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ABSTRACT

ON THE HETEROGENEOUS TRADE AND WELFARE EFFECTS OF GATT/WTO MEMBERSHIP

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We build on the latest developments in the structural gravity literature to quantify the partial and general equilibrium effects of GATT/WTO membership on trade and welfare. Using an extensive database covering manufacturing trade for 186 countries over the period 1980-2016, we find that the average impact of GATT/WTO membership on trade among member counties is large, positive, and significant. We contribute to the literature by estimating country-specific estimates and find them to vary widely across the countries in our sample with poorer members benefitting more. Using these estimates, we simulate the general equilibrium effects of GATT/WTO on welfare, which are sizable and heterogeneous across members, and relatively small for non-member countries. We show that countries not experiencing positive trade effects from joining GATT/WTO can still gain in terms of welfare, due to beneficial terms-of-trade effects.

Keywords: GATT, WTO, Heterogeneous Policy Effects, Structural Gravity, Welfare.
JEL classification: F1, F13, F14

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1 Introduction

The World Trade Organisation (WTO)—the central intergovernmental organization overseeing and administering the multilateral trading system—celebrates its 25th anniversary in 2020. Created in 1995, it provides the institutional framework for the General Agreement on Tariffs and Trade (GATT), which entered into force in 1948, the General Agreement on Trade in Services (GATS), and the Treaty on Trade Related Aspects on Intellectual Property Rights (TRIPS). Since 1948, member countries of the GATT/WTO have continuously reduced customs duties, non-tariff barriers, and export subsidies with the objective to improve market access across countries.[1] The WTO has three important functions which represent the backbone of the multilateral system: i) help negotiate multilateral trade deals, ii) settle cross-border commercial disputes, and iii) serve as a repository for members' trade policies.

GATT and WTO have been created with the objective to promote cross-border trade, thereby improving welfare in all member states. However, in recent years, criticism has increased, and the usefulness of the architecture of WTO has been questioned. Disturbingly, academic attempts to establish empirical evidence for the expected trade supporting effects of the GATT and the WTO have turned out to be difficult. Starting from Andrew Rose's controversial empirical analysis (Rose, 2004), according to which member states of GATT/WTO did not experience significantly different trade patterns than non-members, until today, the succeeding related literature has had difficulties to establish a causal positive GATT/WTO impact on trade and welfare. A large number of empirical studies have concluded that unlike regional trade agreements or currency unions, membership in the GATT or the WTO has not resulted in positive trade effects. At the same time, other empirical analyses conclude that a GATT or WTO accession leads to a rise in exports for most of the member states.[2]

In this paper, we revisit the evidence, building on the latest developments in the struc-

[1] In the early years, the GATT represented primarily a club of mostly industrialized countries. Over the years, membership has increasingly covered the entire world; in 1995 the freshly created WTO had 127 members; today it counts 164 member states.

[2] We refer to Esteve-Pérez et al. (2020) for a recent comprehensive overview of related publications.

tural gravity literature. One key innovation relative to the literature is the treatment of intranational/domestic trade flows. With the exception of Larch et al. (2019), earlier papers have ignored them, probably due to the lack of an appropriate data. We apply an extensive dataset that covers intra- and international trade in manufacturing goods for 186 countries over the period 1980-2016. We show that including intranational flows is crucial to obtain sensible results. The reason is that intranational flows add an important source of variance for econometric identification. With WTO membership almost universal, in recent years the control group of non-members has become very small.

Moreover, the presence of intra-national flows is crucial to estimate theory-consistent country-specific trade effects. In doing so, we provide a second important contribution. It turns out that heterogeneity across GATT/WTO members is strong and, therefore, imposing homogeneity across the GATT/WTO effects across member countries may be misleading. We find that a few countries' trade flows are even hurt.

Finally, we also contribute to the literature by using the trade cost effects of GATT/WTO membership identified in the econometric analysis in order to simulate the welfare effects in a general equilibrium model consistent with the empirical gravity model.[3] We reveal strong differences in countries, possibly providing a rationale for different levels of support for the multilateral system. Interestingly, under general equilibrium, in some countries, negative partial GATT/WTO estimates (implying positive estimated trade cost effects from GATT/WTO membership) are overturned by beneficial price and income effects so that welfare goes up.

Our partial equilibrium estimates suggest that GATT/WTO membership increases exports of GATT/WTO member countries to their fellow GATT/WTO members in a vast majority of the members in our sample. Specifically, our estimates imply that, in terms of volume effects, the average impact of GATT/WTO on members' trade is between 38% and 101%. We demonstrate that, to a significant degree, this result is driven by the theory-

[3]While the methods to obtain the general equilibrium estimates are standard, we are not aware of any study that analyzes the welfare effects of GATT/WTO.

consistent introduction of domestic trade flows in our structural gravity estimations. The most important distinction between our approach and earlier studies is that, while the latter are able to obtain GATT/WTO estimates for different groups of countries, our methods enable us to obtain a whole distribution of country-specific GATT/WTO effects, which can be analyzed across different dimensions. Our estimates reveal that the majority of countries enjoyed increased exports after joining GATT/WTO, but we also obtain negative estimates for some members. Importantly, we find that poorer counties have benefited relatively more in terms of increased exports. This is an encouraging result from a development perspective.

Using these partial estimates, we perform a counterfactual analysis where we quantify the welfare effects of GATT/WTO for all countries in our data. We find that member countries gained in terms of welfare on average 4.37 percent, with a huge variation from -4.24 percent to 28.58 percent. Welfare falls on average by -0.44 percent for non-GATT/WTO members. We find as main drives behind these heterogeneous effects heterogeneous partial trade cost estimates and differing trade openness. Interestingly, some countries with negatively estimated exporter-specific GATT/WTO effects have positive welfare effects from trading with GATT/WTO members, emphasizing the importance of taking into account general equilibrium effects.

Our work is related to a substantial body of empirical work on the effects of GATT/WTO membership on trade. The literature started with the seminal paper by Rose (2004) who found that, in contrast to regional trade agreements and currency unions, a GATT/WTO membership has not generated positive trade effects. This finding has been challenged by a large number of subsequent papers, who have moved the analysis towards a more structural estimation approach and who have tended to find evidence for trade-creating effects. Felbermayr and Kohler (2006) argue that accounting for the extensive margin of trade is crucial. Subramanian and Wei (2007) and Eicher and Henn (2011) find that it is key to allow for treatment heterogeneity and that "the WTO promotes trade, strongly but unevenly". Tomz et al. (2007) argue that is important to classify countries according to their partici-

pation status in the GATT/WTO (instead of formal membership). Chang and Lee (2011) extend the analysis by using nonparametric methods including pair-matching and illustrate even stronger positive effects for specific country groups. The most recent related paper by Esteve-Pérez et al. (2020) seems to confirm the earlier finding by Rose (2004). Results appear to be robust to the use of alternative measures of trade flows, across periods and country groups, and to changes in the periodicity of the data.

The rest of the paper is organized as follows. Section 2 offers some descriptive motivational evidence on the importance of WTO in shaping the modern world trading system. Section 3 reviews the structural gravity theory and specifies our econometric model. Section 4 presents and discusses our partial equilibrium estimates of the impact of GATT/WTO on trade. Section 5 translates the partial estimates into general equilibrium welfare effects. Section 6 concludes.

2 Illustrative Descriptive Evidence

The GATT entered into force in 1948 with 23 member states primarily concerned with reducing tariffs. Today, its successor institution, the WTO, counts 164 member nations. It covers a wide array of aspects related to international trade, including trade in goods and services, textiles, agriculture and the international rules for the protection of patents, trademarks and copyrights.[4] GATT/WTO member states continuously reduced trade barriers over the years. Successive rounds of negotiations in the GATT/WTO have cut tariffs on trade in manufactured goods from an average level of 40 percent in 1947 to around 7 percent for most of the industrialized member countries.[5]

Figure 1 presents a comparison of cross-border trade between GATT/WTO-members and non-member states, by depicting the evolution of total trade within these two groups.

[4]The 23 founding members were: Australia, Belgium, Brazil, Burma, Canada, Ceylon, Chile, China, Cuba, Czechoslovakia, France, India, Lebanon, Luxembourg, Netherlands, New Zealand, Norway, Pakistan, Southern Rhodesia, Syria, South Africa, United Kingdom and the United States.

[5]A comprehensive overview of applied tariff levels is available in the World Integrated Trade Solution (WITS) database.

In 1948, when the GATT was initiated, member states already made up around 70 percent of world trade. This share in global trade steadily increased over the following years with the rise of membership in the GATT/WTO. Today, almost 95 percent of global merchandise trade (approximately 19.5 trillion US-Dollar as of 2018) is taking place under the umbrella of WTO rules. Hence, today, the majority of global trade is organized within the multilateral trading system.

Figure 2 illustrates the evolution of trade in each GATT/WTO-country for 8 years prior to and 8 years post accession to the multilateral trading system, where the data allows such an analysis. The figure shows how trade in each listed year has changed in the pre- and post-accession period relative to the country-specific accession year. Therefore, in the accession year (t=0), the observed change in each country is equal to zero indicated by an index value 1. Larger index values indicate a relative higher trade in the specific year relative to a country's accession year amounting to the respective index value, while smaller numbers appear if trade in a specific year turns out to be smaller than in the accession year.

According to Figure 2 for the majority of GATT/WTO member states total trade with the world has increased after becoming member of the global trading system. The average change of total trade relative to each countries' accession year is positive and increases continuously over the years after GATT/WTO-membership (black dotted line). In case of China, for example, total trade with the world relative to the accession year increased significantly faster than in most other member states. Just within three years after its WTO-membership, China experienced a doubling of total trade. Japan and Germany also experienced a relative strong increase in total trade during the post accession period, although not to the same extent as China. On the other hand, the case of Russia illustrates that countries can experience a drop in total trade after becoming a GATT/WTO member. Five years after WTO membership Russia was still trading less with the world compared to its accession year.

Overall, these descriptive statistics suggest an average trade boosting effect once a country

becomes a member in the GATT/WTO.[6] At the same time trade promoting effects of the GATT/WTO appear to be highly heterogeneous across countries. Besides varying positive growth rates in trade after GATT/WTO membership, there are also countries experiencing a significant decline in cross-border trade.

3 Quantifying the WTO Effects: A Structural Gravity Approach

The gravity model of trade has always been the workhorse to estimate the partial equilibrium impact of various trade policies and other determinants of trade flows, including the impact of GATT/WTO. However, none of the evaluations of GATT/WTO have proceeded to obtain full general equilibrium welfare effects. Instead, in this study, we capitalize on the full structure of the gravity model to perform consistent estimation and general equilibrium (GE) analysis of the effects of GATT/WTO. Since we rely on the standard version of the gravity model, we review the theoretical foundations of structural gravity only briefly, in Section 3.1. Then, in Section 3.2, we review and extend the latest developments in the empirical gravity literature to set up an econometric model that will enable us to obtain a series of heterogeneous GATT/WTO estimates, which will be translated into GE welfare effects in Section 5.

