE	-1,1	-58,1	-23,6	-25,2	-1,6	-2,8
KGZ	2,0	-40,2	-30,8	-9,8	-1,2	-2,2
UZB	6,6	-31,5	1,9	-11,2	-1,2	-2,1
BDI	39,3	-47,6	-9,8	-9,9	-0,9	-1,6
CAF	39,5	-29,9	19,7	-5,6	-0,7	-1,3
TJK	6,5	-44,3	-30,5	-6,7	-0,6	-1,1
ETH	14,9	-25,5	11,9	-1,8	-0,2	-0,3
Country	Neutral bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
MNG	-23,8	1,6	0,1	-17,9	-3,9	-6,9
KHM	-22,2	2,6	5,9	-3,2	-3,3	-6,0
MYS	-25,4	4,6	4,6	-3,9	-2,5	-4,4
SGP	-24,3	2,5	3,3	-3,5	-1,6	-2,8
SLB	-23,6	3,5	1,6	-9,8	-1,4	-2,5
OMN	-23,5	2,6	1,4	-6,6	-1,2	-2,2
ARM	-25,4	2,8	2,1	-10,5	-1,2	-2,1
GIN	-26,3	1,9	6,1	-6,4	-1,2	-2,1
KWT	-26,8	0,9	2,8	-4,0	-1,2	-2,1
THA	-26,9	2,7	3,4	-4,8	-1,1	-2,0
ZMB	-24,9	1,2	1,8	-7,6	-1,1	-2,0
ARE	-25,9	1,5	2,2	-2,7	-0,9	-1,7
AGO	-21,8	1,3	9,1	-8,8	-0,9	-1,7
TGO	-25,5	2,1	1,2	-2,5	-0,8	-1,5
BRN	-26,1	-2,4	2,6	-3,4	-0,8	-1,4
MRT	-25,3	1,8	0,7	-3,6	-0,7	-1,3
ZAF	-26,2	2,2	2,0	-5,0	-0,7	-1,2
SAU	-27,2	0,8	3,2	-4,8	-0,5	-0,9
MOZ	-28,1	1,7	2,1	-1,6	-0,5	-0,9
SEN	-24,8	1,2	1,8	-4,3	-0,5	-0,8
QAT	-26,2	-0,8	3,9	-2,8	-0,4	-0,8
GMB	-26,1	-1,5	1,4	-5,5	-0,4	-0,7
GHA	-27,9	1,8	2,4	-4,0	-0,4	-0,6
MDG	-26,5	1,5	3,2	-2,2	-0,4	-0,6
IDN	-27,8	2,4	2,8	-5,1	-0,4	-0,6
YEM	-26,9	-1,7	-0,9	-7,9	-0,3	-0,6
TUN	-11,9	1,6	2,0	-0,5	-0,3	-0,6
MEX	-25,0	2,9	4,8	-0,2	-0,3	-0,6
NER	-26,0	5,0	3,1	-5,1	-0,3	-0,6
BRA	-27,1	1,8	2,5	-7,3	-0,3	-0,6
SLV	-23,1	3,6	4,2	-0,4	-0,3	-0,5
BLZ	-20,0	3,0	3,7	0,0	-0,3	-0,5
CMR	-26,1	2,4	2,6	-3,9	-0,3	-0,5
MAR	-22,7	2,1	2,0	-0,6	-0,3	-0,5
BGD	-24,9	1,4	5,2	-2,6	-0,2	-0,4
LKA	-22,2	3,1	4,1	-1,6	-0,2	-0,4
PAK	-25,1	2,4	5,3	-2,4	-0,2	-0,3
RWA	-23,0	6,0	3,9	-0,5	-0,2	-0,3
NGA	-26,1	1,5	0,1	-3,0	-0,2	-0,3
NAM	-26,7	2,4	1,7	-0,5	-0,2	-0,3
BEN	-26,3	2,2	2,8	-1,9	-0,2	-0,3
TZA	-21,2	4,5	3,2	-2,4	-0,2	-0,3
EGY	-21,8	3,7	3,4	-0,8	-0,2	-0,3

(continued on next page)

Table A.5 (*continued*)

