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A simple method to *ex-ante* quantify the unobservable effects of trade liberalization and trade protection[☆]

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ABSTRACT

We propose a simple and flexible econometric approach to quantify ex-ante the impact of comprehensive trade liberalization or protection with the structural gravity model. Specifically, we argue that the difference between the estimates of border indicator variables for affected and non-affected countries can be used to measure unobservable changes in bilateral trade costs in response to hypothetical policy changes. To demonstrate the effectiveness of our methods, we focus on the integration between the countries from the Central European Free Trade Agreement (CEFTA) and the European Union (EU); an important policy application that has not been studied before due to a lack of data. We overcome this challenge by utilizing a new dataset on trade and production that covers all EU countries and all CEFTA members (except for Kosovo). The partial equilibrium estimates that we obtain confirm the validity of our methods, while the corresponding general equilibrium effects point to significant and heterogeneous potential gains for the CEFTA countries from joining the EU. The proposed methods are readily applicable to other applications, e.g., Brexit or joining the World Trade Organization (WTO), and can also be extended to ex-post analysis.

1. Introduction

Quantifying the ex-ante effects of trade liberalization, e.g., the impact of regional trade agreements (RTAs) and the expansion of the European Union (EU), or trade protection, e.g., Brexit or the break up of a regional trade agreement between Estonia and Ukraine due to Estonia's accession to the EU, are important but difficult tasks. The transmission channels for the impact of trade protection and trade liberalization are clear and well understood from a theoretical perspective, c.f., Arkolakis et al. (2012). However, difficulties in such evaluation efforts arise in the empirical implementation and, more specifically, with the definition and quantification of the initial change in trade costs that triggers ripple effects in the global economy. While ex-post evaluation analysis usually allows researchers to obtain estimates of the impact of liberalization or protection efforts, e.g., the impact of NAFTA or the impact of applied tariffs, this is not the case with ex-ante studies, e.g., the formation of a new trade agreement, Brexit, or joining the WTO.

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To make our ideas and contribution clear, let us focus on the impact of a new RTA. There are two approaches that researchers have adopted to quantify the ex-ante effects of such an RTA. First, many studies have relied on variables that are observed, e.g., tariffs. The analysis with tariffs is relatively easy to implement because (i) nowadays tariff data are good and widely available, and (ii) it is easy to construct trade cost changes that correspond to the elimination/decrease of tariffs. A drawback of this approach is that tariffs often (especially for developed countries) represent only a small fraction of the trade costs that they face and impose. Thus, the effects of the removal of tariffs are relatively small too and would probably understate the true impact of the RTA in question.

It is possible to improve the measurement of trade costs by relying on additional observable trade policy measures (e.g., non-tariff trade measures, NTMs) and add the changes in those measures to the changes in tariffs for a more comprehensive measure of trade costs and their changes. However, this has two drawbacks/caveats. First, data on NTMs are often scarce and patchy, and the measurement and aggregation of NTMs can be difficult, c.f., UNCTAD-WTO (2012). In addition, even if NTM data were available, the combination of changes in observable NTMs and tariffs may still be viewed as a conservative/lower bound measure of the possible benefits from liberalization or the costs from protection.

The second approach to measure the initial trade cost changes in trade liberalization and protection scenarios is to use estimates of the effects of existing policies, e.g., RTAs. While, by design, this approach is very appropriate for ex-post evaluation, a major drawback when applied for-ex-ante analysis is that the initial shock is constructed based on limited information (often a single RTA estimate) and sometimes based on external sample data, i.e., estimation data that are different from the data used for the counterfactuals. Even if the sample used for the counterfactuals and the estimations were the same, and even if the researcher has the opportunity to obtain several ex-post RTA estimates that can be used for the counterfactual analysis, it is difficult to identify an existing RTA that would match closely to the exact RTA in question.[1]

Against this backdrop, we propose a third method that overcomes the aforementioned challenges to deliver comprehensive estimates of the ex-ante initial impact of trade liberalization and protection. Specifically, we capitalize and extend on the latest developments in the empirical structural gravity literature to estimate the effects of bilateral borders that act in addition to all other trade costs that are observable to the researcher. Thus, the border variables will account for all forces that are unobservable (or observable but not controlled for) in the econometric specification of trade costs. Then, in combination with the estimates of the observable trade policy measures (e.g., tariffs, RTAs, etc.), the difference between the flexibly selected border estimates for the affected group and the corresponding estimates for the properly selected non-affected group would offer a comprehensive account for the potential trade costs that may be eliminated with trade liberalization or generated in the case of protection. As a result, the proposed method could deliver partial estimates of both the observable and the unobservable trade costs, which, in turn, can be employed in ex-ante analyses of various trade liberalization and trade protection scenarios.

We believe that the proposed method has four attractive features. First, it is *simple* because it does not require specific policy data but only the construction and estimation of the effects of appropriate indicator variables, i.e., proper border variables, within a standard structural gravity model. Second, the implementation is *flexible* for two reasons: (i) because it allows selecting both the groups of affected and non-affected countries for the analysis among any pair or group of countries that appear in the sample subject to data availability; and (ii) because it allows for the researcher to explicitly control for all observable bilateral determinants of trade. Third, the approach is *comprehensive* because, by construction, the border estimates will account for all trade costs that have not been captured explicitly by other control variables that are observable to the researcher. Note that, in addition to the border variables, our method allows for the inclusion of tariffs, RTAs, and all other variables for which data are available. Finally, the method is implemented within the standard gravity model and, therefore, the partial equilibrium estimates that it delivers can be integrated within a wide class of *new quantitative trade models*, c.f., Arkolakis et al. (2012), or even complex computational general equilibrium models, such as the standard GTAP model. We demonstrate this in Section 4.2, where we obtain general equilibrium (GE) welfare effects corresponding to our partial equilibrium estimates.

To highlight the effectiveness of our methods we study the integration between the countries from the Central European Free Trade Agreement (CEFTA) and the European Union (EU). The integration of the CEFTA countries has been an extremely important goal for the governments of those nations but also from the perspective of the European Union, especially after the EU released a new strategy for the Western Balkans countries.[2] We offer further details on the background of the CEFTA and EU accession process and status in Section 3.1. Data limitations have been the main obstacle to studying the impact of the potential CEFTA integration with the EU. We overcome this challenge by utilizing the new edition of the International Trade and Production Database for Estimation (ITPD-E-R02), which was constructed by Borchert et al. (2021b, 2022) for the U.S. International Trade Commission. The two main advantages of ITPD-E for our purposes are that (i) it covers all CEFTA countries (except Kosovo) and all EU members as well, and

[1] Baier et al. (2019) provide evidence of heterogeneous EIA trade elasticities and the implications for quantifying the total effects of RTAs on trade and welfare. As will become clear below, the approach that we propose in this paper has two advantages. First, it is significantly simpler to implement. Second, it can utilize much more information for the group of interest.

[2] The economic integration process between EU and the CEFTA countries has been slowly progressing for the last 15 years. Four CEFTA countries (Albania, Montenegro, North Macedonia and Serbia) are EU candidate countries, while Bosnia and Herzegovina and Kosovo are potential candidate countries, and Moldova recently signed a bilateral free trade agreement with the EU. The recent EU strategy in 2018 provided a target accession date of 2025 for Serbia and Montenegro, with the possibility for the other Western Balkans countries to join them, but this target date may be delayed given the 2020 COVID-19 pandemic. A review of the status of the accession process and challenges (Grieveson et al., 2018) finds that the target date is ambitious and may be established more as an incentive for reforms in the countries. Nonetheless, there is still a possibility that in five years or so, Serbia and Montenegro will be new EU members, with the other countries to follow in the next 10 years.

(ii) that it includes consistently constructed domestic trade flows, which are crucial for the implementation of our methods. We offer further details on the dataset in Section 3.2.

Several main findings stand out from our partial equilibrium estimates. Without going into details, we obtain estimates of the effects of all standard gravity variables that are readily comparable to corresponding estimates from the existing literature. In addition, we use border variables to allow for a differential impact of borders on trade within the EU vs. trade between EU and CEFTA countries depending on the direction of trade flows. We find that, without any exception, all border effects are negative, large and statistically significant, as expected. The largest unobserved barriers to trade that are not captured by the standard gravity covariates are in services, followed by mining and agriculture, and the smallest border effects are for manufacturing. We find the variation for services to be intuitive as it is consistent with localized consumption. Pronounced 'home bias' effects may explain the large estimates for agricultural products.

Turning to the border estimates for trade between CEFTA countries and the EU, we see that the additional barriers to trade between CEFTA countries and the EU are larger as compared to the barriers to trade within the EU in each of the four main sectors in our sample. We also document significant variation in the border differential across sectors. Similar to our ranking of the average border effects, the differences are the largest for services, followed by mining and agriculture, and are the smallest in manufacturing. Finally, we document significant asymmetries in the border effects between CEFTA countries and the EU depending on the direction of trade flows. Specifically, our estimates reveal that the border effects faced by CEFTA exports to the EU are larger in agriculture, while the opposite is true for manufacturing and mining. The borders are large and fairly symmetric in the case of services. Capitalizing on the structural properties of the gravity model, we transform our border estimates and their differences into tariff-equivalent effects, which are significantly larger than the existing differences in applied tariffs for each of the three goods sectors in our sample, thus highlighting the importance of our approach to measuring border differentials.