3.1 A Brief Review of the Structural Gravity Model

The following system of equations is well-known in the literature as the structural gravity model of trade. As famously demonstrated by Arkolakis et al. (2012), the structural gravity

[6] We view this only as suggestive evidence as the increase of trade could be due to other reasons than the GATT/WTO membership. The figure may also merely captures country-specific trends in trade growth. To control for other influences and country-specific trends, we will perform a rigorous empirical analysis later on.

model is representative of a very wide class of underlying microfoundations:[7]

$$X_{ij,t} = \frac{Y_{i,t}E_{j,t}}{Y_t}\left(\frac{t_{ij,t}}{P_{j,t}\Pi_{i,t}}\right)^{1-\sigma}, \quad (1)$$

$$\Pi_{i,t}^{1-\sigma} = \sum_j \left(\frac{t_{ij,t}}{P_{j,t}}\right)^{1-\sigma}\frac{E_{j,t}}{Y_t}, \quad (2)$$

$$P_{j,t}^{1-\sigma} = \sum_i \left(\frac{t_{ij,t}}{\Pi_{i,t}}\right)^{1-\sigma}\frac{Y_{i,t}}{Y_t}, \quad (3)$$

Equation (1), known as the structural gravity equation that governs bilateral trade flows, can be conveniently decomposed into two terms: a size term, $\frac{Y_{i,t}E_{j,t}}{Y_t}$, and a trade cost term, $\left(\frac{t_{ij,t}}{P_{j,t}\Pi_{i,t}}\right)^{1-\sigma}$. The first, size term consists of the nominal income in country i in year t, $Y_{i,t}$, country j's aggregate expenditure in year t, $E_{j,t}$, and world output in year t, Y_t, which is the sum over i of $Y_{i,t}$ (and due to world trade balance, also the sum over j of $E_{j,t}$). The intuitive interpretation of the size term, $\frac{Y_{i,t}E_{j,t}}{Y_t}$, is as the hypothetical level of frictionless trade between partners i and j if there were no trade costs. The size term implies that large producers will export more to all destinations; big/rich markets will import more from all sources; and trade flows between countries i and j will be larger the more similar in size the trading partners are. An important implication for the GE analysis of the impact of GATT/WTO is that if countries indeed gain by joining GATT/WTO then they will become larger and, through this size channel, they will trade more not only with the rest of the GATT/WTO members but also with the countries that are outside GATT/WTO.

The natural interpretation of the second, trade cost term in equation (1), $\left(\frac{t_{ij,t}}{P_{j,t}\Pi_{i,t}}\right)^{1-\sigma}$,

[7]Following the first theoretical foundation of gravity in economics by Anderson (1979), a series of prominent papers derive the structural gravity model from alternative micro-foundations, e.g., Anderson and van Wincoop (2003) and Eaton and Kortum (2002)). The gravity model has also been derived at the sectoral level, on the demand side, e.g., Anderson and van Wincoop (2004) and on the supply side, e.g., Costinot et al. (2012), and with intermediate goods, e.g., Caliendo and Parro (2015). Given the purpose of our study to obtain benchmark GE welfare effects of GATT/WTO, we employ the most simple and transparent traditional version of the structural gravity model with one sector and without taking into account intermediates and asset accumulation. We recognize that such extensions are feasible and may be interesting from a policy perspective, but they are beyond the scope of this study. Arkolakis et al. (2012) demonstrate the generality of the structural gravity model. We refer the reader to Anderson (2011), Costinot and Rodríguez-Clare (2014), Head and Mayer (2014), and Yotov et al. (2016) for surveys of the theoretical gravity literature.

corresponds to the total effects of trade costs that drive a wedge between realized and frictionless trade. The trade cost term consists of three components. (i) The vector $t_{ij,t}$ denotes the direct bilateral trade costs between partners i and j in year t. This vector is particularly important for our analysis because, along with many other determinants of trade costs, it is through this channel that the literature, and our study in particular, obtain the initial/direct partial equilibrium estimates of the effects of GATT/WTO. We model and elaborate on the definition of the direct bilateral trade costs vector in the next section.

(ii) The structural term $P_{j,t}$, coined by Anderson and van Wincoop (2003) as inward multilateral resistance has a duel interpretation in the structural gravity model. On the one hand, it is a GE trade cost term that captures the incidence of trade costs on the consumers in country j, as if they imported from a single world market. Thus, the inward multilateral resistance captures the impact of trade diversion effects on the consumers in the gravity model, even for given country sizes. The second theory-consistent interpretation of $P_{j,t}$ is as an ideal consumer price index, c.f., Anderson and Yotov (2010). Thus, in combination with the nominal values for output, $Y_{i,t}$, and expenditure, $E_{i,t}$, the inward multilateral resistance can be used to deliver corresponding real indexes, i.e., real GDP, $Y_{i,t}/P_{i,t}$, and real expenditure, $E_{i,t}/P_{i,t}$, as the measures of welfare that we will construct and employ in Section 5. (iii) Finally, the structural term $\Pi_{j,t}$, defined as outward multilateral resistance by Anderson and van Wincoop (2003) captures the GE incidence of trade costs on the producers in each country. The practical advantage of the outward multilateral resistance is that, through the market clearing condition, it can be linked directly to the factory-gate prices, $p_{j,t}$, in the gravity model as follows:[8]

$$p_{j,t} = \frac{(Y_{j,t}/Y_t)^{\frac{1}{1-\sigma}}}{\gamma_j \Pi_{j,t}}. \tag{4}$$

[8]In addition to being the link (through the outward multilateral resistance, $\Pi_{j,t}$), between the direct/partial equilibrium estimates of bilateral trade costs and the first-order GE effects of trade costs changes on country size, equation (4) is also important from an empirical perspective because it is a restatement of the market clearing condition $Y_i = \sum_i X_{ij}$, which always includes domestic trade flows. As such, equation (4) underscores the importance of domestic trade flows, which, as emphasized in the empirical analysis, will be crucial for our strategy to identify the effects of GATT/WTO.

Here the parameter γ_j can have alternative interpretations, e.g., as a preference or a technology parameter, depending on the underlying theoretical foundations, and all other variables are defined above. Equation (4) establishes an intuitive inverse relationship between factory-gate prices $p_{j,t}$ and the corresponding outward multilateral resistances: the larger the GE incidence of trade costs on the producers, the lower the price that they can receive for their products. The implication for our analysis is that any changes in the vector of bilateral trade costs, e.g., joining the GATT/WTO, will be translated into changes into the factory gate prices for each country in the world through the multilateral resistances, which, in turn, will lead to direct changes in nominal output and expenditures. Thus, the multilateral resistances serve as vehicles that would translate the initial, partial equilibrium effects of joining GATT/WTO to country-specific effects on consumer and producer prices. The direct effects do give the initial impact effects of trade costs on trade flows, while the general equilibrium trade costs also take into account the changes in prices, incomes and expenditures induced by trade cost changes.

3.2 Estimating the Impact of WTO with Structural Gravity

To obtain our estimates of the direct GATT/WTO effects on trade between member countries, we translate the structural gravity equation (1) into the following econometric model:

$$X_{ij,t} = \exp[\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \mathbf{GRAV_{ij,t}}\gamma + \mathbf{INTL_{ij,t}}\delta + \mathbf{GATTWTO_{ij,t}}\beta] + \epsilon_{ij,t}. \quad (5)$$

The variable $X_{ij,t}$ denotes nominal trade flows in levels, which include international and intra-national/domestic trade, for consecutive year t.[9] Consistent with theory, intra-national trade flows are domestic sales that are needed to close the market-clearance conditions for each country. As demonstrated below, the inclusion of domestic trade will play a crucial role for the estimation of the impact of GATT/WTO, not only because it will affect the average/common GATT/WTO estimate but also because it will enable us to obtain country-specific GATT/WTO, which do not exist in the literature.[10] The data that we employ to perform the analysis covers aggregate manufacturing for the period 1980-2016 and include international trade flows and domestic sales for 186 countries. We refer the reader to Larch et al. (2019) for further details on the dataset.[11]

Our most preferred specification includes three sets of fixed effects. The term $\pi_{i,t}$ denotes the set of time-varying source-country dummies, which control for the outward multilateral resistances, countries' output shares and, potentially any other observable and unobservable exporter-specific factors that may influence bilateral trade. The term $\chi_{j,t}$ encompasses the set of time-varying destination-country dummy variables that account for the inward multilateral resistances, total expenditure, and any other observable and unobservable importer-specific characteristics that may influence trade. The term μ_{ij} denotes the set of country-pair fixed effects, which serve two main purposes. First, the pair fixed effects are the most flexible

[9] Cheng and Wall (2005) note that econometric specifications with fixed effects, such as the gravity model employed here, are *"sometimes criticized when applied to data pooled over consecutive years on the grounds that dependent and independent variables cannot fully adjust in a single year's time."* (Footnote 8, p. 52, Cheng and Wall, 2005). Therefore, they recommend the use of interval data instead of data over consecutive years for gravity estimations. Many papers follow this recommendation and, to avoid the Cheng-and-Wall critique, they estimate gravity with interval data. For example, Trefler (2004) also criticizes trade estimations with samples that are pooled over consecutive years and he uses 3-year intervals. Cheng and Wall (2005) and Baier and Bergstrand (2007) use 5-year intervals, while Olivero and Yotov (2012) experiment with 3- and 5-year interval data. More recently, however, Egger et al. (2020) argue that in addition to improving estimation efficiency and avoiding arbitrary dropping of observations, the use of pooled/consecutive-year data in fact improves our ability to capture the adjustment of trade flows in response to trade policy changes.

[10] Some papers already emphasized the benefits of using intra-national trade flows. For example Anderson and van Wincoop (2003) and de Sousa et al. (2012) use intra-national trade data to estimate border effects, Yotov (2012) uses intra-national trade flows to resolve 'the distance puzzle', Bergstrand et al. (2015) use intra-national trade flows to identify globalization effects and the evolution of international borders over time, while Heid et al. (2020) demonstrate that with intra-national trade flows unilateral and non-discriminatory trade policies can be identified.

[11] A list of the 186 countries in our sample appears in Table 2.

and comprehensive measure of time-invariant bilateral trade costs because they absorb all time-invariant gravity covariates along with any other time-invariant bilateral determinants of trade costs that are not observable by the researcher and/or the policy maker, c.f., Egger and Nigai (2015) and Agnosteva et al. (2019). In our main analysis we will employ directional country-pair fixed effects, which will control for any asymmetries in the time-invariant bilateral trade costs. Second, on a related note, the pair fixed effects will absorb most of the linkages between the endogenous trade policy variables and the remainder error term $\epsilon_{ij,t}$ in order to control for potential endogeneity of the former, c.f., Baier and Bergstrand (2007). In principle, the error term in gravity equations may carry some systematic information about trade costs. However, due to the rich fixed effects structure in equation (5), we interpret $\epsilon_{ij,t}$ as a true measurement error. Finally, we note that it does not matter whether the error term $\epsilon_{ij,t}$ in equation (5) may be introduced additively or multiplicatively, c.f., Santos Silva and Tenreyro (2006).