Country	Neutral bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
IND	-25,6	3,5	3,2	-1,7	-0,1	-0,3
UGA	-20,5	4,1	3,3	-0,9	-0,1	-0,3
MDV	-25,4	5,6	5,1	0,3	-0,1	-0,3
BHR	-26,0	2,9	1,4	0,1	-0,1	-0,2
NPL	-20,9	5,7	4,8	0,5	-0,1	-0,2
KEN	-24,1	4,3	4,5	-0,7	-0,1	-0,2
GNB	-27,2	2,3	2,0	0,1	-0,1	-0,2
BRB	-26,2	2,7	2,8	-0,1	-0,1	-0,2
BFA	-20,6	0,7	2,4	0,2	-0,1	-0,1
VEN	-27,7	2,6	4,2	-3,5	-0,1	-0,1
VUT	-30,5	4,7	0,7	-0,5	0,0	-0,1
BWA	-23,2	1,6	2,7	0,8	0,0	0,0
LBN	8,1	-1,0	0,4	0,6	0,0	0,0
BTN	4,9	3,9	1,3	1,4	0,0	0,0
SDN	4,0	1,5	1,4	1,7	0,0	0,1
IRQ	2,0	1,1	2,1	1,6	0,1	0,1
LSO	-29,3	3,5	2,5	1,3	0,1	0,2
AZE	5,6	1,9	1,2	2,6	0,2	0,4

Country	Western bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
KOR	-60,3	3,8	3,1	-18,6	-2,2	-3,9
LBR	-37,7	2,3	6,6	-5,1	-1,8	-3,3
CHL	-65,8	1,5	1,2	-20,5	-1,8	-3,3
UKR	-43,0	4,6	1,8	-9,8	-1,8	-3,2
MMR	-51,0	3,5	3,3	-16,3	-1,5	-2,7
NLD	-42,9	2,8	5,0	-2,4	-1,5	-2,7
SVK	-54,9	3,2	3,5	-1,8	-1,4	-2,6
PER	-68,2	2,4	1,1	-19,5	-1,4	-2,5
AUS	-65,0	0,8	2,3	-23,7	-1,4	-2,5
PHL	-50,3	4,0	3,3	-13,4	-1,4	-2,5
LTU	-37,1	4,0	1,9	-2,6	-1,3	-2,3
MDA	-47,0	4,6	2,7	-6,8	-1,2	-2,2
CZE	-44,9	2,8	3,0	-1,5	-1,2	-2,2
HUN	-48,7	2,9	3,2	-1,6	-1,2	-2,1
GEO	-54,5	5,9	6,8	-8,5	-1,1	-2,1
NZL	-60,6	0,5	1,3	-16,3	-1,1	-2,0
PRY	-41,8	2,3	5,5	-8,9	-0,9	-1,7
CHE	-59,9	2,5	2,5	-4,4	-0,9	-1,7
SLE	-45,5	1,9	1,1	-10,5	-0,9	-1,6
BGR	-44,2	2,9	1,7	-2,5	-0,9	-1,6
EST	-41,5	2,9	1,1	-1,9	-0,8	-1,5
PNG	-31,8	2,5	-0,9	-6,5	-0,8	-1,4
ECU	-51,5	1,8	1,5	-9,5	-0,8	-1,4
FIN	-54,5	2,3	2,5	-5,9	-0,8	-1,4
HND	-50,7	2,7	3,2	-2,9	-0,7	-1,3
BEL	-49,2	2,3	2,6	-0,4	-0,7	-1,3
POL	-44,3	2,6	2,8	-2,3	-0,7	-1,3
SVN	-45,1	2,3	2,2	-0,7	-0,7	-1,2
DEU	-57,8	2,2	2,4	-3,9	-0,7	-1,2
CRI	-56,5	2,6	3,3	-5,0	-0,6	-1,1
TUR	-41,6	3,0	1,8	-4,6	-0,6	-1,1
JPN	-46,8	3,3	2,2	-11,6	-0,6	-1,0
LVA	-35,5	3,1	0,7	-1,0	-0,6	-1,0
TCD	-44,6	1,5	3,3	-13,2	-0,5	-0,9
ROU	-49,9	2,2	2,1	-2,3	-0,5	-0,9
ITA	-52,4	2,0	2,0	-3,8	-0,5	-0,8
URY	-32,9	2,6	2,2	-7,2	-0,4	-0,8
IRL	-62,9	3,0	2,8	-1,5	-0,4	-0,8
COL	-43,9	2,4	2,6	-6,8	-0,4	-0,8
MWI	-44,4	3,4	4,7	-3,3	-0,4	-0,7
AUT	-54,5	1,9	2,3	-1,5	-0,4	-0,7
ISR	-57,9	2,4	1,8	-6,0	-0,4	-0,7
SWE	-47,3	1,9	1,6	-2,2	-0,4	-0,7
CIV	-38,6	2,5	1,9	-3,7	-0,4	-0,7
GRC	-42,6	4,1	3,5	-2,7	-0,4	-0,7