Stimulated by the importance of the manufacturing sector for the CEFTA economies and by the potential for very heterogeneous differences in the impact of borders on trade between CEFTA and EU vs. trade within the EU in aggregate manufacturing, we also obtain estimates for eleven manufacturing industries. The disaggregated estimates confirm our main finding that the CEFTA countries face significantly larger barriers to trade with the EU as compared to the barriers faced by the EU countries on trade with each other. Without any exception, the border estimates for trade between CEFTA countries and the EU are always larger (in absolute value) as compared to the border estimates for trade within the EU. In addition, we confirm that the differences in the borders between CEFTA countries and the EU vs. the borders within the EU are quite heterogeneous across the eleven manufacturing sectors in our sample and also asymmetric depending on the direction of trade flows. Consistent with our findings for aggregate manufacturing, except 'Minerals', the tariff equivalents faced by EU exports to CEFTA are larger than those for CEFTA exports to the EU.

Our partial equilibrium estimates imply that CEFTA members could enjoy large welfare gains from joining the EU. We quantify those gains by performing two GE counterfactual analyses.[3] First, we use data on actually applied tariffs to simulate the impact on exports of a hypothetical harmonization of MFN applied tariffs by the CEFTA countries, as a bloc, to the corresponding EU rates. Consistent with the possible practical implementation of such policy, the EU MFN rates will not affect the preferential tariff rates they accord to their preferential trade partners as they are not acceding into the EU but rather just adopting the MFN rates. Instead of tariffs, the second GE experiment that we perform employs our partial equilibrium border estimates to simulate a decrease of the trade costs between CEFTA countries and the EU to the level of within EU trade barriers. This analysis highlights the substantial difference between the tariff and border scenarios. The predicted gains for the CEFTA countries are substantially larger when using the border estimates to measure the trade cost changes. Importantly, in the borders scenario, we can quantify welfare effects for services, which is not possible in the tariffs scenario.

The rest of the paper is organized as follows. Section 2 presents our identification methods. Section 3 motivates the focus on the integration of the CEFTA countries in the EU (in Section 3.1), and describes our data and sources (in Section 3.2). Section 4 presents our empirical findings. Section 4.1 offers an analysis of our partial equilibrium estimates, while Section 4.2 translates them into GE effects and discusses our findings. Section 5 concludes. The Supplementary Appendix includes additional empirical results, robustness estimates, and a description of the theoretical framework used for our counterfactual analysis.

2. Estimating 'comprehensive' trade cost changes

This section presents our methods to estimate ex-ante comprehensive trade cost changes in response to a hypothetical policy change. For expositional simplicity and clarity, and to facilitate the interpretation of our results in the following sections, we will focus on a specific application, i.e., the integration of CEFTA and EU.[4] Our departing point is the following econometric gravity model, which we adapt to accommodate the specific goals of our study[5]:

$$X_{ij,t} = \exp[\pi_{i,t} + \chi_{j,t} + \mathbf{GRAV}_{ij,t}\eta] + \epsilon_{ij,t}. \quad (1)$$

[3] To perform the counterfactual analysis we rely on a standard GE gravity setting following Dekle et al. (2007, 2008). For details, please see part B of the Supplementary Appendix.

[4] The CEFTA consists of seven countries: Albania, Bosnia and Herzegovina, Kosovo, Moldova, Montenegro, North Macedonia and Serbia. We offer further details on the history and relationship between CEFTA and the EU in Section 3.1.

[5] As famously demonstrated by Arkolakis et al. (2012), this empirical equation is representative of a very wide class of theoretical trade models. We refer the reader to Anderson (2011), Costinot and Rodriguez-Clare (2014), Yotov et al. (2016), and Baier et al. (2018) for reviews of the theoretical foundations of the gravity model.

$X_{ij,t}$ denotes nominal trade flows from source/exporter i to destination/importer j at time t. An important feature of the dependent variable is that, consistent with all of the underlying theoretical models that deliver the structural gravity equation, $X_{ij,t}$ includes international and *intra-national* trade flows.[6] We also note that, due to the separability of the structural gravity model at the sectors level, c.f., Anderson and van Wincoop (2004) and Costinot et al. (2012), Eq. (1) can be estimated at any desired level of aggregation. We capitalize on this property in the empirical analysis, where we obtain sectoral results.[7]

The exponential function, $\exp[\cdot]$, on the right-hand side of Eq. (1) reflects the fact that to obtain our main estimates, we employ the Poisson Pseudo Maximum Likelihood (PPML) estimator.[8] We favour the PPML estimator because, as demonstrated by Santos Silva and Tenreyro (2006, 2011), (i) PPML accounts for heteroskedasticity that often plagues trade data, and (ii) because, due to its multiplicative form, PPML utilizes the information contained in the zero trade flows.

The vector $\pi_{i,t}$ denotes the set of time-varying source-country dummies (i.e., exporter-time fixed effects), while the term $\chi_{j,t}$ encompasses the set of time-varying destination-country dummy variables. These directional (exporter and importer) fixed effects will control for the unobservable multilateral resistances of Anderson and van Wincoop (2003) and the country-specific size terms in the structural gravity model. In addition, they will absorb any other observable and unobservable characteristics that vary over time for each exporter and each importer.

$\mathbf{GRAV}_{ij,t}$ denotes the vector of bilateral determinants of trade flows in our model. Following the existing literature, we include in this vector the standard set of time-invariant covariates that are used in gravity regressions (i.e., the log of bilateral distance ($DIST_{ij}$), and a series of indicator variables capturing whether or not two countries share a common border ($CNTG_{ij}$), a common official language ($LANG_{ij}$), and any colonial ties ($CLNY_{ij}$)). In addition, we control for the impact of regional trade agreements ($RTA_{ij,t}$) as a representative and widely-used time-varying trade policy covariate. To reflect the use of intra-national trade flows, we also use an indicator variable ($BRDR_{ij,t}$) that takes a value of one for international trade and it is equal to zero for domestic sales. The subscript t captures the possibility that the impact of international borders can vary over time. This variable has the advantage of being exogenous by construction, and it will capture the effects of any other determinants of international relative to internal trade, which act in addition to the covariates that we control for explicitly in our specification.

Finally, and most important for our purposes, we capitalize (i) on the fact that the border variable is exogenous by construction and (ii) that it captures the impact of all possible observable and unobservable factors that impact bilateral trade in addition to the standard covariates that we already control for to allow for possible differential border effects across the following dimensions[9]: (i) $BRDR\_EU_{ij,t}$ takes a value of one for international trade within the EU, and it is set to zero otherwise; (ii) $BRDR\_CEFTA\_EU_{ij,t}$ is an indicator variable that takes a value of one for exports from CEFTA members to the EU countries, and it is set to zero otherwise. Similarly, (iii) $BRDR\_EU\_CEFTA_{ij,t}$ is an indicator variable that takes a value of one for exports from EU members to the CEFTA countries, and it is set to zero otherwise. Thus, these two dummy variables allow for potential asymmetries in the border effects between CEFTA and EU countries depending on the direction of trade flows; (iv) $BRDR\_CEFTA_{ij,t}$ takes a value of one for international trade within CEFTA, and it is set to zero otherwise; We also allow for differential border effects (v) between CEFTA and the rest of the world ($BRDR\_CEFTA\_ROW_{ij,t}$) and (vi) between EU and the rest of the world ($BRDR\_EU\_ROW_{ij,t}$). Finally, to interpret the estimates on all border variables as levels, we set $BRDR_{ij,t}$ to zero when any of the other border dummies is equal to one. Thus, the estimate on $BRDR_{ij,t}$ would capture the impact of borders on international trade between the countries in the rest of the world. Taking into account these modelling choices, our main estimating equation becomes:

$$\begin{aligned} X_{ij,t} = {} & \exp[\pi_{i,t} + \chi_{j,t} + \eta_1 DIST_{ij} + \eta_2 CNTG_{ij} + \eta_3 LANG_{ij} + \eta_4 CLNY_{ij} + \eta_5 RTA_{ij,t}] \times \\ & \exp[\eta_6 BRDR\_EU_{ij,t} + \eta_7 BRDR\_CEFTA\_EU_{ij,t} + \eta_8 BRDR\_EU\_CEFTA_{ij,t}] \times \\ & \exp[\eta_9 BRDR\_CEFTA_{ij,t} + \eta_{10} BRDR\_CEFTA\_ROW_{ij,t} + \eta_{11} BRDR\_EU\_ROW_{ij,t}] \times \\ & \exp[\eta_{12} BRDR_{ij,t}] + \epsilon_{ij,t}. \end{aligned} \tag{2}$$

Several features of specification (2) concerning the definition and interpretation of the key border variables and their relation to the other covariates in our estimating equation deserve further discussion. First, we note that, by construction, the border variables in specification (2) will capture the impact of all unobserved trade barriers that act in addition to (i) geography, which is controlled for by the distance and contiguity variables ($DIST_{ij}$ and $CNTG_{ij}$, respectively); (ii) cultural ties, which are controlled for by the language and colonial ties covariates ($LANG_{ij}$ and $CLNY_{ij}$, respectively); and (iii) the average impact of RTAs, as the most prominent trade policy variable. Of course, one may include in the econometric model any additional determinants of bilateral trade flows for which data are available. Then, the interpretation of the border estimates would be as capturing the effects of any impediments to trade that are not explicitly accounted for in the vector of bilateral trade cost covariates.