The term $\mathbf{GRAV_{ij,t}}\gamma$ denotes the vector of standard gravity variables, such as bilateral distance, sharing a common border (contiguity), sharing a common language, and sharing a colonial history, as well as any time-varying bilateral determinants of trade flows, such as RTAs.[12] To establish the representativeness of our sample, we will start the empirical analysis without using the country-pair fixed effects, which would absorb all time-invariant bilateral gravity variables, e.g., distance. Since we include not only international but also intra-national trade flows, we also control for crossing the national borders by including the terms $\mathbf{INTL_{ij,t}}\delta$, which are also allowed to be time-varying. The inclusion of time-varying international border variables is important for the identification of the GATT/WTO because the estimates on these dummies will capture common globalization effects. Bergstrand et al. (2015) demonstrate the that proper control for globalization effects in structural gravity models leads to smaller estimates of the effects of FTAs. Below, we will demonstrate that this is also the case with the country-specific estimates of the impact of GATT and WTO

[12]Data on bilateral distance, contiguous borders, colonial ties and common language were taken from CEPII, c.f., Mayer and Zignago (2011).

that we will obtain. Importantly, to the extent that GATT and WTO have had multilateral trade liberalization effects, the implication is that our border/globalization estimates will capture some of the possible trade liberalization effects of GATT and WTO. Decoupling these effects from the impact of globalization is beyond the scope of this study. However, the implication of our country-specific GATT/WTO estimates is that they are conservative, i.e., possibly biased downward.

$\mathbf{GATTWTO_{ij,t}}\beta$ is the most important vector of variables for our purposes. Following the related literature, we will start our analysis with a specification that obtains a single GATT/WTO estimate. One of the key differences of our quantification of the impact of GATT/WTO membership from all other studies, except for Larch et al. (2019), is that the inclusion of domestic trade flows in our estimating sample allows for possible trade diversion effects of GATT/WTO members from domestic sales. This adjustment is consistent with gravity theory, as described above, and with the objectives of GATT and WTO. Further, an important novelty in our estimations is that we will obtain country-specific GATT/WTO effects within the same theory-consistent estimation framework. To the best of our knowledge, such country-specific quantification does not exist so far in the related literature.

4 On the Partial Equilibrium Effects of GATT/WTO

This section presents our main findings on the direct/partial equilibrium impact of GATT/WTO on the trade flows among member countries. Section 4.1 obtains and discusses the common estimate of GATT/WTO, which is the standard approach in the literature. Then, Section 4.2 presents our novel estimates of the heterogeneous, country-specific effects of GATT/WTO.

4.1 Common Estimates of the Impact of GATT/WTO

Table 1 presents a series of structural gravity estimates. In order to emphasize the importance of proper account for different estimation challenges, we take a sequential approach to obtaining and presenting our results. There are five common features across all columns in Table 1: (i) The dependent variable is always nominal bilateral trade in levels; (ii) The estimator is always PPML; (iii) All estimates are obtained with panel data; (iv) In each specification we control for the unobservable structural multilateral resistance terms, as well as for all other observable and unobservable characteristics that may affect trade on the importer or on the exporter side, with exporter-time and importer-time fixed effects; (v) Finally, all estimates are obtained with consecutive-year data. Thus, the main differences between the five columns in Table 1 are across three dimensions: (i) Whether we use standard time-invariant bilateral gravity variables or pair fixed effects; (ii) Whether or not intra-national trade flows are added to the estimating sample; and (iii) Whether we control for common globalization trends (i.e., whether we use time-varying border variables). Our results indicate that all of these estimation practices play important roles for proper quantification of the effects of GATT/WTO.

Column (1) of Table 1 estimates the gravity model with the set of standard gravity variables and international trade flows only (i.e., without intra-national trade flows), as is standard in the literature and as has been done in the vast majority of papers that evaluate the impact of GATT/WTO.[13] Without going into details, we note that the estimates of the impact of the standard gravity variables are readily comparable to those from the literature, e.g., our estimates are close to the meta-analysis results of Head and Mayer (2014), that are based on an extensive and thorough coverage of gravity paper. This establishes the representativeness of our sample.

The estimates in column (2) of Table 1 introduce country-pair fixed effects. As noted

[13]As noted earlier Larch et al. (2019) is the single exception, of which we are aware of, that also uses domestic trade flows.

earlier, the motivation for the inclusion of pair fixed effects in gravity estimations is twofold. First, they will absorb and will fully control for the impact of all observable and unobservable determinants of bilateral trade. For this reason, we can no longer include in column (2) any of the time-invariant standard gravity covariates, i.e., LN_DIST, $CNTG$, $LANG$, and $CLNY$. In order to allow for asymmetries in the underlying time-invariant trade costs, we employ directional pair fixed effects. Second, on a related note, the use of the pair fixed effects will help mitigate endogeneity concerns related to the trade policy variables in our specification, specifically the RTAs, which are included in column (1), and especially important for our purposes, the GATT/WTO variables, which we introduce next. The main result from column (2), as compared to column (1) is that comprehensive control of all time-invariant trade costs has significant impact on the estimates of the time-varying policy variables in our specification, e.g., RTAs, whose estimate decreases significantly in magnitude and becomes statistically insignificant.

The results in column (3) of Table 1 replicate the estimates from column (2) but also introduce the key variable of interest to our analysis, i.e., the bilateral indicator for GATT/WTO membership (GATTWTO). Two main results stand out from column (2): (i) The estimate on the RTA variable is not statistically significantly affected; and (ii) More importantly, the estimate of the impact of GATT/WTO is actually negative and marginally statistically insignificant. This result is consistent with the findings from the existing literature that GATT/WTO has not been successful in promoting international trade among members.

The results in column (4) of Table 1 replicate the corresponding specification from column (3) but after introducing internal trade flows to the estimating sample. When the gravity model is estimated with intra-national trade flows and standard gravity variables, along with the additional observations for internal trade, at a minimum, we also have to introduce an additional covariate, $INTL\_BRDR$, which is an indicator border variable that takes a value of one for international trade, and is equal to zero otherwise. The idea behind the introduction of this covariate is that it would capture international border effects that drive

a wedge between internal and international trade, and which have not been captured by the other covariates in our estimating model. This said, the explicit inclusion of border dummies is not necessary in our specification because the pair fixed effects absorb all border variables. In fact, the directional pair fixed effects in our specification allow and control for country-specific and asymmetric border effects.

Two main findings stand out from the results in column (4). First, we note that the estimate on RTAs is now positive large and statistically significant. This result is consistent with the results from Dai et al. (2014) and Bergstrand et al. (2015), which are obtained with alternative samples. Second, and most important for our purposes, we see in column (4) that the estimate of the key covariate of interest in our analysis, GATTWTO, is now positive, large and statistically significant. In terms of volume effects, the estimate from column (4) implies that, all else equal, GATT/WTO membership has lead to about 101 percent increase in trade flows among members. This result confirms the importance of the recommendation of Yotov et al. (2016) that structural gravity estimations should be performed with samples that include internal trade flows, and it is consistent with the main result from Larch et al. (2019). The intuition for this result is that the specification with intra-national trade flows explicitly allows for and accounts for diversion from international trade flows due to GATT/WTO membership. Our estimates confirm that this is indeed the case, and imply that the GATT/WTO estimates from studies that do not allow for diversion from domestic sales may be biased downward.

Finally, the estimates in the last column (5) of Table Table 1 replicate the results from column (4) but after also introducing a series of time-varying border variables for each year in the estimating sample, i.e., we introduce fixed effects that correspond to the interaction between $INTL\_BRDR * YEAR$, where YEAR denotes the years in our sample (1980-2016). This specification is motivated by Bergstrand et al. (2015), who demonstrate that (i) the effects of economic integration agreements (EIAs) are significantly larger when common globalization forces are not accounted for; and (ii) that the impact of international borders

on trade has fallen over time. Given the purpose of our study, and for brevity, we do not report the estimates of time-varying border variables. However, we do note that they clearly capture the fall of international borders over time, thus resolving the "missing globalization puzzle" of Coe et al. (2002), who argue that globalization is everywhere but in estimating gravity models.

Consistent with the findings and conclusions of Bergstrand et al. (2015), the estimates in column (5) reveal that once globalization forces are accounted for, the estimates of the policy variables (RTA and GATT/WTO) are smaller in magnitude. Specifically, the GATT/WTO is more than twice smaller (despite the decreased magnitude, the impact of GATT/WTO is still positive and economically and statistically significant), while the RTA effects is more that three times smaller as compared to the corresponding estimates from column (4). The intuition is that the previously larger effects of GATT/WTO and RTA also capture general globalization forces. As noted earlier, this is potentially important for our GATT/WTO estimates because GATT/WTO arguably GATT and WTO have had multilateral globalization effects that are now captured by the estimates of the time-varying border variables in our specification. The implication for the GATT/WTO estimate in column (5) is that it may be biased downward. Thus, we view it as a conservative/lower bound of the true GATT/WTO impact on trade among members. In combination with our estimate from column (4), we establish the bounds of the direct/partial trade volume effects of GATT/WTO on trade among members to be between 38% and 101%, which is comparable to the estimates of Subramanian and Wei (2007) of 65% for developed countries and 32% for developing countries. The analysis in the next section would enable us to go beyond the distinction between developed vs. developing countries by obtaining country-specific GATT/WTO effects.

4.2 On the Heterogeneous Effects of GATT/WTO

In this section, we go beyond what has been done in the existing literature by obtaining country-specific GATT/WTO effects on the exports of each GATT/WTO member country

to its fellow GATT/WTO members. Specifically, we estimate

$$X_{ij,t} = \exp[\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \mathbf{GRAV_{ij,t}}\gamma + \mathbf{INTL_{ij,t}}\delta + \sum_{\mathbf{i}} \beta_{\mathbf{i}}\mathbf{GATTWTO_{ij,t}}] + \epsilon_{ij,t}, \quad (6)$$

where the last term in the square brackets captures the fact that we obtain country-specific estimates of the impact of GATT/WTO. Note that without the use of domestic trade flows, the country-specific GATT/WTO variables would be perfectly collinear with the exporter-time and the importer-time fixed effects in our model and, therefore, one could not identify them in a properly specified (with exporter-time and importer-time fixed effects) structural gravity model. We view the country-specific GATT/WTO as one of our main contributions of this paper.

Since specification (6) delivers a large number of estimates, we present our findings graphically. We start, in Figure 3, with a general analysis of the whole distribution of estimates. Then, in Figure 4, we zoom in on the effects on specific countries. We conclude the section with a visualization, in Figure 5, of the importance of the inclusion of domestic trade flows and accounting for globalization effects for proper quantification of the effects of GATT/WTO.

Panel A of Figure 3 reports all country-specific estimates of the effects of GATT/WTO that we obtain simultaneously from equation (6). We are able to obtain individual GATT /WTO estimates for a total of 143 countries. The estimates are ordered from smallest to largest and, to avoid clutter, the figure does not include country names. (Figure 4 below includes country identifiers.) Four main findings stand out from Panel A of Figure 3. First, we observe very wide heterogeneity in the estimates of the effects of GATT/WTO. Second, we note that most (about two-thirds) of the GATT/WTO estimates that we obtain are positive and sizable. Third, we also obtain a significant number (about one-third) of negative GATT/WTO estimates. Finally, we see the presence of some clear outliers at each end of the distribution of estimates in Panel A Figure 3.

