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In Search of WTO Trade Effects: Preferential Trade Agreements Promote Trade Strongly, But Unevenly*

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The literature measuring the impact of Preferential Trade Agreements (PTA) and WTO membership on trade flows has produced remarkably diverse results. Rose's (2004) seminal paper reports a range of specifications that show no WTO effects, but Subramanian and Wei (2007) contend that he does not fully control for multilateral resistance (which could bias WTO estimates). Subramanian and Wei (2007) address multilateral resistance comprehensively to report strong WTO trade effects for industrialized countries but do not account for unobserved bilateral heterogeneity (which could inflate WTO estimates). We unify these two approaches by accounting for both multilateral resistance and unobserved bilateral heterogeneity, while also allowing for individual trade effects of PTAs. WTO effects vanish and remain robustly insignificant once multilateral resistance, unobserved bilateral heterogeneity, and individual PTA effects are introduced. The result is robust to the use of alternative definitions and coding conventions for WTO membership that have been employed by Rose (2004), Tomz et al. (2007), or by Subramanian and Wei's (2007).

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1. Introduction

Over the past half century, the hallmark of the World Trade Organization (WTO) and its predecessor (GATT) has been the reduction of trade barriers.[1] Trade theory holds that tariff reductions should increase trade flows, but the empirical literature on the trade effects of WTO membership produces surprisingly unambiguous results. Rose (2004, 2005) jumpstarted the literature when he documented the absence of WTO effects on bilateral trade volumes. After updating Rose's dataset to include both *de jure* and *de facto* WTO membership, Tomz, Goldstein and Rivers (2007, henceforth TGR) did find positive WTO trade effects. Alternatively, Subramanian and Wei (2007, henceforth SW) examined different groups of WTO members and reported positive WTO trade effects for industrialized countries only. This diverse literature seems to suggest that empirical specifications or coding conventions influence the identification of WTO trade effects. Instead we show in this paper that the approaches of Rose, SW and TGR all produce a consistent result, one that confirms the absence of positive WTO trade effects. Consistency requires, however, that the empirical approach accounts comprehensively for three crucial trade determinants: multilateral resistance, unobserved bilateral heterogeneity, and distinct effects across preferential trade agreements (PTAs).

Neither Rose (2004), TGR, nor SW account for variations that distinct PTAs may have on trade effects. If these effects are not identical for all PTAs and all countries, coefficient estimates are subject to omitted variable bias. Rose (2005, Table A5) subsequently did produce a positive WTO impact on trade flows when individual PTAs were included. We can, however, show that this effect vanishes when we account for multilateral resistance as comprehensively as possible. Anderson and van Wincoop (2003) explicitly outline the omitted variables bias in the absence of a full account of multilateral resistance. SW highlight that multilateral resistance is crucial to estimating strong WTO trade effects.[2]

While SW control for multilateral resistance, they do not account for all time-invariant similarities/differences among trading partners that could affect bilateral trade. A substantial portion of trading partners' bilateral heterogeneity may be unobserved to extend beyond distance or geographic

[1] Henceforth we use WTO as a synonym for GATT/WTO.
[2] Theoretical foundations of the trade flow regressions developed by Anderson (1979), Bergstrand (1985), Deardorff (1998), Baier and Bergstrand (2001), Eaton and Kortum (2002), and Anderson and van Wincoop (2003) all highlight a role of some form of multilateral price indices. Multilateral resistance represents the notion that bilateral trade depends not on absolute but *relative* trade costs. Rose's (2004 and 2005) multilateral resistance controls do not vary by importer/exporter, nor are they time varying, and therefore capture only average trade cost over time. Trade increases due to falling transport costs over a time period when a country also joined the WTO may then be attributed to WTO membership.

measures. Unobserved bilateral heterogeneity may include political, personal, and/or civic factors.[3] Two countries may well exhibit natural (partly unobserved) affinities for mutual trade before they join a PTA. In this case, the omission of country-pair fixed effects renders WTO and/or PTA estimates that are biased upwards (e.g., Egger, 2000 and Cheng and Wall, 2005). Baldwin (2006) judges unobserved bilateral heterogeneity to be of such crucial importance for policy purposes that he recommends ignoring results obtained without country-pair fixed effects.