Second, even if the border variables and their estimates are capturing/reflecting trade costs and preferences (e.g., 'home bias' effects) that cannot be affected by trade policy, we note that what is relevant for our analysis is not the estimate of the border per

[6] More recent literature emphasizes the role to take into account domestic sales and frictions, see for example Coşar and Fajgelbaum (2016), Allen and Arkolakis (2014), Ramondo et al. (2016), and Fajgelbaum and Redding (2022). In structural gravity, the importance of also including domestic sales was emphasized by Yotov (2012), Bergstrand et al. (2015) and Heid et al. (2021), for example. Yotov (2022) provides a survey of the use of intra-national trade flows for structural gravity estimations.

[7] For a discussion of the challenges and approaches to estimate gravity with disaggregated data, we refer the reader to Yotov et al. (2016) and Borchert et al. (2021a).

[8] Sensitivity estimates, which are included in the Supplementary Appendix, demonstrate that our main results are robust to the use of the OLS estimator.

[9] We thank an anonymous referee for suggesting a more detailed definition of the border effects, which also allows for asymmetric border effects, than the one that we implemented in the original version of the paper.

se, but rather the difference between the estimates of the border effects for the groups of interest, i.e., $BRDR\_CEFTA\_EU_{ij,t}$ and $BRDR\_EU\_CEFTA_{ij,t}$ in our case, and for the EU as reference group, i.e., $BRDR\_EU_{ij,t}$. Given the history of strong integration within the EU, we would expect that the borders for trade within the EU will be significantly smaller as compared to the borders between the EU and the CEFTA countries, and the object of interest to us will be the difference between the two border estimates.

Further capitalizing on the structural properties of the gravity model, we can express the difference between the border faced by EU exports to CEFTA as a tariff-equivalent index[10]:

$$\%\Delta t_{EU\rightarrow CEFTA} = \left[\left(\frac{\exp(\hat{\eta}_{BRDR\_EU})}{\exp(\hat{\eta}_{BRDR\_EU\_CEFTA})}\right)^{\frac{1}{1-\sigma}} - 1\right] \times 100, \tag{3}$$

where, $\hat{\eta}_{BRDR\_EU}$ and $\hat{\eta}_{BRDR\_EU\_CEFTA}$ are the estimates of the border variables $BRDR\_EU_{ij,t}$ and $BRDR\_EU\_CEFTA_{ij,t}$ from Eq. (2), respectively, and σ is the elasticity of substitution.

Finally, we note that our methods allow for very flexible definitions of the border barriers, both within the group of interest and within the reference group. Therefore, these definitions can be refined further depending on the goals and institutional background behind the policy change. For example, in the case of EU-CEFTA integration, it may be appropriate to define the border for the reference group as the border between the 'old/initial' EU members and the countries from Eastern Europe (e.g., Romania and Bulgaria), which are similar to the CEFTA members across many economic indicators and are among the countries that joined the EU most recently.[11] Concerning the treatment group of interest, one can estimate heterogeneous impact across the CEFTA members. Note that, in the case of CEFTA-EU integration, identification of the country-specific borders comes from two sources, i.e., the time dimension and the pair dimension (because the EU includes many members). However, in principle, the panel dimension of the data is sufficient to identify pair-specific borders too. The panel dimension would allow for the estimation of time-varying (or based on intervals) border effects. Given the methodological purpose of our paper, we abstract from such refinements in our estimating specification and we focus on two variables only, which are sufficient to prove the validity of our methods.

3. Application and data

Section 3.1 of this section motivates the focus on the main application for our analysis, i.e., the integration of the CEFTA countries in the EU, while Section 3.2 describes the data and sources that we employ to perform the empirical analysis.

3.1. CEFTA-EU integration: Background and relevance

The purpose of this section is to describe the importance of the integration process between the CEFTA countries and the EU and to offer some institutional background on the CEFTA-EU accession process and status. The EU has expressed a strong interest to integrate the CEFTA countries with European markets and has used Union membership to encourage the integration process. The CEFTA consists of seven countries: Albania, Bosnia and Herzegovina, Kosovo, Moldova, Montenegro, North Macedonia and Serbia. Most of the CEFTA countries (except Moldova) are geographically within the EU, surrounded by Italy, Croatia, Romania, Bulgaria and Greece. Any economic or political instability in CEFTA will transmit to the EU, which is only a recent memory for the former Yugoslav countries.[12] The CEFTA countries are still recovering from the aftermath of conflicts in the 1990s: the Bosnian (1992–95) and Kosovo (1998–99) wars and the skirmishes in Serbia (1999–2001) and North Macedonia (2001). Even presently, Kosovo and Serbia still have a tense relationship as Serbia does not formally recognize Kosovo's independent status. Higher trade between the countries through further integration can increase the opportunity costs of war and reduce the possibility of conflict (see Martin et al., 2008; Vicard, 2012, for examples).

The CEFTA-EU integration process has been progressing slowly for the last 15 years and the CEFTA countries are at different stages of integrating their institutions to European standards. The accession process is governed by the *Acquis Communautaire* or EU acquis, which constitutes the body of EU legislation and potential members have to transpose the EU legislation into their national law. The EU acquis is composed of 35 chapters that deal with all aspects of legislation from free movement of goods (chapter 1) and workers (chapter 2) to social policy and employment (chapter 19) and science and research (chapter 25). Four CEFTA countries (Albania, Montenegro, North Macedonia and Serbia) are EU candidate countries, which means that the EU officially recognize them as potential EU members and can start accession negotiations. Montenegro and Serbia are further along the process than Albania and North Macedonia, having started negotiations on 18 (Serbia) and 33 (Montenegro) chapters out of the 35 chapters in the EU acquis, but the negotiations on only 2–3 chapters have provisionally closed. Albania and North Macedonia have candidate status but have not started negotiations on the EU acquis. North Macedonia finally resolved its long-standing name dispute in January 2019 with Greece, which was the main obstacle to beginning negotiations. The country, however, faces new challenges in its accession with Bulgaria related to issues of identity, language and history. The European Council opened accession negotiations in March 2020 but they have yet to adopt the negotiating framework. Bosnia and Herzegovina and Kosovo are potential candidate countries, and their accession negotiations are further along.

[10] Similarly, we can express the difference between the border faced by CEFTA exports to EU as a tariff-equivalent index by using the estimate on $BRDR\_CEFTA\_EU$ instead $BRDR\_EU\_CEFTA$.

[11] See Iliev et al. (2016) for a gravity analysis of the evolution of the borders between Bulgaria and the EU.

[12] Former Yugoslavia was made up of Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia and Serbia, along with Croatia and Slovenia.

As the first step towards integration, the CEFTA countries have progressively negotiated bilateral trade agreements with the EU. The bilateral free trade agreements, referred to as Association and Stabilization Agreement has been concluded with North Macedonia (2004), Albania (2009), Montenegro (2010), Serbia (2013), Bosnia and Herzegovina (2015) and Kosovo (2016). The EU has also recently concluded the Deep and Comprehensive Free Trade Area (DCFTA) with Moldova (2014). These bilateral trade agreements grant tariff-free access to most exports into the EU, with some agricultural goods still attracting either tariff rates or tariff-rate quotas. These trade agreements grant tariff-free market access into the EU but exports from the CEFTA countries still encounter border costs as they are subject to border inspections by Customs, food and health agencies and other technical inspectorates. These trade agreements also give preferential access to EU exports into CEFTA countries.

The EU announced a new strategy for the region in 2018, which has heightened the need to examine the effects of integration between CEFTA and the EU. The new EU strategy for the Western Balkans countries (i.e. CEFTA countries minus Moldova) provided a target accession date of 2025 for the next batch of EU expansion, but this target date may be delayed given the 2020 COVID-19 pandemic. Given the current accession status, it is likely Serbia and Montenegro will be the first two CEFTA countries to join the EU, with North Macedonia possibly being the next country. There are, however, many challenges to the reforms needed in the EU acquis and Grieveson et al. (2018) concludes that the target date is ambitious and serves more as an incentive for reforms.

The CEFTA countries also recognize that further integration amongst themselves can help their integration with the EU. After the EU, other CEFTA countries represent the next largest market for imports and exports for CEFTA countries. The CEFTA only covers market access for all industrial goods and most agricultural goods but has recently expanded to include trade facilitation and services liberalization.[13] In 2017, the CEFTA countries endorsed a regional action plan to promote economic integration amongst themselves, with the view to encourage economic convergence with the EU.[14] For example, the trade measures in the action plan adopt trade facilitation measures and data systems that conform to EU standards. Most relevant for our paper is an action to investigate the impacts of harmonizing their MFN tariff regimes with the EU's common external tariff regimes as a method to encourage more integration between CEFTA and the EU. However, there was little detail about what the harmonization of the MFN tariff regimes will entail or how it will be implemented in the regional action plan.[15]

A priori, it is difficult to determine the general equilibrium effects on trade between CEFTA countries and the EU if the CEFTA countries harmonize their MFN tariff regimes with the EU's. Trade of most industrial goods between EU and CEFTA enjoys preferential tariff-free status through the Stabilisation and Association Agreements and will not be affected by the harmonization of the MFN tariff regimes. These agreements also provide preferential market access for some agricultural trade. So adjustments in tariff rates will likely have the most effect on CEFTA countries' imports from non-EU countries, which can then divert some demand from EU imports. Adjustments in MFN tariff rates will also depend on whether the MFN tariff rates are higher or lower than the EU tariff rates. If the MFN tariff rate for a product reduces to a lower EU tariff rate, imports from non-EU countries may be more attractive to a CEFTA importer who will reduce their existing imports from the EU. If the MFN tariff rate for a product increases to a higher EU tariff rate, the importer may reduce their existing imports from non-EU countries and import from the EU. This analysis is further complicated as the CEFTA countries do not have the same MFN tariff regime among themselves.