To get a clearer picture and understanding of the estimates at the tails of the distribution,

we visualize them in the lower panels of Figure 3. For clarity, we have dropped the extreme cases at each end.[14] Panels B and C of Figure 3 reveal some clear breaks in the estimates on both sides. Specifically, for the negative estimates, apart from the extreme and clear negative outliers, there is a break between the estimates -0.4 and -0.5. On the positive side, there is a break between the estimates of 1.1 and 1.23. Inspection of the number of observations used for identification shows that many of the countries at the two tails of the distribution have only few observations used for identification. Therefore, in combination with the clear breaks, this motivates us to treat these estimates with caution as outliers, especially in the general equilibrium analysis, where, as described below, we approach them in several alternative ways.

In order to improve exposition and interpretation, the three panels of Figure 4 are designed to map the estimates from Figure 3, but without the outliers, to the countries for which they are obtained. An important pattern that see in Figure 4 is that the GATT/WTO estimates that we obtain are generally larger for poorer and less developed countries.[15] A possible explanation for this result is that these countries joined GATT/WTO more recently and this opened doors for more secure trade with the large GATT/WTO members. Similarly, a possible explanation for the fact that our estimates of the effect of f GATT/WTO for the richer and more developed countries is that many of those countries were founders of GATT, which formed a long time prior to our sample's coverage. Thus, they may have already exhausted significant part of the potential benefits from trade with other large countries that also joined prior to the period that is covered in our sample. It is important to emphasize that the large number of positive estimates that we obtained, even for the old and large

[14]This resulted in the dropping of a total of 40 countries, which are indicated with an '*' in Table 2. As can be seen from 2, the dropped countries are usually very small economies or former Soviet republics. Thus, Figure 3 presents 107 of the 143 GATT/WTO that we obtain initially.

[15]This finding is consistent with the results from Eicher and Henn (2011), who find that the effect of the WTO membership on trade is only positive before the formation of RTAs and among proximate developing countries. However, it is different from the results in Subramanian and Wei (2007) who argue that GATT/WTO increase trade more for developed countries. In addition to differences in the estimating samples, we believe that the different methodology (of including domestic trade flows) is a the driving force behind the differences with these studies.

GATT/WTO members, is driven by their trade with the members that joined during the period of investigation. The effects of GATT/WTO on countries that joined before 1980 are controlled for by the pair fixed effects in our specification, however, they cannot be identified separately due to lack of data.

We conclude this section with an investigation of the importance of two adjustments to the econometric gravity model that have potentially important implications for the estimations of trade policy effects with the structural gravity equation. Specifically, these adjustments are: (i) including internal trade flows; and (ii) controlling for common globalization effects. To facilitate the discussion we visualize our findings in Figure 5. The blue estimates in the figure replicate our results from Figure 4, i.e. they are obtained with intra-national trade flows and after accounting for globalization. The red estimates in Figure 5 are obtained from an econometric model that is identical to our main specification with the only difference being that intra-national trade flows are not included in the estimating sample. The message is clear and consistent with the recommendations for structural gravity estimations of Yotov et al. (2016) and the main result from Larch et al. (2019): The inclusion of intra-national trade flows is important and it leads to larger estimates of the impact of GATT/WTO membership. Figure 5 shows that, with very few exceptions, the GATT/WTO estimates obtained without internal trade flows are always smaller as compared to the corresponding effects that are obtained with internal trade flows in the sample.

The green estimates in Figure 5 are obtained from an econometric model that is identical to our main specification with the only difference being that we do not include the time-varying border dummy variables that are designed to control for common globalization trends. Two main findings stand out. First, most of the GATT/WTO estimates that are obtained without controlling for globalization are larger than the corresponding estimates that do control for common globalization trends. This result is consistent with the findings of Bergstrand et al. (2015). Second, we see that the difference between the green and the blue estimates in Figure 5 is very heterogeneous. Thus, the main implication of this analysis

is that it is important to account for globalization effects in the structural gravity estimations. In addition, to the extent that GATT and WTO may have had multilateral trade liberalization effects for global trade, an additional and specific implication of this analysis is that our border/globalization estimates may have captured some of the trade liberalization effects of GATT and WTO that have affected trade globally. Decoupling these effects from the impact of globalization is beyond the scope of this study. However, the implication for our country-specific GATT/WTO estimates is that they may possibly be biased downward.

In sum, we draw the following four main conclusions based on the partial equilibrium analysis in this section. First, all else equal, the average impact of GATT/WTO on aggregate manufacturing trade among member countries is positive, and economically and statistically significant. Specifically, our estimates imply that, in terms of volume effects, the average impact of GATT/WTO on members' trade is between 38% and 101%. Second, our country-specific estimates reveal that the effects of GATT/WTO are widely heterogeneous across members. The majority of countries enjoyed increased exports after joining GATT/WTO, but we also obtain negative estimates for some members. Importantly, we find that pooper counties have benefitted relatively more in terms of increased exports. This is an encouraging result from a development perspective. Finally, our analysis underscores the importance of including domestic trade flows as mandated by theory and of properly accounting for globalization effects in the structural gravity model.

5 On the Welfare Effects of GATT/WTO

Capitalizing on the partial equilibrium estimates, we offer country-specific welfare estimates for all countries in our dataset. In order to be able to perform our counterfactual analysis, we have to prepare appropriate data across three dimensions.

First, we had to construct a square/balanced dataset of exporters and importers for a cross-section. To ensure a maximum number of non-missing observations, we used data from the last five years (2012-2016) and we averaged trade flows for all country pairs in our

dataset.[16] For GATT/WTO membership, we took as relevant year the year 2016. In this way, we are able to use all 186 countries for our counterfactual analysis, which are listed in alphabetical order in column (1) of Table 3.

Another crucial feature of the data set used in the GE counterfactual analysis is that it had to include production/internal trade flows for all countries in the sample, i.e., the data for the counterfactual analysis has to be balanced. To this end, few options were available, including using GTAP data. Our decision was to rely on and extend the dataset that was used to obtain the partial estimates, which included internal trade flows for 154 countries. Our strategy was to replace missing intra-national trade flows by using the median value of international relative to internal trade for the countries for which we did have internal trade flows data (which is 1.962 in our sample).

Third, we had to decide how to treat the outlier partial GATT/WTO estimates, which we identified in the estimation section, i.e., estimates below -0.41 and above 1.2. To this end, and in order to offer a comprehensive and transparent analysis, we experimented with four alternative sets of partial equilibrium estimates, including: (i) A set that consists of all GATT/WTO estimates, including the extreme outliers; (ii) A set, where we have replaced the estimates for the outliers with zeroes; (iii) A set, where we set the estimates for the outliers to be equal to the aggregate estimate from column (5) of Table 1 (0.32); and (iv) A set where we set the estimates for the negative outliers to be equal to a lower bound that is based on the natural break that we identified in Figure 3, i.e., we set all outlier estimates to -0.4012. Similarly, we replace all positive outliers with 1.105, which is the estimate at the break in the upper tail of the distribution. We obtain estimates, which we present and discuss below, with all four sets of partial equilibrium estimates.

With the resulting square dataset of 186 countries at hand, we used the standard structural gravity framework, as for example described in Yotov et al. (2016), to perform our gen-

[16] For Taiwan we use 2006 values, the most recent year with trade data for Taiwan in our dataset.

eral equilibrium counterfactual analysis.[17] Specifically, we investigate the effects of GATT/WTO membership for all countries in the dataset by assuming zero effect in the baseline and using our exporter-specific partial estimates for the GATT/WTO members, for which the trade cost counterfactual changes are given by $((\exp(\text{GATT/WTO estimate}))^{1/(1-\sigma)} - 1) \times 100$, where we set σ equal to 5, which is a standard value in the literature. These data and estimates, combined with the underlying theory of structural gravity, deliver the welfare effects of GATT/WTO membership that we report in Table 3. Welfare changes are calculated as change in real manufacturing GDP, given in percent.

Comparing the results from the four different scenarios shows that the main difference is for some smaller countries. For example Dem. Rep. of Congo, Niger, Gambia, Afghanistan, Bulgaria, Botswana, St. Vincent and the Grenadines, and Benin see substantial smaller effects when we replace outliers with zeros (column (5)), with the aggregate value (column (6)), or with bounds (column (7)). The reason is that for these countries the point estimates are positive and large (larger than 1.2). For other countries, such as Suriname, Fiji, Rwanda, Madagascar, Belize, Myanmar, Mozambique, and Liberia we see larger effects, as we replace the large negative point estimates (smaller than -0.4). As discussed in the estimation

[17] Assuming an endowment economy with CES preferences, we can write nominal output as $Y_{i,t} = \sum_j X_{ij,t} = \sum_j (\gamma_i p_{i,t})^{1-\sigma} t_{ij,t}^{1-\sigma} E_{j,t}/P_{j,t}$, where we replaced X_{ij} using the solution for expenditures on goods shipped from country i to country j of the consumer's optimization problem. We follow Dekle et al. (2007; 2008) to define country i's share in country j's spending as $\pi_{ij,t} = X_{ij,t}/E_{j,t}$. Using hats to denote ratios of counterfactual to baseline values, the change of $\pi_{ij,t}$ between the baseline (denoted with superscript b) and the counterfactual (denoted with superscript c) can be written as $\hat{\pi}_{ij,t} = \pi_{ij,t}^c/\pi_{ij,t}^b = \left(\hat{p}_{i,t}\hat{t}_{ij,t}\right)^{1-\sigma} / \sum_l \pi_{lj,t}^b \left(\hat{p}_{l,t}\hat{t}_{lj,t}\right)^{1-\sigma}$. Due to the assumption of an endowment economy, we have $E_{i,t} = Y_{i,t} + TI_{i,t} = p_{i,t}Q_{i,t} + TI_{i,t}$, where $Q_{i,t}$ are initial endowments in i in year t and $TI_{i,t}$ denote trade imbalances, which are held constant between baseline and counterfactual. Hence, $\hat{Y}_{j,t} = \hat{p}_{j,t}$ and $\hat{E}_{i,t} = E_{i,t}^c/E_{i,t}^b = (\hat{Y}_{i,t}Y_{i,t}^b + TI_{i,t})/E_{i,t}^b$, and $\hat{Y}_{i,t}$ can be calculated as $Y_{i,t}^b\hat{Y}_{i,t} = \sum_j \frac{\pi_{ij,t}^b(\hat{Y}_{i,t}\hat{t}_{ij,t})^{1-\sigma}}{\sum_l \pi_{lj,t}^b(\hat{Y}_{l,t}\hat{t}_{lj,t})^{1-\sigma}}(\hat{Y}_{j,t}Y_{j,t}^b + TI_{j,t})$. We can solve these equations with trade flows data and a value for σ only, using $Y_{i,t} = \sum_j X_{ij,t}$, $E_{j,t} = \sum_i X_{ij,t}$, $TI_{i,t} = E_{i,t} - Y_{i,t}$, and $\pi_{ij,t} = X_{ij,t}/E_{j,t}$. We use $p_{i,t}$ from Germany as our numéraire. The changes in $t_{ij,t}$, $\hat{t}_{ij,t}$, form the basis of our counterfactual experiment. With $\hat{Y}_{i,t}$, we can calculate the remaining changes: $\hat{E}_{j,t} = (\hat{Y}_{j,t}Y_{j,t}^b + TI_{j,t})/E_{j,t}^b$, $\hat{p}_{j,t} = \hat{Y}_{j,t}$, $\hat{P}_{j,t} = (\sum_l \pi_{lj,t}^b(\hat{p}_{l,t}\hat{t}_{lj,t})^{1-\sigma})^{1/(1-\sigma)}$, and $\hat{\pi}_{ij,t} = (\hat{p}_{i,t}\hat{t}_{ij,t})^{1-\sigma}/(\sum_l \pi_{lj,t}^b(\hat{p}_{l,t}\hat{t}_{lj,t})^{1-\sigma})$. Real GDP changes (our measure of welfare) are given by: $\hat{W}_{j,t} = (\hat{\pi}_{ii,t})^{1/(1-\sigma)}$. We refer the reader to Yotov et al. (2016) for a detailed discussion of the multilateral resistances, their properties and construction, as well as more detailed discussion about performing a counterfactual analysis. In addition, Head and Mayer (2014) and Costinot and Rodríguez-Clare (2014) offer very informative and insightful reviews of the cutting-edge approaches to perform general equilibrium analysis with the structural gravity model.

section, for these countries we view our point estimates as outliers. Hence, the welfare effects for those countries should be taken with care. The different ways of treating outliers clearly highlight this fact. Encouragingly, as the outliers are smaller countries, our welfare effects for many of the other countries are hardly affected by the way we treat the outliers. In the following, we will focus on our results from column (7) of Table 3 where we replace the outliers with bounds.