(*continued on next page*)

Table A.5 (*continued*)

Country	Western bloc Trade Eastern	Western	Neutral	Total	Output	Welfare
ARG	-40,7	0,9	1,5	-7,0	-0,4	-0,7
DNK	-49,8	2,0	1,5	-2,1	-0,4	-0,7
GBR	-47,4	2,3	1,9	-3,6	-0,3	-0,6
FRA	-52,0	1,7	1,6	-3,1	-0,3	-0,6
CAN	-35,8	2,7	2,6	-1,3	-0,3	-0,6
GTM	-47,6	3,2	2,9	-2,6	-0,3	-0,6
ALB	-40,6	2,9	3,9	-1,4	-0,3	-0,6
NOR	-45,9	2,2	1,8	-1,9	-0,3	-0,6
DOM	-41,4	4,0	5,4	-2,2	-0,3	-0,5
ESP	-47,7	1,9	1,9	-2,0	-0,3	-0,5
PRT	-49,9	1,7	1,2	-1,3	-0,3	-0,5
HTI	-35,5	2,9	10,5	-2,5	-0,2	-0,4
JAM	-46,0	3,1	3,9	-1,3	-0,2	-0,4
BHS	-7,4	0,2	-7,9	-1,4	-0,2	-0,4
USA	-37,8	3,1	2,4	-4,0	-0,2	-0,3
PAN	-40,1	1,7	1,4	-2,4	-0,2	-0,3
FJI	-43,4	5,8	2,8	-0,7	-0,2	-0,3
ATG	-38,2	2,7	1,2	0,2	-0,2	-0,3
PLW	-13,9	2,0	4,9	-0,2	-0,1	-0,3
DMA	-41,2	1,9	0,0	0,7	-0,1	-0,3
HRV	-44,0	1,9	2,2	0,1	-0,1	-0,2
BIH	-12,9	1,7	2,2	0,5	-0,1	-0,2
TLS	-21,1	6,8	5,8	0,2	-0,1	-0,2
TON	-42,4	5,8	3,2	0,1	-0,1	-0,1
TUV	-24,3	3,8	0,5	1,5	0,3	0,5
KIR	-20,2	4,2	2,2	2,0	0,5	0,9

Note: Changes of trade flows with each of the three blocs and total trade flows are expressed in percentage points. Output and welfare changes are also expressed in percentage points. Countries in each bloc are ordered according to their welfare loss in the scenario. Calculations assume a trade elasticity of 3.8 and a supply elasticity of 1.24.

with the normalization $\sum_i \widehat{w}_i = 0$.

Calculate the change in trade shares as

$$\widehat{\lambda}_{ij} = \frac{\left(\widehat{w}_i \widehat{\tau}_{ij}\right)^{1-\sigma}}{\sum_k \lambda_{kj}\left(\widehat{w}_k \widehat{\tau}_{kj}\right)^{1-\sigma}}$$

for all combinations of i and j.