Despite the importance and need to evaluate the benefits of integration for CEFTA countries, data availability has limited any analysis on the topic. Databases such as the WIOD or GTAP, which are widely used for general equilibrium counterfactual analysis such as the one performed here, do not contain data for the CEFTA countries. The databases generally list the CEFTA countries in regional aggregates.[16] Constructing a general equilibrium model of the CEFTA countries is also difficult as these countries (except Albania and Serbia) do not have national input–output tables.

3.2. Data: Description and sources

To perform the empirical analysis, we employ the second release of *The International Trade and Production Database for Estimation* (ITPD-E-R02), which is developed and maintained by the U.S. International Trade Commission (ITC), c.f., Borchert et al. (2021b, 2022). The original ITPD-E consists of inter- and intra-national trade flows for 243 countries and 170 industries for the years between 2000 and 2016.[17] The inclusion of domestic trade flows in the ITPD-E is a crucial feature for the implementation of our methods. Another very important feature of the ITPD-E with respect to our purposes is that it covers all EU countries and all CEFTA economies (except for Kosovo) as well. This is an advantage over other databases, e.g., WIOD and the GTAP datasets, which are widely used for general equilibrium counterfactual analysis. However, neither WIOD nor GTAP cover the CEFTA countries. Albania is an exception.

Given the methodological purpose of our paper, and for computational and expositional purposes too, we make several choices regarding the dimensions of the ITPD subsample that we employ for our analysis. First, we focus on 2013, which allows for a

[13] The agreement was originally signed in 1992 but the current members joined between 2006–207 as previous members (Poland, Hungary, Czech Republic, Slovakia, Slovenia, Romania and Bulgaria) left CEFTA once they acceded into the EU. Croatia was still a member in 2006 but left in 2013 when it joined the EU.

[14] The regional action plan can be accessed here: https://www.wb6cif.eu/wp-content/uploads/2020/01/Multi-annual-Action-Plan-for-a-Regional-Economic-Area-in-the-Western-Balkans-Six.pdf.

[15] This action originated from a recommendation in the South East Europe 2020 Strategy, but that report also does not elaborate on this recommendation.

[16] The GTAP database only lists Albania as a separate country, while the rest are either in the "Rest of Europe" or "Rest of Eastern Europe" (for Moldova) regional aggregates. The World Input–Output Database (WIOD) lists the CEFTA countries in the "Rest of the World" aggregate.

[17] Of the 170 sectors in ITPD-E-R02, 28 are in agriculture, 7 are in mining and energy, 118 are in manufacturing, and 17 are in services. For summary statistics and further details on ITPD-E-R02, we refer the reader to Borchert et al. (2021b, 2022), and for its use for gravity estimations see Borchert et al. (2021a).

comprehensive coverage across most countries and across most sectors. Experiments with alternative years confirm the robustness of our main findings. On the country dimension, to obtain our partial estimates we use all countries from the ITPD-E-R02, but we limit the number of countries for the general equilibrium analysis to 165. For consistency of the analysis across the different sectors, the selection criteria for the countries used in the GE analysis was that they appear as importers and exporters in each of the four main sectors in our sample. In sensitivity analysis (see Table 7 from the Supplementary Appendix), we confirm the robustness of our results to including only the countries for which there is at lease some domestic trade data.

Finally, on the sectoral dimension, we focus the analysis on the four major sectors, which comprise each economy, including agriculture, mining, manufacturing and services. In addition, given the importance of the manufacturing sector for the CEFTA economies and for robustness, we also obtain partial estimates for eleven manufacturing sectors, which we label broadly as Chemicals, Electronics, Food, Machines, Metals, Minerals, Rubber, Textiles, Transport, Wood, and Other. To obtain our partial equilibrium estimates, we use disaggregated data for all 170 industries from ITPD-E-R02 (28 for agriculture, 7 for mining, 118 for manufacturing, and 17 for services), along with proper fixed effects as dictated by theory. Specifically, to obtain our estimates for agriculture we rely on data for 28 industries. We use 7 industries to obtain the estimates for mining, 118 industries to obtain the estimates for manufacturing, and 17 industries to obtain the estimates for services.[18] To perform the GE counterfactual analysis in Section 4.2, we aggregate the 170 industries from ITPD-E to four broad sectors (agriculture, mining, manufacturing, and services) as described next.

While the ITPD-E data is constructed specifically to be used in estimations, it is highly unbalanced and there is a significant number of missing observations for domestic trade. This makes it not suitable for counterfactual analysis. Despite these caveats, and to highlight the importance of our methods, we decided to transform the data into a balanced dataset, which enables us to perform GE analysis. The main objective of the GE experiments that we will present in Section 4.2 is to use the same data and the same methods to compare the effects of a trade liberalization scenario based on observable tariff changes vs. a trade liberalization scenario based on the border estimates that we obtain in our partial analysis. Thus, given the strong assumptions that we make to construct the balanced data, we view our GE experiments as a tool to highlight our methods rather than as a definitive policy analysis. With this caveat in mind, we took the following steps to construct a balanced data for the counterfactual analysis.

First, as discussed already, we limit the number of countries to those that appear as exporters and importers in all four major sectors. This resulted in a sample of 165 countries. Second, to impute missing observations for domestic trade, we construct the ratio of total exports to internal sales for each of the 170 industries in ITPD-E-R02 for which data were available. Then, we use these ratios in combination with data on total exports for each country and disaggregated industry to fill in missing intra-national trade values. Third, because ITPD-E-R02 does not include any domestic trade for 14 industries (concentrated in agriculture and services), we construct an average ratio between international and domestic trade for the corresponding broad sectors, and we use these ratios in combination with data on total exports to fill in the missing intra-national trade values. Finally, we aggregate the resulting balanced dataset to the four sectors that we employ in our analysis.[19]

We also employ several other data sets in addition to ITPD-E. Data on the standard gravity covariates for our gravity estimations come from the Dynamic Gravity Dataset (DGD) of the U.S. International Trade Commission, and we refer the reader to Gurevich and Herman (2018) for further details on DGD. In order to investigate the effect of CEFTA countries adopting the EU common external tariff, we make use of MFN tariff data that come from https://wits.worldbank.org/WITS/WITS/Restricted/Login.aspx. The original tariff data are at the HS17 8-digit level for Albania, Bosnia and Herzegovina, Moldova, Montenegro, and Serbia, while the tariff data for Macedonia are at the HS17 6-digit level. We aggregate all tariff data to the HS17 6-digit level, as correspondence tables to HS07 and SITC Reve. 3 & 4 are only available at the 6-digit level. We aggregate the tariff data in two different ways: (i) unweighted by taking simple averages, (ii) weighted by total import shares of the respective sectors. We then merge SITC Rev. 3 & 4 correspondences and HS07 correspondences to be able to match with our mining, manufacturing, and agricultural trade flows data.

4. Empirical analysis and findings

This section presents our empirical findings. Section 4.1 offers an analysis of our partial equilibrium estimates, while Section 4.2 describes the results from our general equilibrium analysis.

[18] In principle, it is possible to obtain gravity estimates for each of the 170 ITPD-E industries. Given the methodological emphasis of this paper, we limit the number of sectors for expositional purposes.

[19] This procedure enabled us to impute 57% of observations for agriculture, 75% of observations for mining, 76% of observations for manufacturing, and 46% of observations for services. While the shares of imputed values at the most disaggregated level are quite large (i.e., there are a lot of missing country-industry observations for domestic trade), the correlation across countries between the raw and imputed aggregate domestic trade for each of the broad sectors is 0.99. To gauge the potential impact of our imputation procedure, we perform robustness GE analysis with raw vs. imputed values for manufacturing (the sector with the largest share of imputed observations). See Table 7 from the Supplementary Appendix. These analysis reveals that, despite the large number of imputed values, the welfare effects obtained with the two samples are not dramatically different. More important for our purposes, the differences between the tariff and the border scenarios are fully consistent with our main findings.

Table 1
Sectoral gravity estimates CEFTA, 2013.