The main results from Table 3 are in-line with expectations. Total exports of GATT /WTO members increase welfare on average by 3.88 percent, whereas welfare falls on average by -0.44 percent for non-GATT/WTO members. Behind these average effects is a substantial heterogeneity across the countries in our sample. The welfare effects range from -4.24 percent for Liberia to 28.58 percent for the Gambia.

To better understand these heterogeneous effects, in Figure 6, we plot the welfare effects against the change in trade costs. There is a strong negative correlation of -0.819, which shows that if there is a substantial drop in trade costs due to GATT/WTO, the welfare effects are also larger. This visualizes the importance of the direct, partial effect. However, the correlation is far from perfect, which shows the general equilibrium channels at work. The general equilibrium effects, which work through price and income changes, are the strongest for the most open countries, i.e., countries that sell a large share of their output abroad. For example, for Laos, Gambia, Myanmar, and Rep. of Congo, which all have a very low share of domestic sales in our data and are all clearly above our regression line, implying larger than average, predicted welfare gains given their trade cost change. On the other hand, countries like China, Syria, Japan, and India, for example, sell a lot domestically and are below our linear best-fit line plotted in red in Figure 6.

In Figure 6 we also see quite some countries with negative partial GATT/WTO estimates (note that a positive change in trade cost is associated with a negative point estimate of GATT/WTO membership). As expected, some of these countries see negative welfare effects. However, some of them still see positive welfare effects (as, for example, Australia, Burkina

Faso, Bolivia, Ecuador, Spain, France, United Kingdom, Guinea, Greece, Guatemala, Hong Kong, China, Honduras, Kenya, Sri Lanka, Macao, Nigeria, Nicaragua, Nepal, Panama, Peru, Paraguay, Uganda, Rep. Yemen, and Zambia). The reason for the positive welfare effects despite the negative partial effects are cheaper imports from GATT/WTO trading partners with substantial drops in their trade costs. This implies that GATT/WTO membership has for many countries positive trade cost change effects that we already see in the partial estimates. These positive trade cost effects spill over to trading partners due to cheaper imports. Hence, even countries with negatively estimated exporter-specific GATT/WTO effects may see positive welfare effects from trading with GATT/WTO members.

6 Conclusion

Does the GATT/WTO create trade and increase welfare of its members? Most trade policy practitioners would answer affirmatively. However, so far, the empirical literature has provided conflicting evidence. Given the current debates about the future of the world trading system and the benefits and costs of multilateralism, a convincing answer to the question is of eminent importance.

Fortunately, since the first econometric paper by Rose (2004), the research community has substantially improved the methods and has firmly anchored the gravity equation, the workhorse of empirical trade studies, into theory. However, so far, not all of the improvements have been applied to the debate about the GATT/WTO. Building on this progress, in this paper, we provide novel estimates. In line with Larch et al. (2019), we show that, in order to identify the effect properly, one needs to account for intra-national trade flows. Not only is such a strategy mandated by theory, it also improves estimation efficiency and facilitates identification.

Most importantly, this strategy allows us to obtain country-specific estimates of the impact of GATT and WTO on the manufacturing exports of member countries. We find that, while heterogeneous, the majority of our estimates are positive and sizeable. Based on

these, our counterfactual analysis finds the following welfare effects for a GATT and WTO membership: countries joining the rules based trading system achieved welfare gains of 3.88 percent on average. WTO membership is worth an increase in welfare of 3.5 percent for Germany, 6.7 percent for Israel, and 1.1 percent for the US. In contrast, welfare is -0.44 percent lower for the average country outside GATT/WTO.

Overall, the empirical findings of this study show strong positive trade and welfare effects resulting from a GATT- and WTO-membership. Our findings suggest that the rules-based international trade system with the WTO as its crucial pillar has played an important role for economic prosperity over the past decades.

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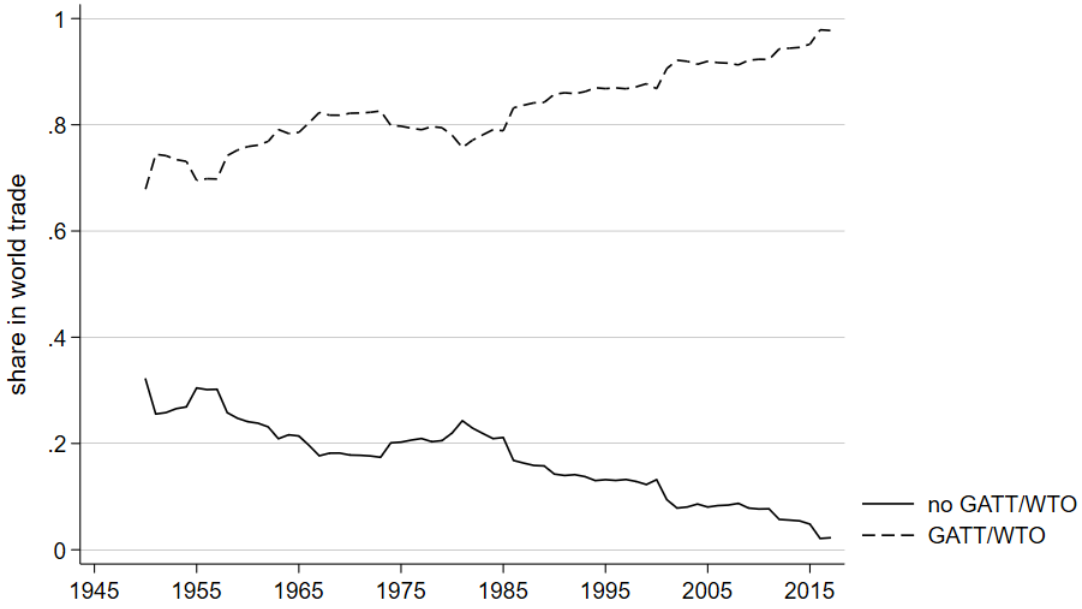
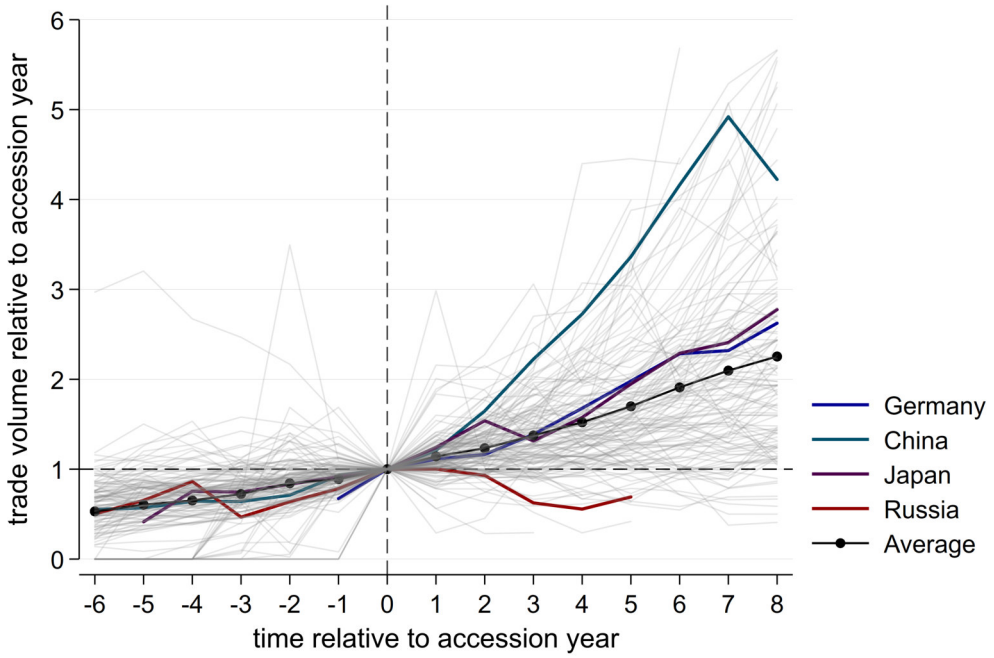
Figure 1: Share of GATT/WTO Members vs. Non-Members in World Trade Volume Over Time



Note: This figure depicts cross-border trade between GATT/WTO-members and non-member states, by depicting the evolution of each groups' share in total trade.
Source: Direction of Trade Statistics (DOTS), WTO.

Figure 2: Average Annual Change in Trade Before and After GATT/WTO Accession, by country