1 For any particular country j, calculate the change in welfare using the formula

$$\widehat{W}_j = \widehat{\lambda}_{jj}^{-\frac{1}{\sigma-1}}$$

Theory-consistent estimation of the model

After multiplying both sides by p_{ij} to obtain nominal trade flows, and using the fact that the exponential function and the logarithm are inverse functions, the demand function in Eq. (A.1) can be rewritten as

$$p_{ij}q_{ij} = \exp\left(\ln\alpha_{ij} + \ln p_{ij}^{1-\sigma} + \ln E_j P_j^{\sigma-1}\right)$$

Using the relation in Eq. (A.2.), prices satisfy $p_{ij} = \tau_{ij}\frac{w_i}{A_i}$, so that in an equilibrium the equation can be rewritten as

$$p_{ij}q_{ij} = \exp\left(\ln\alpha_{ij} + \ln\tau_{ij}^{1-\sigma} + (1-\sigma)\ln\frac{w_i}{A_i} + \ln E_j P_j^{\sigma-1}\right)$$

After defining terms for nominal trade flows $X_{ij} \equiv p_{ij}q_{ij}$, exporter fixed effects $\delta_i \equiv (1-\sigma)\ln\frac{w_i}{A_i}$, importer fixed effects $\gamma_j \equiv \ln E_j P_j^{\sigma-1}$, and bilateral fixed effects $\omega_{ij} \equiv \ln\alpha_{ij}$, the equation is brought to a form in which all elements on the right hand side, except trade costs, are replaced by fixed effects:

$$X_{ij} = \exp\left(\ln\tau_{ij}^{1-\sigma} + \delta_i + \gamma_j + \omega_{ij}\right)$$

Adding the time dimension, to make use of the panel structure of the data, the equation becomes

$$X_{ijt} = \exp\left(\ln\tau_{ijt}^{1-\sigma} + \delta_{it} + \gamma_{jt} + \omega_{ijt}\right)$$

We assume that tastes for varieties (α_{ij}) are time-invariant and write ω_{ij} instead of ω_{ijt}. Finally, to obtain the estimating equation we specify how trade costs depend on observables. In our implementation, we specify trade costs as a function of MATR and various explanatory factors contained in a vector Z:

$$\ln\tau_{ijt}^{1-\sigma} = \beta_0 + \beta_1 MATR_{ijt} + \psi Z'_{ijt}$$

This implies the specification in Eq. 1 in the main text.

Extension: theoretical model with a positive supply elasticity

In the theoretical model described above the supply elasticity is zero. In our general equilibrium simulations, we use a more general model that features a positive supply elasticity. We use the model described by Allen et al (2020), which modifies the production function to use intermediate inputs I_i, which are a CES aggregate of home and foreign goods with the same elasticity of substitution as that of consumers. This way of introducing intermediates into the production function is sometimes called “roundabout production”.

The production function in the extended model is

$$f(L_i, I_i) = (A_i L_i)^{\zeta} I_i^{1-\zeta}.$$

The parameter $\zeta \in (0,1]$ is the share of labor input in the production function. The model in the previous sections corresponds to the special case $\zeta = 1$.

The derivation of the equilibrium equations is more involved in this case and we refer the reader to appendix B in Allen et al (2020), in particular to Proposition 4 in Appendix B.9, for all the steps of the derivation. The algorithm for comparative now contains a larger set of endogenous variables that need to be solved for in step 3. Define the trade elasticity $\theta = \sigma - 1 > 0$ and the supply elasticity $\psi = \frac{1-\zeta}{\zeta} \geq 0$. The algorithm in terms of these constants is the following:

1 Calculate $Y_i = \sum_j X_{ij}$ for all i and $E_j = \sum_i X_{ij}$ for all j.

2 Calculate trade shares $\lambda_{ij} = \frac{X_{ij}}{E_j}$ for all combinations of i and j.

3 Solve for price changes ($\hat{p}_i$, $\hat{P}_i$) in the system of equations

$$\hat{p}_i^{1+\theta+\psi}\hat{P}_i^{-\psi} = \frac{1}{Y_i}\sum_j \lambda_{ij}\hat{\tau}_{ij}^{-\theta}\ \hat{P}_j^{\theta}\hat{p}_j\left(\hat{p}_j/\hat{P}_j\right)^{\psi} E_j,\ \forall i$$

$$\hat{P}_i^{-\theta} = \sum_j \lambda_{ji}\hat{\tau}_{ji}^{-\theta}\ \hat{p}_j^{-\theta},\ \forall i$$

with a price normalization (Allen et al, 2020, Condition 6).