	(1) Manufacturing	(2) Agriculture	(3) Mining	(4) Services
A. Gravity estimates				
DIST	−0.792	−1.236	−1.257	−0.315
	(0.038)**	(0.053)**	(0.122)**	(0.062)**
CNTG	0.328	0.425	0.340	0.561
	(0.077)**	(0.095)**	(0.219)	(0.117)**
LANG	0.427	0.460	0.346	0.588
	(0.058)**	(0.069)**	(0.124)**	(0.099)**
RTA	0.252	0.137	0.650	0.025
	(0.061)**	(0.080)+	(0.128)**	(0.097)
BRDR_EU	−2.545	−3.131	−4.773	−5.652
	(0.127)**	(0.139)**	(0.335)**	(0.188)**
BRDR_CEFTA_EU	−3.518	−5.049	−5.023	−7.138
	(0.218)**	(0.236)**	(0.507)**	(0.370)**
BRDR_EU_CEFTA	−4.088	−4.386	−6.601	−7.373
	(0.209)**	(0.254)**	(0.577)**	(0.356)**
BRDR_CEFTA	−3.334	−4.130	−4.677	.
	(0.267)**	(0.263)**	(0.688)**	(.)
BRDR_CEFTA_ROW	−4.948	−5.021	−4.633	−8.132
	(0.191)**	(0.241)**	(0.448)**	(0.312)**
BRDR_EU_ROW	−3.061	−4.279	−4.453	−6.205
	(0.125)**	(0.142)**	(0.328)**	(0.212)**
BRDR	−3.280	−4.684	−4.639	−6.017
	(0.135)**	(0.187)**	(0.299)**	(0.180)**
B. CEFTA vs. EU Border: Tariff equivalents				
$\%\Delta t_{CEFTA\rightarrow EU}$	−14.972	−27.370	−4.078	−21.938
	(2.841)**	(2.529)**	(7.123)**	(4.181)**
$\%\Delta t_{EU\rightarrow CEFTA}$	−22.679	−18.878	−26.262	−24.937
	(2.429)**	(3.092)**	(6.374)**	(3.925**
N	2 225 938	221 960	38 762	42 821

Notes: Panel A of this table reports gravity estimation results for the four main sectors in the sample including manufacturing, agriculture, mining, and services. All estimates are obtained with data for 2013. The data for each main sector is constructed by pooling (not summing) the data for all individual products within the corresponding main sector. The estimator is PPML and the dependent variable is nominal bilateral trade. All estimations are obtained with exporter-product and importer-product fixed effects, whose estimates are omitted for brevity. Standard errors are clustered by country pair and are reported in parentheses. $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. Panel B of the table reports tariff-equivalent trade cost changes, which are calculated as $\%\Delta t_{CEFTA\rightarrow EU} = ((exp(BRDR\_EU)/exp(BRDR\_CEFTA\_EU))^{1/(1-\sigma)} - 1) \times 100$ and $\%\Delta t_{EU\rightarrow CEFTA} = ((exp(BRDR\_EU)/exp(BRDR\_EU\_CEFTA))^{1/(1-\sigma)} - 1) \times 100$, respectively, where we set $\sigma = 7$. The standard errors in Panels B are constructed with the Delta method. See text for further details.

4.1. On the uneven impact of EU and CEFTA borders

The estimation results that we report and analyse in this section are based on econometric specification (2). We start with a discussion of our findings across the four main sectors in the sample, including manufacturing, agriculture, mining, and services. Then, we zoom in on the determinants of trade flows across eleven manufacturing categories, as described in the data section. Following the best estimation practices from the structural gravity literature, which we summarized in Section 2, we obtain our main results with the PPML estimator.[20]

Several findings stand out from the estimates for the four main sectors in our sample, which appear in Table 1. First, overall, we note that the estimates of the effects of the standard gravity covariates are readily comparable with the corresponding values from the existing literature, e.g., Borchert et al. (2021a). Turning to the specific covariates, we see that distance is a very significant impediment to international trade. The estimates on $DIST$ are large, negative, and significant at any conventional level for each of the four sectors. According to our results, agriculture and mining are the two sectors where the negative impact of distance is the strongest, while the effect of distance on services trade is the weakest. We find this heterogeneity intuitive and we point to transportation costs as a natural explanation for it.

Consistent with most of the existing gravity literature, we obtain positive estimates of the effects of contiguity and language. In each case, the impact of these determinants of trade is positive in all sectors. However, the effect of contiguity is not statistically significant for mining, and the estimate of the effects of common language is the smallest for mining. A possible explanation for this result is specialization in this natural resource industry. We also obtain positive estimates of the impact of RTAs in each sector,

[20] Estimates obtained with the OLS estimator are also consistent with our main findings. The corresponding OLS results can be found in Tables 4 and 5 of the Supplementary Appendix.

and all but those for services are statistically significant. This result confirms the important and successful positive effect of trade policies in promoting bilateral trade among RTA members, and it is consistent with findings from the extensive related literature. According to our estimates, RTAs have been most effective in mining, followed by manufacturing and agriculture.

Next, we turn to the estimates of the impact of international borders, which are of central interest to us. We remind the reader that, by construction, our border variables are indicators that are designed to capture the impact of all observable and unobservable barriers to trade that act on international relative to internal trade, after controlling for all standard gravity covariates. Five main results stand out. First, based on the estimates from Table 1, we conclude that the average impact of borders on international relative to internal trade is very large and significant. All border estimates that we identified are large, negative, and statistically significant at all conventional levels.[21] This is consistent with the extensive literature that studies the effects of borders and home bias in trade.[22] All BRDR estimates are negative and significant at any conventional level.

Second, according to our results (e.g., based on the estimates of $BRDR$ but also reflected in the other border effects), the largest barriers to trade that are not captured by the standard gravity covariates are in services, followed by mining and agriculture, and the smallest border effects are for manufacturing. We find the variation for services to be intuitive as it is consistent with localized consumption. Pronounced 'home bias' effects may explain the large estimates for agricultural products.

Third, turning to the estimates on $BRDR\_CEFTA\_EU$, $BRDR\_EU\_CEFTA$ and $BRDR\_EU$, we see that, without any exception, the barriers to trade between CEFTA countries and the EU are larger as compared to the barriers to trade within the EU. This is reflected in the larger (in absolute value) estimates on $BRDR\_CEFTA\_EU$ and $BRDR\_EU\_CEFTA$ as compared to the corresponding values for $BRDR\_EU$, and is consistent with our expectations.

Fourth, we note significant asymmetries in the border effects between CEFTA and EU depending on the direction of trade flows. Specifically, our estimates reveal that the border effects faced by CEFTA exports to the EU are larger in agriculture, while the opposite is true for manufacturing and mining. The borders are large and fairly symmetric in the case of services. Finally, we find that the differential in the borders between CEFTA and EU as compared to the borders within the EU varies across the four main sectors in our sample. It is the largest in services, followed by mining and agriculture, and it is the smallest in manufacturing. This result is consistent with our conclusions regarding the heterogeneity in the overall effects of borders across sectors.

The variation across sectors and the asymmetries in the border effects depending on the direction of trade flows are captured in Panel B of Table 1, where we calculate tariff equivalents of the border differentials according to Eq. (3).[23] Standard errors are constructed with the Delta method. The most important message from Panel B is that, for each sector and regardless of the direction of trade flows, the tariff equivalents of the border difference are larger as compared to the existing tariff differences for the goods sectors. This supports our assumption that, in addition to tariffs, there are other barriers to trade between CEFTA countries and the EU.

In the case of agriculture, the trade-weighted average tariff for the CEFTA countries is 11.58 percent, which is significantly lower as compared to the 18.88 percent border differential tariff equivalent that we obtain for EU exports to CEFTA and even smaller than the 27.37 percent for CEFTA exports to the EU.[24] The corresponding numbers for mining are 1.68 percent weighted average tariffs and 4.08 and 26.26 percent tariff equivalent border differentials, respectively. And for manufacturing the numbers are 5.22 percent weighted average tariffs and 14.97 and 22.68 percent tariff equivalent border differentials, respectively. Importantly, there is no tariff data that corresponds to the large (21.94 and 24.94 percent) tariff equivalent border differentials that we obtain for services.[25] This highlights the advantages and importance of using our estimation structural gravity approach to measure border differentials.

Stimulated by the importance of the manufacturing sector for the CEFTA economies and by the potential for very heterogeneous differences in the impact of borders on trade between CEFTA countries and the EU vs. trade within the EU within the aggregate manufacturing sector, next we obtain and present estimates for 11 disaggregated manufacturing industries. Our results appear in Table 2, where, as before, we include the PPML gravity estimates in Panel A and the tariff equivalents of the border differences are reported in Panel B of Table 2. Standard errors in panel B are constructed with the Delta method.

Without going into details, we note that our conclusions regarding the impact of the standard gravity variables for total manufacturing are supported by the disaggregated manufacturing estimates from Table 2. More importantly, the results in panel B reveal that the differences in the borders between CEFTA countries and the EU vs. the borders within the EU are quite heterogeneous across the eleven manufacturing sectors in our sample and also asymmetric depending on the direction of trade flows. Overall, we confirm the finding that trade between the CEFTA countries and the EU faces larger barriers to trade as compared to the barriers faced by the EU countries for trade with each other. This is supported by the fact that without any exception and regardless of the direction of trade flows, the border estimates for trade between CEFTA countries and the EU are always larger (in absolute value)

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[21] Due to missing data, we could not obtain an estimate of the border for services trade between the CEFTA countries.

[22] For analysis of the effects of borders and 'home bias' in the United States see Wolf (2000), Hillberry and Hummels (2003), Millimet and Osang (2007), Head and Mayer (2010), Coughlin and Novy (2012) and Yilmazkuday (2012); for the European Union see Nitsch (2000), Chen (2004), and Head and Mayer (2010); for OECD countries (Wei, 1996); for China see Young (2000), Poncet (2003, 2005), Holz (2009) and Hering and Poncet (2009); for Spain see Llano and Requena (2010); for France see Combes et al. (2005); for Brazil see Fally et al. (2010); for Germany see Nitsch and Wolf (2013) and Lameli et al. (2015); for Canada see Agnosteva et al. (2019) and Anderson et al. (2018) for the world.

[23] Following the literature, we set $\sigma = 7$.

[24] The large and asymmetric effects for agriculture are consistent with the fact that the EU imposes high sanitary and phytosanitary (SPS) conditions, which are among the most common and restrictive NTMs in Europe and sometimes lead to long delays at the borders crossing into EU (e.g. from Serbia into Croatia).

[25] The large border differences in services trade can be due to various unified standards within the EU, which impose barriers to services trade with outsiders. International restrictiveness in services is known to be particularly high in the area of data flow and limited mutual recognition. Another possible explanation is that trade in services is highly localized consumption.