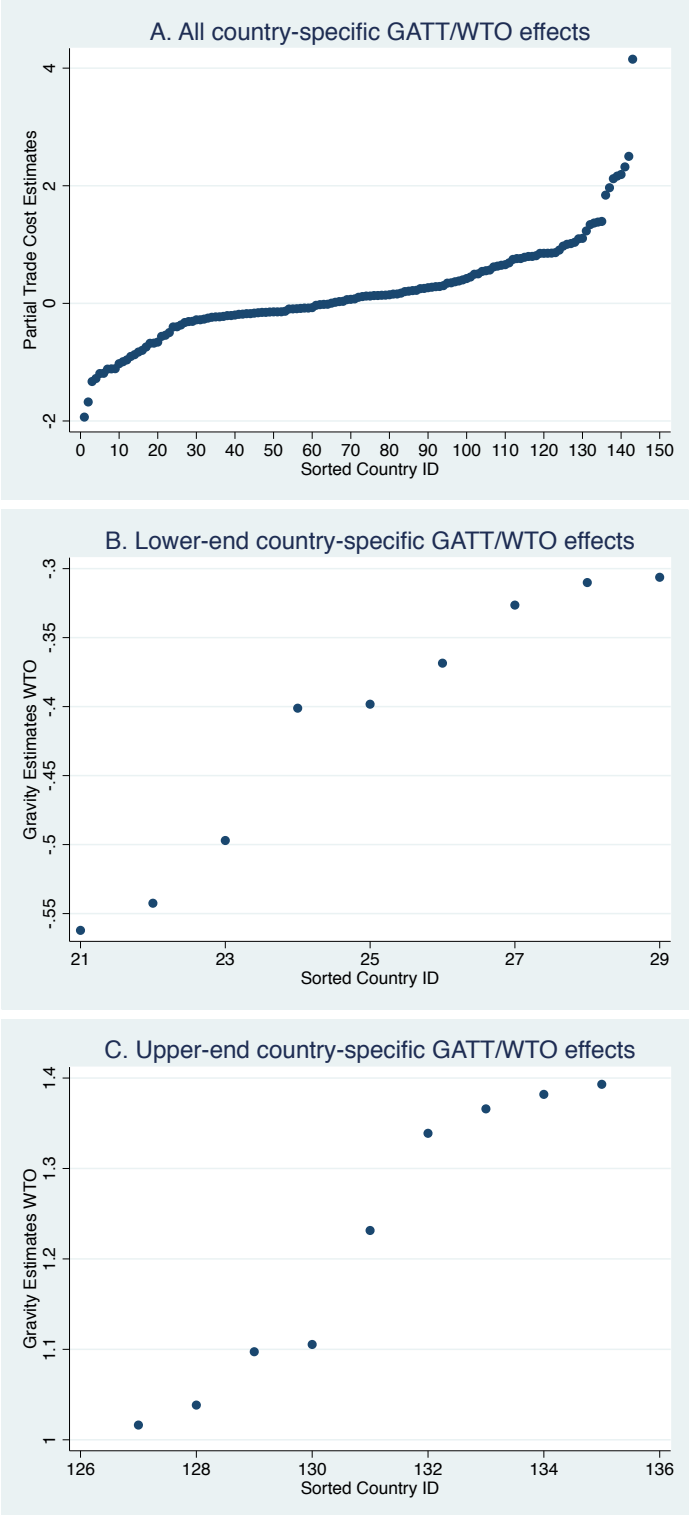
Note: This figure illustrates the evolution of trade in each GATT/WTO member state for 8 years prior to and 8 years after GATT/WTO-membership, where the data allows such an analysis. The figure quantifies how trade changed in the pre- and post-accession period relative to the country-specific accession year. Accordingly, in the accession year (t=0), the observed change in each country is equal to zero indicated by an index value 1. Larger index values indicate a relative higher trade growth in the specific year relative to a country's accession year, while smaller numbers appear if trade in a specific year turns out to be smaller than in the accession year.
Source: Direction of Trade Statistics (DOTS), WTO.

Table 1: Estimates of the Effects of GATT/WTO

	(1) GRAV	(2) PAIR	(3) WTO	(4) INTRA	(5) GLBZN
RTA	0.331	0.033	0.032	0.440	0.120
	(0.047)**	(0.045)	(0.045)	(0.064)**	(0.042)**
LN_DIST	-0.797				
	(0.028)**				
CNTG	0.412				
	(0.063)**				
LANG	0.174				
	(0.059)**				
CLNY	0.028				
	(0.078)				
GATTWTO			-0.194	0.698	0.320
			(0.076)*	(0.078)**	(0.064)**
N	735940	720069	720069	723181	723181

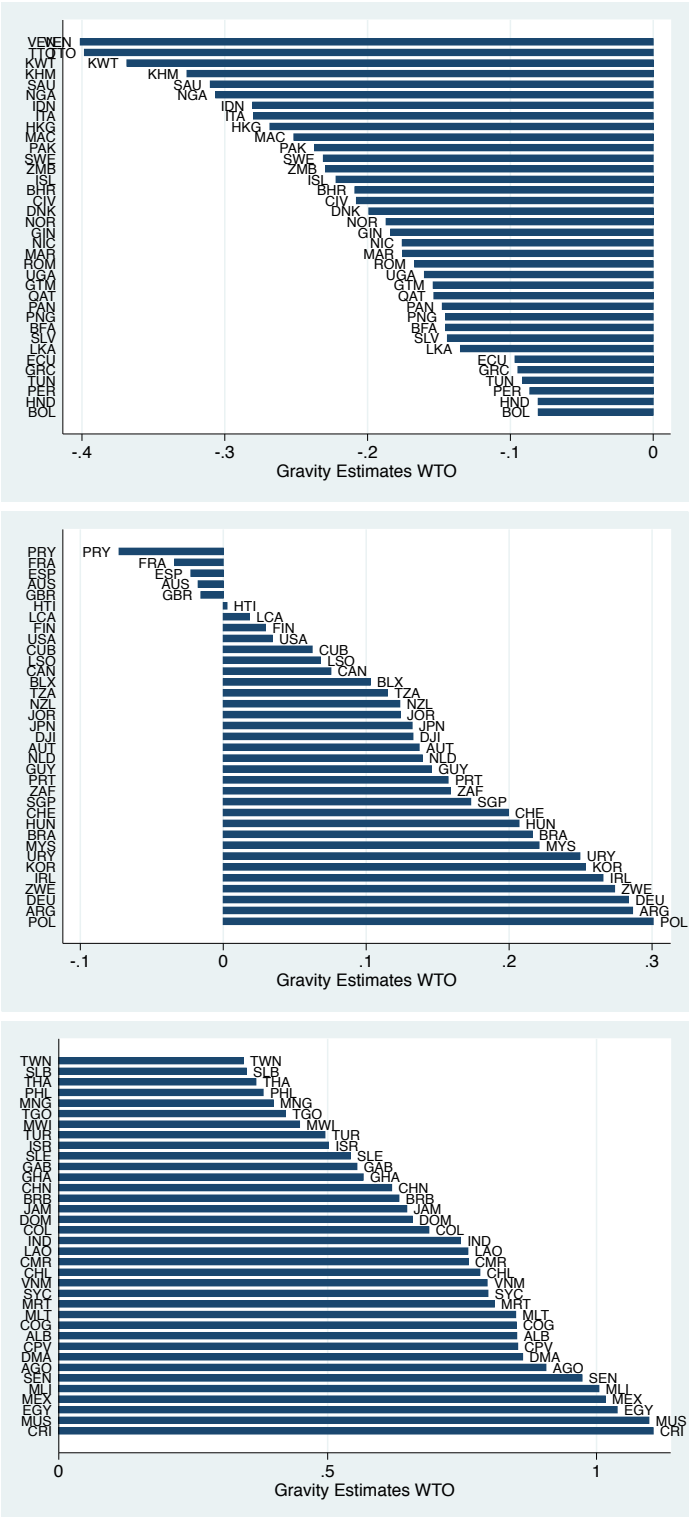
Notes: This table reports estimates of the partial equilibrium effects of GATT/WTO on members' trade. The dependent variable is always nominal bilateral trade in levels. The estimator is always PPML. All estimates are obtained with panel data over consecutive years. Each specification includes exporter-time and importer-time fixed effects, whose estimates are omitted for brevity. The estimates in column (1) are obtained with standard gravity variables. Column (2) introduces pair fixed effects. Column (3) adds a dummy variable for GATT/WTO membership. The estimates in Column (4) are based on a sample including intra-national trade flows, in addition to the international trade flows that are used in columns (1)-(3). Finally, column (5) introduces time-varying border dummy variables to account for common globalization trends. Standard errors are clustered by country pair. $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Figure 3: Country-specific Effects of GATT/WTO I



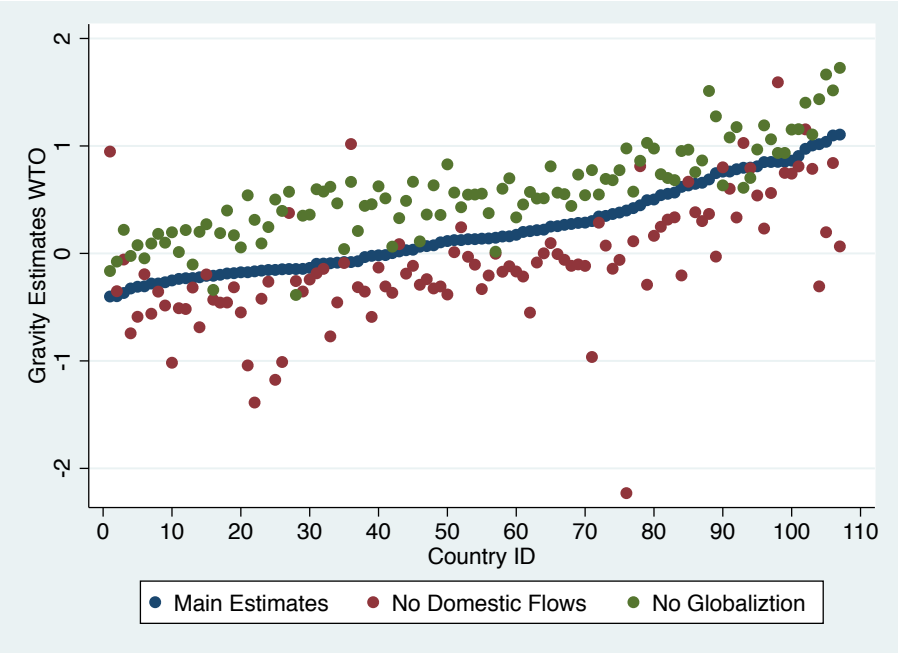
Note: This figure visualizes the estimates of the country-specific GATT/WTO effects that are obtained from equation (6). The estimates in each panel are ordered from smallest to largest. Country labels are omitted to avoid clutter. Country names are presented in 4. Figure Panel A plots all estimates. Panel B presents only the estimates from the lower tail of the distribution, after eliminating the 19 extremely large (in absolute value) negative estimates. Panel C presents only the estimates from the upper tail of the distribution, after eliminating the 6 extremely large positive estimates. See text for further details.

Figure 4: Country-specific Effects of GATT/WTO II



Note: This figure visualizes the estimates of the country-specific GATT/WTO effects that are obtained from equation (6). The estimates are ordered from smallest to largest, starting from the top and moving to the bottom panel of the figure. 3-letter country ISO codes appear on the Y-axis and gravity estimates of the effects of GATT/WTO based on equation (6) are on the X-axis. For clarity, the figure omits estimates that are smaller than -0.34 and larger than 1.08. See text for further details.

Figure 5: GATT/WTO Effects, Domestic Trade, and Globalization



Note: This figure presents estimates that enable us to gauge the importance of two adjustments (i.e., (i) including internal trade flows; and (ii) controlling for common globalization effects) to the econometric gravity model that have potentially important implications for the estimations of the GATT/WTO effects with the structural gravity equation. The blue estimates in the figure replicate our results from Figure 4, i.e. they are obtained with intra-national trade flows and after accounting for globalization, and, for clarity, the outliers are dropped. The red estimates are obtained from an econometric model that is identical to our main specification but without domestic trade flows. Finally, the green estimates are obtained from an econometric model that is identical to our main specification but without the time-varying border dummy variables that control for common globalization trends. See text for further details.