Calculate the change in trade shares as

$$\hat{\lambda}_{ij} = \hat{\tau}_{ij}^{-\theta}\ \hat{p}_i^{-\theta}\hat{P}_j^{\theta}$$

for all combinations of i and j.

1 For any particular country j, calculate the change in real output using the formula:

$$\hat{Q}_j = \left(\hat{p}_j/\hat{P}_j\right)^{\psi}$$

and the change in welfare using the formula:

$$\hat{W}_j = \left(\hat{p}_j/\hat{P}_j\right)^{1+\psi}.$$

The case of autarky with a positive supply elasticity

In the limit, if country i moves to complete autarky, then $\widehat{\tau}_{ij}$ goes to infinity if $i \neq j$ and is equal to one otherwise. Realizing that (because the trade elasticity is positive) $\widehat{\tau}_{ij}^{-\theta} \rightarrow 0$ whenever $i \neq j$, and assuming that trade is initially balanced, both equations in step 3 of the algorithm for country i simplify to the following relationship for prices:

$$(\widehat{p}_i / \widehat{P}_i) = \lambda_{ii}^{\frac{1}{\theta}}.$$

This implies that, in the limit, the variation in welfare of the country moving to autarky is

$$\widehat{W}_i = \lambda_{ii}^{\frac{1+\psi}{\theta}}.$$

For all other countries, their change in trade flows and welfare can be computed numerically with the usual algorithm, by setting their trade costs with the autarkic country to a large enough number.

References

Aiyar, S; J. Chen; C. Ebeke; R. Garcia-Saltos; T. Gudmundsson; A. Ilyina; A. Kangur; T. Kunaratskul; S. Rodriguez; M. Ruta; T. Schulze; G. Soderberg; and J.P. Trevino (2023). "Geoeconomic fragmentation and the future of multilateralism", IMF Staff Discussion Note, 2023/01.

Alesina, A.F., Furceri, D., Ostry, J.D., Papageorgiou, C., Quinn, D.P., 2020. Structural Reforms and Elections: Evidence from a World-Wide New Dataset, NBER Working Papers 26720, National Bureau of Economic Research, Inc. In: .

Allen, T., Arkolakis, C., Takahashi, Y., 2020. Universal gravity. J. Polit. Econ. 128 (2), 393–433.

Anderson, J.E., Van Wincoop, E., 2003. Gravity with gravitas: a solution to the border puzzle. Am. Econ. Rev. 93, 170–192.

Antràs, P, de Gortari, A., Itskhoki, O., 2017. Globalization, inequality and welfare. J. Int. Econ. 108, 387–412.

Arkolakis, C., Costinot, A., Rodriguez-Clare, A., 2012. New trade models, same old gains? Am. Econ. Rev. 102, 94–130.

Armington, P., 1969. A theory of demand for products distinguished by place of production. Int. Monetary Fund Staff Papers 16, 159–176.

Baier, S.L., Bergstrand, J.H., 2007. Do free trade agreements actually increase members' international trade? J. Int. Econ. 71, 72–95.

Baier, S.L., Yotov, Y.V., Zylkin, T., 2019. On the widely differing effects of free trade agreements: lessons from twenty years of trade integration. J. Int. Econ. 116, 206–226.

Baier, S., Bergstrand, J., Clance, M., 2018. Heterogeneous effects of economic integration agreements. J. Dev. Econ. 135, 587–608.

Bajzik, J., Havranek, T., Irsova, Z., Schwarz, J., 2020. Estimating the Armington elasticity: the importance of study design and publication bias. J. Int. Econ. 127, 103383.

Baldwin, R., Taglioni, D., 2007. Trade effects of the euro: a comparison of estimators. J. Econ. Integr. 22, 790–818.

Bergstrand, J.H., Larch, M., Yotov, Y.V., 2015. Economic integration agreements, border effects, and distance elasticities in the gravity equation. Eur. Econ. Rev. 70, 307–327.

Buera, F.J., Oberfield, E., 2020. The global diffusion of ideas. Econometrica 88 (1), 83–114.