Once we allow for both unobserved bilateral heterogeneity and differential PTA trade effects we find that SW's original dataset and econometric specification delivers no WTO effects for industrialized countries. The result holds even after we include *de facto* WTO members, as in TGR. Since SW and Rose/TGR differ in their coding convention of WTO and PTA variables, we also confirm our results using both coding conventions.[4] Combining the three approaches (unobserved bilateral heterogeneity controls as in Rose, 2004; individual PTA effects as in Rose, 2005; and multilateral resistance as in SW), highlights that the omission of *either* control renders the WTO coefficients biased upward.

Our empirical results confirm Rose's (2004 and 2004b) finding that WTO membership has no significant impact on bilateral trade flows. In addition, the structure of the results supports a key feature of Anderson and van Wincoop's (2003) derivation of multilateral resistance: a comprehensive account of multilateral resistance requires the inclusion of all possible factors that determine trade costs. Country-pair fixed effects provide the most comprehensive account of both observed and unobserved factors in this regard. To date, our paper is the first that combines controls for both multilateral resistance and unobserved bilateral heterogeneity in a large bilateral trade dataset.

Our findings also highlight that WTO membership coding conventions do not affect results when estimates are purged of potential omitted variable bias. We do highlight, however, that SW style coding is susceptible to producing biased WTO estimates under two specific conditions. The bias typically occurs when (a) industrialized and developing PTAs differ considerably in their trade effects and (b) PTA effects are constrained to one aggregate PTA coefficient. More importantly, this bias is especially detrimental when WTO membership effects are separated into industrialized and developing countries.

Rose's original work paved the way for a voluminous literature that subsequently examined WTO effects in the presence of firm heterogeneity, sample selection bias, nonparametric methods,

[3] SW introduce unobserved bilateral heterogeneity in their Table 5, but drop multilateral resistance controls in these regressions.

[4] Rose/TGR coding of trade agreement memberships is *mutually inclusive* (dummies identify *all* PTA and WTO memberships), while SW coding is *hierarchical mutually exclusive* (see, Section 3 for a detailed discussion).

missing trade, and/or selection bias (see, e.g., Carrere, 2006; Felbermayr and Kohler, 2006 and 2007; Helpman et al., 2007; Liu, 2007; Chang and Lee, 2007). Here we follow the original Rose/TGR and SW methodologies closely to derive the important conclusion that differences across these three prominent approaches can be reconciled when appropriate controls render unbiased estimates.

After presenting the data in Section 2, we extend SW to account for each individual PTA's trade creation (Section 3) as well as unobserved bilateral heterogeneity (Section 4). In Section 5, we reexamine Rose (2004, 2005) and extend his analysis to fully account for multilateral resistance in the presence of individual PTA effects. Section 6 provides a detailed discussion of the impacts of individual PTAs on trade and highlights the diversity of their effects by region. In addition, we observe that the results produced by the most comprehensive specification also return the most reasonable trade effects. Section 7 concludes.

2 Data

Our data is based on an updated version of SW's unbalanced panel.[5] Their bilateral trade values are derived from the IMF's *Direction of Trade Statistics,* deflated by the U.S. consumer price index. The dataset features not only a WTO dummy, but also a dummy that represents industrialized countries' unilateral trade concessions to developing trading partners under the GATT/WTO's Generalized System of Preferences (GSP) from 1979 onwards. We update the SW dataset to attribute a value of zero to GSP country-pairs that represent an industrialized country *exporting* to a developing country. These pairs should be identified as "pure" WTO effects, since GSP is granted as a *unilateral* preference (for industrialized countries' *imports* from developing countries only).[6] We also identify Luxembourg as a member of the European Union (EU) in 2000, and correct other minor coding errors identified by TGR. These changes do not affect our or SW's results qualitatively.

SW employ Rose's definition of *de jure* WTO membership. However, TGR indicated that *de facto* WTO members should also be considered, and that their exclusion may bias WTO effects downwards. To illustrate that WTO effects vanish *even* when accounting for *de facto* membership, we use TGR's WTO membership definition throughout and refer the interested reader to the working paper version of this study which features all results in the original SW and Rose coding (Eicher and Henn, 2008). The conclusions are unaffected by the coding convention.

[5] We use SW's preferred dataset which excludes observations with import values of less than 500 thousand dollars.
[6] SW's coding convention assigns a zero to GSP trade partners' WTO dummy (see Section 3).