Appendix

Table 2: List of countries in the main estimating sample

ISO	Country Name	ISO	Country Name	ISO	Country Name
AFG*	Afghanistan	GIB	Gibraltar	NRU	Nauru
AGO	Angola	GIN	Guinea	NZL	New Zealand
ALB	Albania	GMB*	Gambia	OMN *	Oman
AND	Andorra	GNB*	Guinea-Bissau	PAK	Pakistan
ARE	United Arab Emirates	GNQ	Equatorial Guinea	PAN	Panama
ARG	Argentina	GRC	Greece	PCN	Pitcairn
ATG*	Antigua and Barbuda	GRD*	Grenada	PER	Peru
AUS	Australia	GRL	Greenland	PHL	Philippines
AUT	Austria	GTM	Guatemala	PNG	Papua New Guinea
BDI*	Burundi	GUY	Guyana	POL	Poland
BEN*	Benin	HKG	Hong Kong	PRK	Korea
BFA	Burkina Faso	HND	Honduras	PRT	Portugal
BGD*	Bangladesh	HTI	Haiti	PRY	Paraguay
BGR*	Bulgaria	HUN	Hungary	PSE	Occupied Palestinian Territory
BHR	Bahrain	IDN	Indonesia	PYF	French Polynesia
BHS	Bahamas	IND	India	QAT	Qatar
BLX	Belgium and Luxembourg	IRL	Ireland	ROM	Romania
BLZ*	Belize	IRN	Iran, Islamic Republic of	RWA*	Rwanda
BMU	Bermuda	IRQ	Iraq	SAU	Saudi Arabia
BOL	Bolivia	ISL	Iceland	SEN	Senegal
BRA	Brazil	ISR	Israel	SGP	Singapore
BRB	Barbados	ITA	Italy	SHN	Saint Helena
BRN*	Brunei Darussalam	JAM	Jamaica	SLB	Solomon Islands
BTN	Bhutan	JOR	Jordan	SLE	Sierra Leone
BWA *	Botswana	JPN	Japan	SLV	El Salvador
CAF*	Central African Republic	KEN*	Kenya	SMR	San Marino
CAN	Canada	KHM	Cambodia	SOM	Somalia
CCK	Cocos Islands	KIR	Kiribati	SPM	Saint Pierre and Miquelon
CHE	Switzerland	KOR	Republic of Korea	STP	Sao Tome and Principe
CHL	Chile	KWT	Kuwait	SUR*	Suriname
CHN	China	LAO	Lao People's Democratic Republic	SWE	Sweden
CIV	Côte d'Ivoire	LBN	Lebanon	SWZ*	Swaziland
CMR	Cameroon	LBR*	Liberia	SYC	Seychelles
COG	Congo	LBY	Libyan Arab Jamahiriya	SYR	Syrian Arab Republic
COK	Cook Islands	LCA	Saint Lucia	TCA	Turks and Caicos Islands
COL	Colombia	LKA	Sri Lanka	TCD*	Chad
COM	Comoros	LSO	Lesotho	TGO	Togo
CPV	Cape Verde	MAC	Macao	THA	Thailand
CRI	Costa Rica	MAR	Morocco	TKL	Tokelau
CUB	Cuba	MDG*	Madagascar	TMP	East Timor
CXR	Christmas Island	MDV*	Maldives	TON*	Tonga
CYM	Cayman Islands	MEX	Mexico	TTO	Trinidad and Tobago
CYP *	Cyprus	MLI	Mali	TUN	Tunisia
DEU	Germany	MLT	Malta	TUR	Turkey
DJI	Djibouti	MMR*	Myanmar	TUV	Tuvalu
DMA	Dominica	MNG	Mongolia	TWN	Taiwan
DNK	Denmark	MOZ*	Mozambique	TZA	United Republic of Tanzania
DOM	Dominican Republic	MRT	Mauritania	UGA	Uganda
DZA	Algeria	MSR	Montserrat	URY	Uruguay
ECU	Ecuador	MUS	Mauritius	USA	United States of America
EGY	Egypt	MWI	Malawi	VCT*	Saint Vincent and the Grenadines
ESH	Western Sahara	MYS	Malaysia	VEN	Venezuela
ESP	Spain	NAM*	Namibia	VGB	British Virgin Islands
ETH	Ethiopia	NCL	New Caledonia	VNM	Viet Nam
FIN	Finland	NER *	Niger	VUT*	Vanuatu
FJI*	Fiji	NFK	Norfolk Island	WLF	Wallis and Futuna Islands
FLK	Falkland Islands (Malvinas)	NGA	Nigeria	WSM*	Samoa
FRA	France	NIC	Nicaragua	YEM*	Yemen
FRO	Faeroe Islands	NIU	Niue	ZAF	South Africa
GAB	Gabon	NLD	Netherlands	ZAR*	Zaire
GBR	Great Britain	NOR	Norway	ZMB	Zambia
GHA	Ghana	NPL*	Nepal	ZWE	Zimbabwe

Notes: This table lists the 186 countries that are used in the estimating sample that delivers the main results in the paper. '*' indicates the 36 countries with extreme GATT/WTO estimates. See text for further details.

Table 3: Welfare analysis of GATT/WTO membership

(1) Country names	(2) ISO codes	(3) WTO member	(4) with outliers	(5) outliers =0	(6) outliers =agg.	(7) outliers =bounds
Afghanistan	AFG	Yes	46.31	0.38	5.94	20.17
Albania	ALB	Yes	10.60	10.04	10.10	10.27
Algeria	DZA	No	-0.10	-0.12	-0.13	-0.12
Andorra	AND	No	0.02	-0.11	-0.11	-0.06
Angola	AGO	Yes	8.90	9.15	9.28	8.98
Antigua and Barbuda	ATG	Yes	-4.52	1.31	3.45	-0.74
Argentina	ARG	Yes	6.54	6.54	6.56	6.54
Australia	AUS	Yes	0.97	0.97	0.98	0.96
Austria	AUT	Yes	2.97	2.88	2.90	2.92
Bahamas, The	BHS	No	-2.61	-2.59	-2.55	-2.62
Bahrain	BHR	Yes	-1.18	-0.88	-0.68	-1.10
Bangladesh	BGD	Yes	-3.20	1.28	3.44	-1.01
Barbados	BRB	Yes	5.84	5.74	5.85	5.82
Belgium-Luxembourg	BLX	Yes	3.44	3.27	3.30	3.33
Belize	BLZ	Yes	-9.02	1.76	6.18	-2.84
Benin	BEN	Yes	25.67	2.94	7.87	22.43
Bermuda	BMU	No	-3.01	-3.06	-3.06	-3.04
Bhutan	BTN	No	-0.30	-0.40	-0.44	-0.35
Bolivia	BOL	Yes	0.99	0.96	0.97	0.97
Botswana	BWA	Yes	39.20	1.80	6.31	17.66
Brazil	BRA	Yes	0.77	0.77	0.78	0.77
British Virgin Islands	VGB	No	-0.81	-0.82	-0.83	-0.82
Brunei	BRN	Yes	5.36	0.68	1.39	4.02
Bulgaria	BGR	Yes	45.62	1.06	4.83	16.28
Burkina Faso	BFA	Yes	1.25	0.82	0.96	1.02
Burundi	BDI	Yes	-0.97	0.36	1.39	-0.39
Cambodia	KHM	Yes	-1.53	-1.58	-1.59	-1.56
Cameroon	CMR	Yes	5.59	5.03	5.13	5.14
Canada	CAN	Yes	1.38	1.38	1.39	1.38
Cape Verde	CPV	Yes	4.36	4.35	4.36	4.35
Cayman Islands	CYM	No	-0.64	-0.60	-0.57	-0.61
Central African Republic	CAF	Yes	16.42	1.42	4.07	12.40
Chad	TCD	Yes	-2.36	1.33	3.65	-0.92
Chile	CHL	Yes	13.25	13.26	13.26	13.26
China	CHN	Yes	0.79	0.79	0.79	0.79
Christmas Island	CXR	No	-0.37	-0.39	-0.39	-0.39
Cocos (Keeling) Islands	CCK	No	0.11	-0.38	-0.53	-0.13
Colombia	COL	Yes	3.04	3.02	3.02	3.03
Comoros	COM	No	0.10	-0.01	-0.07	0.08
Congo, Dem. Rep.	ZAR	Yes	98.87	3.17	7.15	18.05
Congo, Rep.	COG	Yes	23.03	22.32	22.50	22.39
Cook Islands	COK	No	-0.26	-0.35	-0.36	-0.33
Costa Rica	CRI	Yes	10.33	10.31	10.32	10.32
Cote d'Ivoire	CIV	Yes	-0.44	-0.90	-0.85	-0.78
Cuba	CUB	Yes	0.85	0.83	0.83	0.83
Cyprus	CYP	Yes	-4.23	1.92	4.94	-1.06
Denmark	DNK	Yes	-1.27	-1.25	-1.23	-1.26
Djibouti	DJI	Yes	1.05	1.06	1.14	1.02
Dominica	DMA	Yes	8.22	7.67	7.83	8.01
Dominican Republic	DOM	Yes	10.36	10.34	10.35	10.35
East Timor	TMP	No	0.00	-0.03	0.00	-0.02
Ecuador	ECU	Yes	0.64	0.61	0.61	0.62
Egypt, Arab Rep.	EGY	Yes	6.38	6.33	6.41	6.32
El Salvador	SLV	Yes	-0.60	-0.62	-0.62	-0.62
Equatorial Guinea	GNQ	No	-0.65	-0.69	-0.69	-0.67
Ethiopia (excl. Eritrea)	ETH	No	-0.07	-0.16	-0.17	-0.13
Faeroe Islands	FRO	No	0.59	0.54	0.55	0.56
Falkland Island	FLK	No	0.34	0.30	0.31	0.31
Fiji	FJI	Yes	-6.76	0.68	3.67	-2.35
Finland	FIN	Yes	0.73	0.69	0.70	0.70
France	FRA	Yes	0.61	0.59	0.60	0.59
French Polynesia	PYF	No	0.11	0.03	0.04	0.06
Gabon	GAB	Yes	11.28	11.47	11.47	11.43
Gambia, The	GMB	Yes	52.26	4.17	10.66	28.58
Germany	DEU	Yes	3.51	3.48	3.50	3.49
Ghana	GHA	Yes	12.77	12.70	12.83	12.68
Gibraltar	GIB	No	0.11	0.17	0.16	0.11
Greece	GRC	Yes	0.83	0.09	0.20	0.38
Greenland	GRL	No	0.72	0.66	0.67	0.68
Grenada	GRD	Yes	7.82	0.56	1.74	5.86
Guatemala	GTM	Yes	0.58	0.53	0.55	0.54
Guinea	GIN	Yes	0.36	0.45	0.55	0.36
Guinea-Bissau	GNB	Yes	5.12	1.21	1.84	4.05
Guyana	GUY	Yes	1.19	1.51	1.64	1.40
Haiti	HTI	Yes	2.81	2.80	2.81	2.80
Honduras	HND	Yes	0.54	0.52	0.52	0.53
Hong Kong, China	HKG	Yes	3.56	3.55	3.57	3.55
Hungary	HUN	Yes	5.32	5.08	5.10	5.17
Iceland	ISL	Yes	-1.49	-1.49	-1.49	-1.49
India	IND	Yes	2.77	2.85	2.91	2.79
Indonesia	IDN	Yes	-0.38	-0.38	-0.37	-0.39
Iran, Islamic Rep.	IRN	No	-0.08	-0.10	-0.10	-0.09
Iraq	IRQ	No	-1.21	-1.27	-1.27	-1.26
Ireland	IRL	Yes	3.85	3.86	3.87	3.86
Israel	ISR	Yes	6.73	6.60	6.62	6.66

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Table 3 – *Continued from previous page*