Table 2
Sectoral gravity estimates CEFTA, 2000–2016.

	(1) Food	(2) Textiles	(3) Wood	(4) Chemicals	(5) Rubber	(6) Minerals	(7) Metals	(8) Machines	(9) Electronics	(10) Transport	(11) Other
A. Gravity estimates											
DIST	−0.864	−0.973	−1.101	−0.921	−0.717	−1.117	−0.773	−0.535	−0.638	−0.623	−0.801
	(0.039)**	(0.059)**	(0.047)**	(0.043)**	(0.068)**	(0.065)**	(0.076)**	(0.047)**	(0.054)**	(0.094)**	(0.074)**
CNTG	0.643	0.236	0.625	0.243	0.403	0.477	0.268	0.439	0.100	0.685	0.409
	(0.085)**	(0.093)*	(0.076)**	(0.090)**	(0.145)**	(0.103)**	(0.121)*	(0.099)**	(0.100)	(0.148)**	(0.129)**
LANG	0.631	0.162	0.362	0.503	0.366	0.353	0.680	0.409	0.268	0.387	0.145
	(0.064)**	(0.078)*	(0.068)**	(0.069)**	(0.107)**	(0.088)**	(0.081)**	(0.070)**	(0.099)**	(0.112)**	(0.105)
RTA	0.251	0.079	0.259	0.207	0.501	0.194	0.371	0.272	0.142	0.682	0.110
	(0.067)**	(0.081)	(0.089)**	(0.074)**	(0.102)**	(0.113)$^{+}$	(0.135)**	(0.077)**	(0.082)$^{+}$	(0.131)**	(0.127)
BRDR_EU	−3.569	−1.120	−3.087	−2.299	−1.571	−2.535	−2.351	−2.176	−2.127	−2.518	−2.334
	(0.118)**	(0.178)**	(0.155)**	(0.172)**	(0.313)**	(0.210)**	(0.225)**	(0.180)**	(0.196)**	(0.251)**	(0.220)**
BRDR_CEFTA_EU	−4.532	−3.613	−3.832	−3.125	−3.333	−3.767	−2.878	−3.219	−2.703	−3.765	−3.299
	(0.245)**	(0.305)**	(0.333)**	(0.326)**	(0.405)**	(0.358)**	(0.360)**	(0.353)**	(0.390)**	(0.566)**	(0.346)**
BRDR_EU_CEFTA	−4.861	−3.809	−4.004	−3.529	−3.476	−3.334	−3.726	−4.347	−4.127	−4.106	−4.084
	(0.230)**	(0.281)**	(0.263)**	(0.338)**	(0.355)**	(0.280)**	(0.359)**	(0.295)**	(0.338)**	(0.476)**	(0.361)**
BRDR_CEFTA	−3.208	−6.346	−3.057	−2.720	−4.009	−2.533	−2.782	−4.116	−2.462	−5.819	−3.053
	(0.232)**	(0.526)**	(0.318)**	(0.426)**	(0.524)**	(0.356)**	(0.339)**	(0.608)**	(0.531)**	(0.623)**	(0.444)**
BRDR_CEFTA_ROW	−5.418	−5.182	−4.667	−4.770	−4.547	−4.037	−4.940	−4.692	−4.323	−5.455	−5.198
	(0.218)**	(0.283)**	(0.250)**	(0.288)**	(0.352)**	(0.256)**	(0.339)**	(0.290)**	(0.328)**	(0.499)**	(0.371)**
BRDR_EU_ROW	−4.658	−2.098	−3.500	−2.687	−2.594	−3.029	−3.457	−2.452	−2.322	−2.976	−3.118
	(0.112)**	(0.159)**	(0.145)**	(0.160)**	(0.228)**	(0.192)**	(0.255)**	(0.152)**	(0.186)**	(0.274)**	(0.239)**
BRDR_ROW_ROW	−4.826	−2.997	−3.611	−3.168	−3.139	−3.308	−3.626	−2.685	−1.947	−3.505	−3.647
	(0.142)**	(0.174)**	(0.185)**	(0.143)**	(0.210)**	(0.250)**	(0.218)**	(0.151)**	(0.212)**	(0.275)**	(0.277)**
B. CEFTA vs. EU Border: Tariff equivalents											
$\%\Delta t_{CEFTA\rightarrow EU}$	−14.833	−33.994	−11.679	−12.853	−25.459	−18.556	−8.406	−15.965	−9.152	−18.778	−14.853
	(3.311)**	(3.011)**	(4.440)**	(4.483)**	(4.612)**	(4.220)**	(4.438)*	(4.758)**	(5.645)	(7.237)**	(3.840)**
$\%\Delta t_{EU\rightarrow CEFTA}$	−19.372	−36.121	−14.166	−18.523	−27.214	−12.462	−20.472	−30.359	−28.348	−23.265	−25.296
	(2.913)**	(2.780)**	(3.386)**	(4.311)**	(3.967)**	(3.121)**	(3.885)**	(3.228)**	(3.712)**	(5.653)**	(3.698)**
N	295 473	227 901	236 754	197 510	55 922	156 467	146 954	265 069	359 370	146 229	138 289

Notes: Panel A of this table reports gravity estimation results for the 11 main sectors within manufacturing in the sample, as they appear in the column names. All estimates are obtained with data for 2013. The data for each main manufacturing sector is constructed by pooling (not summing) the data for all individual manufacturing products within the corresponding main sector. The estimator is PPML and the dependent variable is nominal bilateral trade. All estimations are obtained with exporter-product and importer-product fixed effects, whose estimates are omitted for brevity. Standard errors are clustered by country pair and are reported in parentheses. $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. Panel B of the table reports tariff-equivalent trade cost changes, which are calculated as $\%\Delta t_{CEFTA\rightarrow EU} = ((exp(BRDR\_EU)/exp(BRDR\_CEFTA\_EU))^{1/(1-\sigma)} - 1) \times 100$ and $\%\Delta t_{EU\rightarrow CEFTA} = ((exp(BRDR\_EU)/exp(BRDR\_EU\_CEFTA))^{1/(1-\sigma)} - 1) \times 100$, respectively, where we set $\sigma = 7$. The standard errors in Panels B are constructed with the Delta method. See text for further details.

as compared to the border estimates for trade within the EU. Also consistent with our findings for aggregate manufacturing, we see from Panel B of Table 2 that, except for 'Minerals', the tariff equivalents faced by EU exports to CEFTA are larger than those for CEFTA exports to the EU. Based on the analysis in this section, we conclude that CEFTA members have the potential to face significantly lower barriers to trade upon accession to the European Union, which may lead to significant gains in terms of welfare. We use our structural gravity estimates to quantify the potential for such gains in the next section.

4.2. On the GE effects of CEFTA-EU harmonization

We employ the standard structural gravity general equilibrium framework following Dekle et al. (2007, 2008) to perform two counterfactual experiments that quantify the total GE impact on the exports of the countries in our sample.[26] The first experiment simulates the harmonization of MFN tariffs by the CEFTA countries to the EU tariff rates. To perform this analysis, we use data on actually applied tariffs, as described in the Data Section 3.2, to change the vector of trade costs for the CEFTA members. As the tariff data were available at the HS17 8-digit classification, we aggregated them up using trade shares as weights to match the level of aggregation for the GE analysis. For the counterfactual analysis, we set MFN tariffs to zero for trade between EU member countries and CEFTA member countries and set the MFN import tariffs of the CEFTA members for all their other trading partners besides the EU member countries to the MFN import tariff level of the EU.

The second experiment simulates the accession of the CEFTA countries to the EU in terms of the trade costs that these countries face for their trade with the EU. To perform this analysis, we rely on the estimates from Section 4.1. Specifically, we change the vector of trade costs that are faced by the CEFTA members so that the trade costs that they face with the EU are the same as the trade costs among the existing EU members. To this end, mechanically, to construct the counterfactual vector of trade costs, we replace the estimates on $BRDR\_CEFTA\_EU$ and $BRDR\_EU\_CEFTA$ to those on $BRDR\_EU$ for each of the 14 sectors in our sample.

[26] A description of the framework can be found in Appendix B of the Supplementary Appendix.

Table 3
Welfare effects of CEFTA ($\sigma = 7$).