Cabrillac, B., Al-Haschimi, A., Babecka-Kurcharcukova, O., Borin, A., Bussiere, M., Cezar, R., Derviz, A., Dimitropoulou, D., Ferrara, L., Gatcher, M., Gaulier, G., Hukkinen, J., Keeney, M., Lodge, D., Mancini, M., Marsilli, C., Martinez-Martin, J., Mroczek, W., Muck, J., Pavlova, E., Rariga, J., Salasevicius, J., Santabarbara, D., Skudelny, F., Slopek, U., Steingress, W., Tuckett, A., van Horen, N., van Limbergen, D., Walravens, L., Worz, J., 2016. Understanding the weakness in global trade – what is the new normal?. In: ECB Occasional Paper Series n.178, September.

Caliendo, L., Parro, F., 2015. Estimates of the trade and welfare effects of NAFTA. Rev. Econ. Stud. 82, 1–44.

Caliendo L. and F. Parro (2022), "Trade policy", in G. Gopinath, E. Helpman, and K. Rogoff (eds.) *Handbook of International Economics*, Vol. 5, pp. 219–225, Elsevier.

Campos, R., Timini, J., 2022. Unequal trade, unequal gains: the heterogeneous impact of MERCOSUR. Appl. Econ. forthcoming.

Campos, R., Timini, J., Vidal, E., 2021. Structural gravity and trade agreements: does the measurement of domestic trade matter? Econ. Lett. 208, 110080.

Campos R., S. Pienknagura, J. Timini (forthcoming), "How far has globalization gone? (and what is behind it)", Banco de España Working Paper, forthcoming.

Cerdeiro, D., Johannes, E., Mano, R., Muir, D., Peiris, S., 2021. Sizing up the effects of technological decoupling. In: *IMF Working Papers*, 21/69.

Costinot, Arnaud, and Andrés Rodríguez-Clare. 2018. "The US Gains from Trade: Valuation Using the Demand for Foreign Factor Services." Journal of Economic Perspectives, 32 (2): 3-24.

Dekle, Robert, Eaton, Jonathan, Kortum, Samuel, 2007. The American Economic Review, 97 (97), 351–355.

Disdier, A., Fugazza, M., 2020. A Practical Guide to the Economic Analysis of Non-Tariff Measures. UNCTAD-WTO.

Egger, P.H., Tarlea, F., 2015. Multi-way clustering estimation of standard errors in gravity models. Econ. Lett. 134, 144–147.

Egger, P.H., Larch, M., Nigai, S., Yotov, Y.V., 2021. Trade costs in the global economy: measurement, aggregation and decomposition. In: World Trade Organization Staff Working Paper ERSD-2021-2.

Eichengreen, B., Irwin, D.A., 1995. Trade blocs, currency blocs and the reorientation of world trade in the 1930s. J. Int. Econ. 38, 1–24.

Estefania-Flores, J., Furceri, D., Hannan, S.A., Ostry, J.D., Rose, A.K., 2022. A measurement of aggregate trade restrictions and their economic effects. In: IMF Working Paper No. 2022/001.

Fajgelbaum, P., Khandelwal, A., 2021. The economic impacts of the US-China trade war. In: NBER Working Paper Series n. 29315, September.

Fally, T., 2015. Structural gravity and fixed effects. J. Int. Econ. 97, 76–85.

Felbermayr, G.J., Gröschl, J., Steininger, M., 2022. Quantifying Brexit: from ex post to ex ante using structural gravity. Rev. World Econ. 158, 401–465.

Felbermayr, G.J., Larch, M., Yalcin, E., Yotov, Y.V., 2020. On the heterogeneous trade and welfare effects of GATT/WTO membership. In: CESifo Working Paper Series No. 8555.

Galle, S., Rodríguez-Clare, A., Yi, M., 2023. Slicing the pie: quantifying the aggregate and distributional effects of trade. Rev. Econ. Stud. 90 (1), 331–375. January.

Georgieva, K., Gopinath, G., Pazarbasioglu, C., 2022. Why We Must Resist Geoeconomic Fragmentation—And How. IMF Blog. https://blogs.imf.org/2022/05/22/why-we-must-resist-geoeconomic-fragmentation-and-how/.