(1) Country names	(2) ISO codes	(3) WTO member	(4) with outliers	(5) outliers =0	(6) outliers =agg.	(7) outliers =bounds
Italy	ITA	Yes	-0.72	-0.76	-0.75	-0.75
Jamaica	JAM	Yes	7.51	7.51	7.56	7.51
Japan	JPN	Yes	1.02	1.04	1.04	1.03
Jordan	JOR	Yes	1.55	1.55	1.61	1.52
Kenya	KEN	Yes	0.01	0.98	1.98	0.11
Kiribati	KIR	No	-0.14	-0.47	-0.54	-0.35
Korea, Dem. Rep.	PRK	No	-1.26	-1.26	-1.24	-1.26
Korea, Rep.	KOR	Yes	2.60	2.61	2.62	2.60
Kuwait	KWT	Yes	-1.11	-0.90	-0.76	-1.05
Lao PDR	LAO	Yes	23.16	23.15	23.16	23.15
Lebanon	LBN	No	-0.58	-0.62	-0.63	-0.62
Lesotho	LSO	Yes	1.68	2.07	2.01	1.92
Liberia	LBR	Yes	-14.88	3.03	9.47	-4.24
Libya	LBY	No	-3.17	-3.04	-2.94	-3.16
Macao	MAC	Yes	0.58	0.58	0.63	0.56
Madagascar	MDG	Yes	-5.46	3.53	9.56	-3.27
Malawi	MWI	Yes	3.52	3.76	3.90	3.60
Malaysia	MYS	Yes	4.29	4.31	4.33	4.30
Maldives	MDV	Yes	1.32	0.26	0.36	0.70
Mali	MLI	Yes	15.02	15.17	15.47	14.97
Malta	MLT	Yes	20.41	20.28	20.34	20.30
Mauritania	MRT	Yes	6.16	6.34	6.48	6.22
Mauritius	MUS	Yes	21.44	21.59	21.71	21.48
Mexico	MEX	Yes	12.51	12.49	12.49	12.50
Mongolia	MNG	Yes	5.62	5.56	5.55	5.58
Montserrat	MSR	No	0.30	0.24	0.23	0.25
Morocco	MAR	Yes	-0.47	-0.49	-0.47	-0.49
Mozambique	MOZ	Yes	-10.37	4.33	10.58	-2.71
Myanmar	MMR	Yes	-5.46	8.26	15.42	-0.07
Namibia	NAM	Yes	-3.26	1.40	5.52	-1.09
Nauru	NRU	No	0.57	0.39	0.37	0.45
Nepal	NPL	Yes	-0.31	3.14	4.81	1.53
Netherlands	NLD	Yes	5.02	5.01	5.02	5.01
New Caledonia	NCL	No	0.75	0.73	0.73	0.74
New Zealand	NZL	Yes	1.73	1.75	1.77	1.74
Nicaragua	NIC	Yes	0.59	0.57	0.57	0.58
Niger	NER	Yes	50.36	1.03	6.09	20.62
Nigeria	NGA	Yes	0.11	0.06	0.08	0.08
Niue	NIU	No	-0.10	-0.17	-0.17	-0.14
Norfolk Island	NFK	No	-0.31	-0.41	-0.43	-0.39
Norway	NOR	Yes	-0.83	-0.85	-0.84	-0.84
Oman	OMN	Yes	-3.33	1.30	4.01	-1.40
Pakistan	PAK	Yes	-0.36	-0.27	-0.17	-0.34
Palestine	PSE	No	-1.27	-1.29	-1.29	-1.29
Panama	PAN	Yes	0.09	0.05	0.06	0.06
Papua New Guinea	PNG	Yes	-1.21	-1.21	-1.21	-1.21
Paraguay	PRY	Yes	1.25	1.27	1.30	1.25
Peru	PER	Yes	0.64	0.63	0.63	0.63
Philippines	PHL	Yes	5.05	5.03	5.04	5.04
Pitcairn	PCN	No	-1.53	-1.53	-1.53	-1.53
Poland	POL	Yes	3.60	3.56	3.58	3.57
Portugal	PRT	Yes	1.84	1.83	1.84	1.84
Qatar	QAT	Yes	-0.13	0.02	0.13	-0.09
Romania	ROM	Yes	0.03	-0.78	-0.69	-0.46
Rwanda	RWA	Yes	-5.92	1.62	7.20	-1.98
Saint Helena	SHN	No	0.30	0.06	-0.08	0.17
Saint Pierre and Miquelon	SPM	No	0.37	0.30	0.31	0.32
Samoa	WSM	Yes	-4.38	0.70	2.54	-1.06
San Marino	SMR	No	-0.64	-0.62	-0.61	-0.63
Sao Tome and Principe	STP	No	-0.21	-0.27	-0.26	-0.25
Saudi Arabia	SAU	Yes	-0.27	-0.27	-0.19	-0.32
Senegal	SEN	Yes	12.68	12.62	12.69	12.62
Seychelles	SYC	Yes	8.84	9.03	9.15	8.89
Sierra Leone	SLE	Yes	5.00	4.34	4.55	4.95
Singapore	SGP	Yes	7.35	7.36	7.44	7.35
Solomon Islands	SLB	Yes	2.90	3.05	3.11	2.99
Somalia	SOM	No	-0.88	-1.76	-2.17	-1.24
South Africa	ZAF	Yes	2.31	1.74	1.88	1.93
Spain	ESP	Yes	0.42	0.42	0.44	0.42
Sri Lanka	LKA	Yes	0.80	0.81	0.84	0.79
St. Lucia	LCA	Yes	0.17	1.23	1.81	0.96
St. Vincent & Grenadines	VCT	Yes	24.16	0.57	2.86	10.09
Suriname	SUR	Yes	-7.13	0.23	2.96	-2.62
Swaziland	SWZ	Yes	-3.23	0.94	3.34	-1.71
Sweden	SWE	Yes	-1.48	-1.47	-1.46	-1.47
Switzerland	CHE	Yes	3.70	3.84	3.92	3.74
Syrian Arab Republic	SYR	No	-0.05	-0.06	-0.06	-0.05
Taiwan	TWN	Yes	7.52	7.53	7.53	7.53
Tanzania	TZA	Yes	4.23	3.39	3.66	3.45
Thailand	THA	Yes	5.62	5.63	5.65	5.62
Togo	TGO	Yes	2.29	1.99	2.03	2.12
Tokelau	TKL	No	-0.02	-0.60	-0.73	-0.43
Tonga	TON	Yes	-2.02	1.15	2.96	-0.49
Trinidad and Tobago	TTO	Yes	-2.02	-1.95	-1.91	-1.97
Tunisia	TUN	Yes	-0.27	-0.31	-0.28	-0.30
Turkey	TUR	Yes	3.05	2.90	2.97	2.94
Turks and Caicos Isl.	TCA	No	0.23	0.13	0.17	0.18
Tuvalu	TUV	No	-0.79	-1.12	-1.20	-1.01

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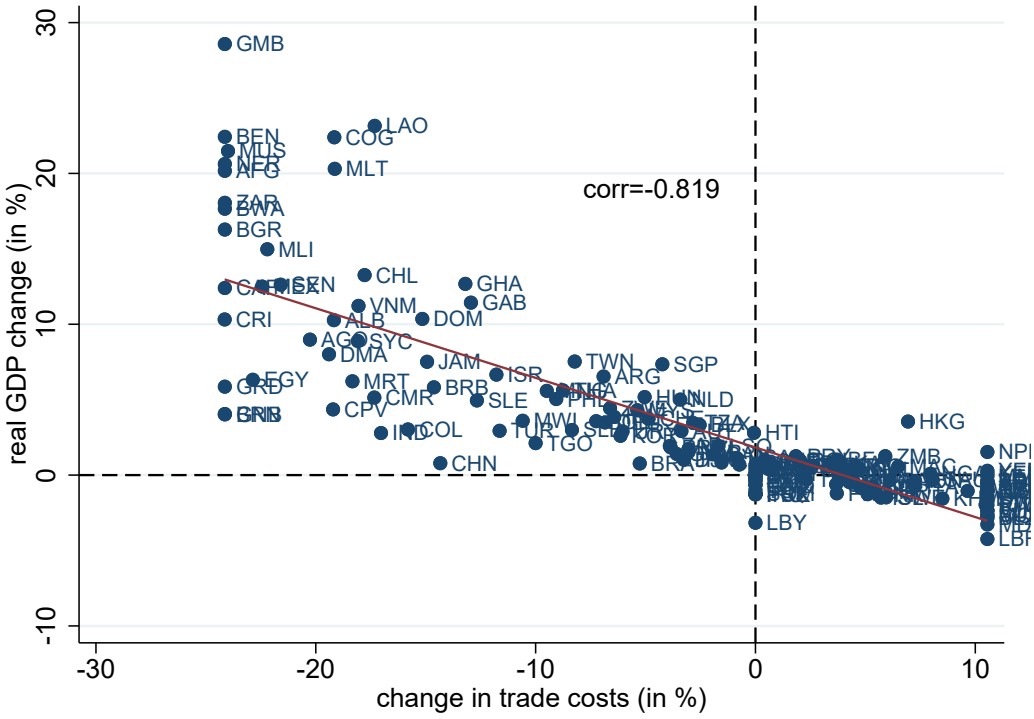
Table 3 – *Continued from previous page*

(1) Country names	(2) ISO codes	(3) WTO member	(4) with outliers	(5) outliers =0	(6) outliers =agg.	(7) outliers =bounds
Uganda	UGA	Yes	2.15	0.35	1.21	0.30
United Arab Emirates	ARE	Yes	-1.23	3.13	6.72	-0.49
United Kingdom	GBR	Yes	0.93	0.91	0.93	0.92
United States	USA	Yes	1.14	1.14	1.14	1.14
Uruguay	URY	Yes	2.90	2.89	2.89	2.89
Vanuatu	VUT	Yes	-4.23	0.82	3.87	-2.34
Venezuela	VEN	Yes	-0.40	-0.42	-0.42	-0.41
Vietnam	VNM	Yes	11.24	11.22	11.24	11.22
Wallis and Futura Isl.	WLF	No	0.60	0.23	0.16	0.36
Western Sahara	ESH	No	-0.27	-0.40	-0.42	-0.35
Yemen, Rep.	YEM	Yes	-0.20	0.74	1.26	0.28
Zambia	ZMB	Yes	3.76	1.03	1.66	1.25
Zimbabwe	ZWE	Yes	4.53	4.40	4.54	4.43

Notes: This table reports results from our counterfactual analyses. Column (1) lists the country names. Column (2) gives the ISO country codes, and column (3) provides information whether a country is WTO member. Columns (4) to (7) report the welfare results (real GDP percentage changes) from an ex-post evaluation of the impact of WTO membership. Column (4) presents the results using the estimates including outliers. In column (5) we set estimates below -0.41 and above 1.2 to zero. Column (6) gives real GDP percentage changes when we replace outliers (values below -0.41 and above 1.2) with the aggregate estimate from column (5) of Table 1 (0.32). Column (7) provides welfare results when setting all estimates below -0.41 to -0.4012, and all estimates above 1.2 to 1.105. Please see for further details Section 5.

Figure 6: Plot of Welfare Changes Against Change in Trade Costs



Note: This figure plots the welfare changes (real GDP percentage changes) against the change in trade costs from the results obtained when using bounds for outliers, i.e., results from column (7) of Table 3.