Country	Manufacturing		Agriculture		Mining		Services
	Tariff	Border	Tariff	Border	Tariff	Border	Border
PANEL A: CEFTA countries							
ALB	2.31	23.15	0.30	2.53	0.05	1.30	−0.00
BIH	3.64	19.67	0.72	6.44	0.20	0.55	−0.00
MDA	1.52	17.00	1.97	7.24	−0.03	0.40	−0.00
MKD	3.76	24.36	1.86	5.44	0.78	2.25	−0.00
MNE	2.84	17.53	10.33	19.26	0.02	0.09	−0.00
SRB	3.64	18.34	1.97	4.83	0.05	0.24	3.89
PANEL B: EU countries and ROW							
AUT	0.02	0.08	0.09	0.42	−0.00	0.01	0.04
BEL	0.00	0.01	0.03	0.11	0.00	0.00	0.01
BGR	0.07	0.31	0.23	0.95	0.02	0.35	0.05
CYP	0.00	0.00	0.05	0.24	0.00	−0.00	0.07
CZE	0.01	0.06	0.02	0.07	0.00	0.03	0.01
DEU	0.01	0.04	0.02	0.06	−0.00	0.00	0.01
DNK	0.00	0.01	0.01	0.04	0.00	0.00	0.00
ESP	0.00	0.01	0.01	0.05	−0.00	0.00	0.00
EST	0.00	0.01	0.00	0.02	0.00	0.01	0.01
FIN	0.00	0.01	0.00	−0.00	−0.00	0.00	0.00
FRA	0.00	0.01	0.01	0.05	0.00	0.00	0.00
GBR	0.00	0.01	0.01	0.02	0.00	0.00	0.00
GRC	0.06	0.28	0.08	0.32	0.00	0.07	0.04
HRV	0.25	1.17	0.65	2.84	0.01	0.30	0.11
HUN	0.02	0.12	0.23	0.90	0.00	0.14	0.05
IRL	0.00	0.00	−0.00	−0.01	−0.00	0.00	0.01
ITA	0.02	0.10	0.03	0.12	0.00	0.00	0.00
LTU	0.00	0.01	0.03	0.14	0.00	0.05	0.01
LUX	0.00	0.01	−0.01	−0.05	−0.00	0.00	0.00
LVA	0.00	0.01	0.01	0.04	0.00	0.08	0.02
MLT	0.01	0.03	0.01	0.03	0.12	1.17	0.01
NLD	0.00	0.01	0.01	0.03	−0.00	0.00	0.00
POL	0.01	0.04	0.01	0.07	0.00	0.05	0.00
PRT	0.00	0.00	0.00	0.00	−0.00	0.00	0.00
ROU	0.05	0.25	0.03	0.13	0.00	0.16	0.02
SVK	0.02	0.08	−0.00	−0.00	−0.00	0.01	0.02
SVN	0.14	0.62	0.92	3.91	0.00	0.16	0.23
SWE	0.00	0.01	0.00	0.01	−0.00	0.00	0.00
ROW	−0.00	−0.00	−0.00	−0.00	0.00	−0.00	−0.00

Notes: This table reports results for our CEFTA border and tariff scenario assuming an elasticity of substitution of 7 ($\sigma = 7$). Column (1) gives the country abbreviations, and columns (2), (4), and (6) report the welfare changes from our tariff scenario for manufacturing, agriculture, and mining, respectively. Columns (3), (5), (7), and (8) report the welfare changes from our border scenario for manufacturing, agriculture, mining, and services, respectively.

The border-estimates approach has two advantages. First, as discussed in the previous section, the differences in the border effects that we obtain should capture the impact of any existing observable and unobservable trade barriers that act differentially on trade between CEFTA countries and the EU vs. trade within the EU. Second, our results indicate that the borders are also different between the groups in the services sector, where tariffs are not applicable. Finally, before we present and discuss our results, we note that in each of the two experiments we obtain 'full' general equilibrium effects for all countries in our sample and report the welfare effects (real expenditure changes), which are the single most important statistics from counterfactual analyses in trade (see Arkolakis et al., 2012). The results are calculated separately for each of the sectors in our sample.

We present results for the 6 CEFTA countries, the EU countries, plus one Rest of the World aggregate (ROW). Column (1) of Table 3 gives the country abbreviation. Columns (2), (4), and (6) report the percentage changes in welfare for the tariff scenario for manufacturing, agriculture, and mining, respectively. Columns (3), (5), (7), and (8) report the percentage change of welfare for the border liberalization scenario for manufacturing, agriculture, mining, and services, respectively. The table consists of two panels: Panel A reports the results for the 6 CEFTA countries, while Panel B reports the results for the EU countries and the ROW aggregate. To obtain the aggregated welfare effects for ROW, we calculate the weighted mean from all welfare changes with the output shares as weights. All results in Table 3 assume an elasticity of 7, which is at the higher end of average estimates of the elasticity of substitutions and therefore leads to more conservative results.[27]

[27] In the Supplementary Appendix, we also provide results based on an elasticity of 4, which is on the lower end of the spectrum for the elasticity of substitution in the Armington model. Typically, welfare effects are larger with lower values of σ (see Anderson and van Wincoop, 2003; Yotov et al., 2016).

Before we discuss our findings, we remind the reader that, due to the strong assumptions and the significant number of imputed observations that were needed to balance the dataset so that it is suitable for GE experiments, the analysis that we present in this section should be viewed as a tool to highlight our methods rather than as definitive policy analysis.[28] Specifically, our main objective is to use the same data and the same methods to compare the effects of a trade liberalization scenario based on observable tariff changes vs. a trade liberalization scenario based on the border estimates that we obtain in our partial analysis.

Subject to this caveat, the following results stand out from our estimates in the tariff-change scenario. First, the welfare effects for the CEFTA countries are typically positive. Often the welfare effects are around 2%–3%. Further, some CEFTA countries have lower average trade-weighted MFN tariffs than the EU countries. Hence, their tariff level increases to the level of the MFN tariff rate against all non-EU trade partners.[29] However, most trade of CEFTA member countries occurs within the EU. Hence, this liberalization leads to positive total welfare changes. Comparing across sectors, we find quite substantial heterogeneous effects. Agriculture still has comparable high MFN tariffs of around 10%, while they are below 5% in mining, and around 5% in total manufacturing. This also explains the larger effects of the welfare changes in agriculture, as compared to manufacturing and mining.

Besides the substantial heterogeneity across sectors, we also find substantial, but also intuitive, heterogeneity across countries. For the CEFTA countries, the initial MFN tariff rate and the initial openness explain quite well the resulting welfare effects. For the EU countries and the ROW, the effects are small in all sectors. The obvious reason here is that for the EU countries trade with the CEFTA countries is only a small fraction of their overall exports, and hence liberalizing tariffs does not lead to substantial welfare effects.

Let us next turn to our border scenario. Note that for the border scenario we also report results for services, which we could not include in our tariff scenario, as tariff data for services are not available. We find substantial increases in the welfare effects for all 6 CEFTA countries in manufacturing, agriculture, and mining, and these increases are larger than in the tariff scenario. This highlights that only relying on tariff data to investigate the effects of the integration between the CEFTA countries and the EU may miss a substantial part of the potential effects of trade liberalization. The comprehensive measure of the change in bilateral trade costs based on differences in the border estimates can be useful to quantify these additional gains.

Comparing across sectors, we find the largest increases again in agriculture, followed by manufacturing. Besides heterogeneity across sectors, we again find substantial heterogeneity among countries. Albania, Bosnia and Herzegovina, and North Macedonia are predicted to be the countries with the largest gains. As before, the gains for the EU countries and ROW are small, but we also observe some intuitive heterogeneity in these regions, e.g., larger gains for the countries that are closer to and more integrated with the CEFTA countries (e.g., Croatia, Greece, Hungary, etc.).

We conclude with an analysis of the effects for services, which are interesting for two reasons. First, as noted before, there are no tariffs in the services sector. Thus, we can only simulate counterfactual effects in response to changes in our border measures. Second, according to the ITPD-E data, Serbia is the only country that has reported services trade with the EU.[30] This has implications for our GE indexes and also some interesting modelling and policy implications too.

Turning to the estimates, we see two main results. First, Serbia enjoys sizable gains in the services sectors, while all other CEFTA countries suffer minor losses. The natural explanation for the losses is GE trade diversion, which is the only impact on the other CEFTA countries since they do not trade with the EU. The finding of losses for some of the CEFTA countries has an interesting policy implication, which is that the less some of the CEFTA countries integrate with the EU, the larger would the possibility that they may suffer due to GE forces. This result also points to an opportunity for improvement in our methods. Specifically, it is possible that joining the EU may trigger action on the extensive margin of trade, i.e., new links between the CEFTA and EU countries in services trade, which are not captured by our model.

5. Conclusion

We introduced a simple econometric approach to quantify ex-ante the comprehensive impact of trade liberalization and protection with the empirical structural gravity model, and we demonstrated the effectiveness of our methods by quantifying the partial and GE impact on trade and welfare of the integration of the CEFTA countries with the EU. Our partial equilibrium estimates revealed that even after controlling for the impact of standard proxies for trade costs (e.g., distance, language, etc.) trade borders within the EU are large and, more importantly for our purposes, that the borders between the CEFTA and the EU countries are even larger. We also observed significant heterogeneity in the border estimates across sectors and asymmetries depending on the direction of trade flows. A byproduct of our analysis is that we were able to obtain ad-valorem equivalents of the trade barriers for services, which are not subject to tariffs. The GE experiments that we performed demonstrated that (i) integration with the EU will have a large positive impact on welfare for the CEFTA countries, and (ii) that a simple elimination of tariffs may heavily under-predict the impact of CEFTA integration with the EU.

[28] We show some robustness concerning the imputation in the Supplementary Appendix. For mining, we do not have any positive trade flow observations for the Marshall Islands as exporter and no domestic sales, and we, therefore, had to drop it for the counterfactual analysis for mining. Similarly, we had to exclude Lesotho and Swaziland for the counterfactual analysis for services as we did not have any positive international trade flow observations for those countries in services.

[29] We provide information about the MFN tariffs and initial shares of spending on domestic goods for manufacturing, agriculture, mining, and services in the Supplementary Appendix.

[30] International trade data for services for all other countries are for Russia and Belarus. The CEFTA countries may have small trade flows with other countries too. However, these are not reported in the ITPD-E-R02. This points to potential opportunities for improvements in the data.