Gourinchas, P.O., 2022. Shifting Geopolitical Tectonic Plates. IMF Finance and Development. https://www.imf.org/en/Publications/fandd/issues/2022/06/shifting-geopolitical-tectonic-plates-straight-talk.

Gowa, J., Hicks, R., 2013. Politics, institutions, and trade: lessons of the interwar era. Int. Organ. 67, 439–467.

Head K. and T. Mayer (2014), "Gravity equations: workhorse, toolkit, and cookbook", in G. Gopinath, E. Helpman, and K. Rogoff (eds.), *Handbook of International Economics*, Vol. 4, pp. 131–195, Elsevier.

Head, K., Mayer, T., Ries, J., 2010. The erosion of colonial trade linkages after independence. J. Int. Econ. 81, 1–14.

Heid, B., Larch, M., Yotov, Y.V., 2021. Estimating the effects of non-discriminatory trade policies within structural gravity models. Canadian J. Econ./Rev. Canadienne d'Econ. 54, 376–409.

Huo, Z., Levchenko, A., Pandalai-Nayar, N., 2019. International comovement in the global production network. In: NBER Working Paper Series, June.
IMF (2022). Asia and pacific regional economic outlook. April 2022.
Jacks, D.S., Novy, D., 2020. Trade blocs and trade wars during the interwar period. Asian Econ. Policy Rev. 15, 119–136.
Kee, H.L., Nicita, A., Olarreaga, M., 2009a. Estimating trade restrictiveness indices. Econ. J. 119, 172–199.
L'Hotellerie-Fallois, P., Vergara Caffarelli, F., Geeroms, H., de Almeida, A.M., Bisciari, P., Byrne, S., Campos, R.G., Conefrey, T., Cappariello, R., Damjanović, M., Estrada, A., Gunnella, V., Gutiérrez Chacón, E., Haincourt, S., Hoeberichts, M., Kadow, A., van Limbergen, D., Mancini, M., Martín Machuca, C., Roth, M., Sastre, T., Timini, J., 2020. A review of economic analyses on the potential impact of Brexit. In: ECB Ocassional Paper Series n. 249, October.
Mayer, T., Vicard, V., Zignago, S., 2019. The cost of non-Europe, revisited. Econ. Policy 34, 145–199.
Niu Z., C. Liu, S. Gunessee, and C. Milner (2018), "Non-tariff and overall protection: evidence across countries and over time", 154: 675–703.
Novy, D., 2012. Gravity redux: measuring international trade costs with panel data. In: CEPR Discussion Paper, p. 1114.
Perla, J., Tonetti, C., Waugh, M.E., 2021. Equilibrium technology diffusion, trade, and growth. Am. Econ. Rev. 111 (1), 73–128.
Ravikumar B., Ana Maria Santacreu, Michael Sposi, Capital accumulation and dynamic gains from trade, Journal of International Economics, Volume 119, 2019, Pages 93-110, ISSN 0022-1996, https://doi.org/10.1016/j.jinteco.2019.04.009.
Reinhart, C., Rogoff, K., 2009. This Time is Different: Eight Centuries of Financial Folly. Princeton University Press, Princeton.
Santos Silva, M.C., Silvana Tenreyro, 2006. The Log of Gravity," The Review of Economics and Statistics, 88. MIT Press, pp. 641–658.
Timini, J., Viani, F., 2022. A highway across the Atlantic? Trade and welfare effects of the EU-mercosur agreement. Int. Econ. 169, 291–308.
Waugh, M.E., 2010. International trade and income differences. Am. Econ. Rev. 100, 2093–2124.
Wolf, N., Ritschl, A.O., 2011. Endogeneity of currency areas and trade blocs: evidence from a natural experiment. Kyklos 64, 291–312.
Yotov, Y.V., 2022. On the role of domestic trade flows for estimating the gravity model of trade. Contemp. Econ. Policy forthcoming.
Yotov, Y.V., Piermartini, R., Monteiro, J., Larch, M., 2016. An Advanced Guide to Trade Policy Analysis. World Trade Organization, Geneva.