We hope that the simplicity and flexibility of our methods, along with their compatibility with the standard quantitative trade models, will make them useful for benchmark policy analysis. In addition to offering a comprehensive account of the impact of non-tariff barriers to trade, which is especially relevant for services trade, we see an important application of our methods for quantifying the impact of regional integration and the impact of "borders" within countries. While tariffs are not imposed for domestic trade, there is plenty of evidence that domestic trade is not frictionless and that proper quantification of domestic trade costs is important for quantifying the effects of both international and domestic policies.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jce.2023.06.006.

References

Agnosteva, Delina E., Anderson, James E., Yotov, Yoto V., 2019. Intra-national trade costs: Assaying rgional frictions. Eur. Econ. Rev. 112 (C), 32–50.
Allen, Treb, Arkolakis, Costas, 2014. Trade and the topography of the spatial economy. Q. J. Econ. 129 (3), 1085–1140.
Anderson, James E., 2011. The gravity model. Annu. Rev. Econ. 3, 133–160.
Anderson, James E., Larch, Mario, Yotov, Yoto V., 2018. GEPPML: General equilibrium analysis with PPML. World Econ. 41 (10), 2750–2782.
Anderson, James E., van Wincoop, Eric, 2003. Gravity with gravitas: A solution to the border puzzle. Amer. Econ. Rev. 93 (1), 170–192.
Anderson, James E., van Wincoop, Eric, 2004. Trade costs. J. Econ. Lit. 42 (3), 691–751.
Arkolakis, Costas, Costinot, Arnaud, Rodriguez-Clare, Andrés, 2012. New trade models, same old gains? Amer. Econ. Rev. 102 (1), 94–130.
Baier, Scott L., Kerr, Amanda, Yotov, Yoto V., 2018. Gravity, distance, and international trade. In: Blonigen, Bruce A., Wilson, Wesley W. (Eds.), Handbook of International Trade and Transportation. Chapters. Edward Elgar Publishing, pp. 15–78, Chapter 2.
Baier, Scott L., Yotov, Yoto V., Zylkin, Thomas, 2019. On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration. J. Int. Econ. 116, 206–226.
Bergstrand, Jeffrey H., Larch, Mario, Yotov, Yoto V., 2015. Economic integration agreements, border effects, and distance elasticities in the gravity equation. Eur. Econ. Rev. 78, 307–327.
Borchert, Ingo, Larch, Mario, Shikher, Serge, Yotov, Yoto V., 2021a. Disaggregated gravity: Benchmark estimates and stylized facts from a new database. Rev. Int. Econ..
Borchert, Ingo, Larch, Mario, Shikher, Serge, Yotov, Yoto V., 2021b. The international trade and production database for estimation (ITPD-E). Int. Econ. 166 (C), 140–166.
Borchert, Ingo, Larch, Mario, Shikher, Serge, Yotov, Yoto V., 2022. The International Trade and Production Database for Estimation R02 (ITPD-E-R02). USITC Working Paper 2022-07-A.
Chen, Natalie, 2004. Intra-national versus international trade in the European Union: Why do national borders matter? J. Int. Econ. 63 (1), 93–118.
Combes, Pierre-Philippe, Lafourcade, Miren, Mayer, Thierry, 2005. The trade-creating effects of business and social networks: Evidence from France. J. Int. Econ. 66, 1–29.
Coşar, A. Kerem, Fajgelbaum, Pablo D., 2016. Internal geography, international trade, and regional specialization. Am. Econ. J. Microecon. 8 (1), 24–56.
Costinot, Arnaud, Donaldson, Dave, Komunjer, Ivana, 2012. What goods do countries trade? A quantitative exploration of Ricardo's ideas. Rev. Econom. Stud. 79 (2), 581–608.
Costinot, Arnaud, Rodriguez-Clare, Andrés, 2014. Trade theory with numbers: Quantifying the consequences of globalization. In: Gopinath, Gita, Helpman, Elhanan, Rogoff, Kenneth S. (Eds.), Handbook of International Economics, Vol. 4. Elsevier Ltd., Oxford, Chapter 4.
Coughlin, C.C., Novy, D., 2012. Is the international border effect larger than the domestic border effect? Evidence from US trade. CESifo Econ. Stud. 59 (2), 249–276.
Dekle, Robert, Eaton, Jonathan, Kortum, Samuel, 2007. Unbalanced trade. Am. Econ. Rev.: Pap. Proc. 97, 351–355.
Dekle, Robert, Eaton, Jonathan, Kortum, Samuel, 2008. Global rebalancing with gravity: Measuring the burden of adjustment. IMF Staff Pap. 55 (3), 511–540.
Fajgelbaum, Pablo, Redding, Stephen J., 2022. Trade, structural transformation, and development: Evidence from Argentina 1869–1914. J. Polit. Econ. 130 (5), 1249–1318.
Fally, Thibault, Paillacar, Rodrigo, Terrac, Cristina, 2010. Economic geography and wages in Brazil: Evidence from micro-data. J. Dev. Econ. 91, 155–168.
Grieveson, Richard, Grubler, Julia, Holzner, Mario, 2018. Western Balkans EU Accession: Is the 2025 Target Date Realistic?. wiiw Policy Notes 22, The Vienna Institute for International Economic Studies.
Gurevich, Tamara, Herman, Peter, 2018. The Dynamic Gravity Dataset: 1948–2016. USITC Working Paper 2018–02–A.
Head, Keith, Mayer, Thierry, 2010. Illusory border effects: Distance mismeasurement inflates estimates of home bias in trade. In: Brakman, S., van Bergeijk, P. (Eds.), The Gravity Model in International Trade: Advances and Applications. Cambridge.
Heid, Benedikt, Larch, Mario, Yotov, Yoto V., 2021. Estimating the effects of non-discriminatory trade policies within structural gravity models. Can. J. Econ. 54 (1), 376–409.
Hering, Laura, Poncet, Sandra, 2009. Market access and individual wages: Evidence from China. Rev. Econ. Stat. 91 (1), 145–159.
Hillberry, Russell, Hummels, David, 2003. Intranational home bias: Some explanations. Rev. Econ. Stat. 85 (4), 1089–1092.
Holz, Carsten A., 2009. No razor's edge: Reexamining Alwyn Young's evidence for increasing interprovincial trade barriers in China. Rev. Econ. Stat. 91 (3), 599–616.
Iliev, Dragomir, Stefanov, Galin, Yotov, Yoto, 2016. Estimating Bulgaria's trade borders with the EU: An application of the empirical gravity model of trade. Bus. Manag. 1 (4).
Lameli, Alfred, Südekum, Jens, Nitsch, Volker, Wolf, Nikolaus, 2015. Same same but different: Dialects and trade. Ger. Econ. Rev. 16 (3), 290–306.
Llano, Carlos, Requena, Francisco, 2010. The border effects in Spain: An industry-level analysis. Empirica 37 (4), 455–476.
Martin, Philippe, Mayer, Thierry, Thoenig, Mathias, 2008. Civil wars and international trade. J. Eur. Econom. Assoc. 6 (2–3), 541–550.
Millimet, Daniel L., Osang, Thomas, 2007. Do state borders matter for U.S. Intranational trade? The role of history and internal migration. Can. J. Econ. 40 (1), 93–126.
Nitsch, Volker, 2000. National borders and international trade: Evidence from the European Union. Can. J. Econ. 33 (4), 1091–1105.
Nitsch, Volker, Wolf, Nikolaus, 2013. Tear down this wall: On the persistence of borders in trade. Can. J. Econ. 46 (1), 154–179.
Poncet, Sandra, 2003. Measuring Chinese domestic and international integration. China Econ. Rev. 115, 1–21.
Poncet, Sandra, 2005. A fragmented China: Measure and determinants of Chinese domestic market disintegration. Rev. Int. Econ. 13, 409–430.
Ramondo, Natalia, Rodríguez-Clare, Andrés, Saborío-Rodríguez, Milagro, 2016. Trade, domestic frictions, and scale effects. Amer. Econ. Rev. 106 (10), 3159–3184.
Santos Silva, J.M.C., Tenreyro, Silvana, 2006. The log of gravity. Rev. Econ. Stat. 88 (4), 641–658.

Santos Silva, J.M.C., Tenreyro, Silvana, 2011. Further simulation evidence on the performance of the Poisson Pseudo-Maximum Likelihood estimator. Econom. Lett. 112 (2), 220–222.

UNCTAD-WTO, 2012. A Practical Guide to Trade Policy Analysis. WTO, Geneva.

Vicard, Vincent, 2012. Trade, conflict, and political integration: Explaining the heterogeneity of regional trade agreements. Eur. Econ. Rev. 56 (1), 54–71.

Wei, Shang-Jin, 1996. Intra-National Versus International Trade: How Stubborn are Nations in Global Integration? NBER Working Papers No 5531.

Wolf, Holger C., 2000. Intranational home bias in trade. Rev. Econ. Stat. 82 (4), 555–563.

Yilmazkuday, Hakan, 2012. Understanding interstate trade patterns. J. Int. Econ. 86, 158–166.

Yotov, Yoto V., 2012. A simple solution to the distance puzzle in international trade. Econom. Lett. 117 (3), 794–798.

Yotov, Yoto V., 2022. On the role of domestic trade flows for estimating the gravity model of trade. Contemp. Econ. Policy.

Yotov, Yoto V., Piermartini, Roberta, Monteiro, José-Antonio, Larch, Mario, 2016. An Advanced Guide to Trade Policy Analysis: The Structural Gravity Model. UNCTAD and WTO, Geneva.

Young, Alwyn, 2000. The Razor's edge: Distortions and incremental reform in the People's Republic of China. Q. J. Econ. 115 (4), 1091–1135.