A single aggregate PTA indicator dummy has been prominent in a number of empirical trade flow studies (see e.g., Rose 2000, 2004, 2005, Glick and Rose 2002, SW, TGR), to capture the average effect of PTAs on trade flows. We extend the SW dataset and introduce a more extensive set of PTAs used by Rose (2005) and by Ghosh and Yamarik (2004) to properly account also for individual trade effects of less known PTAs. In section 4, we additionally include country-pair fixed effects to the dataset to control for unobserved bilateral heterogeneity in bilateral trading relationships. Further modifications to the dataset are introduced in Section 5. Specifically, we show that results are robust to Rose's (2004, 2005) mutually inclusive coding of multilateral trade, while continuing to comprehensively account for multilateral resistance, TGR's *de facto* WTO membership, and individual PTA effects.[7] Note that following SW, this extension splits Rose's WTO dummy into two groups, representing industrialized and developed WTO members. Rose (2004b) indicated that such a split could lead to selection bias, it "conditions on success" (since industrialized countries liberalized trade more than their developing counterparts). We show that the WTO dummy split does not drive results. The dimensionality of the dataset remains constant throughout, with 55,831 observations for 177 countries and 11,797 bilateral trade pairs in five year intervals from 1950 to 2000.

3. Extending the Empirical Framework to Account for Individual PTA Effects

We first extend the general framework of SW to fully account for the impacts of all trade agreements (WTO, GSP, and individual PTAs). Section 4 then extends the econometric model to account for unobserved heterogeneity in bilateral trading relationships. The SW setup has two important characteristics: First, time-varying fixed effects are introduced to capture multilateral resistance for importers, δ_{mt}, and exporters, λ_{xt} (where the "*m*", "*x*", and "*t*" subscripts identify importer, exporter and time, respectively).[8] Multilateral resistance can be conveniently accounted for with these fixed effects, since any nation faces only one import/export price index at any point in time. The inclusion of these time-varying importer and exporter effects requires, however, the dependent variable to be bilateral imports, $Imports_{mxt}$, instead of the commonly used average trade flow variable.[9] To maintain consistency our dependent variable is identical to SW's.[10]

[7] Our "Rose dataset" does not *exactly* replicate Rose's original results since our (and SW's) dependent variable is bilateral imports (to allow for multilateral resistance controls) while Rose averaged import and exports. SW also use data at five-year intervals vs. Rose's annual data. Our tables show that these differences do not drive the results.
[8] The motivation for time-varying importer and exporter dummies is outlined lucidly in Baldwin and Taglioni (2006).
[9] Some argue that this is advantageous, since trade theories yield predictions on *unidirectional* trade (see Freund, 2000; Anderson and van Wincoop, 2003; Baldwin and Taglioni, 2006).
[10] See section 2 for further data description.

The second important characteristic of the SW approach is their coding convention. SW code the trade agreement indicator dummies mutually exclusively to quantify "pure" GSP and WTO effects. The key assumption in SW is that PTA membership "represents the culmination of trade integration." Thus SW code trade agreement indicators such that *all* trade creation is *exclusively* attributed to PTAs, even if both trading partners are currently (or were previously) WTO/GSP members. Specifically, when two trading partners are members of the WTO, GSP, and the same PTA, only the PTA dummy takes the value "1". Coding is hierarchical throughout, so that when both WTO and GSP dummies could display a "1," only the GSP variable takes that value. Since the dependent variable is bilateral imports, the dummies' specifications are defined exclusively on the basis of importer participation in the WTO or GSP.

SW disaggregate the WTO dummy further to identify membership effects for industrialized and developed nations, $WTOIndustrial_{mt}$ *and* $WTODeveloping_{mt}$ respectively. Our baseline regression (SW's preferred specification in their Table 4) is then

$$\begin{aligned}\log\left(Imports_{mxt}\right) &= \alpha + \delta_{mt} + \lambda_{xt} + \beta_1 WTOIndustrial^*_{mt} + \beta_2 WTODeveloping^*_{mt} + \beta_3 GSP^*_{mxt} + \beta_4 PTA_{mxt} \\ &+ \beta_5 CurrencyUnion_{mxt} + \beta_6 CurColony_{\mathrm{mxt}} + \beta_7 EverColony_{\mathrm{mx}} + \beta_8 CommonColonizer_{\mathrm{mx}} \\ &+ \beta_9 CommonLanguage_{\mathrm{mx}} + \beta_{10} CommonNation_{\mathrm{mx}} + \beta_{11} Border_{\mathrm{mx}} + \beta_{12} Distance_{mx} + \varepsilon_{\mathrm{mxt}}\end{aligned} \quad (1)$$

Note that the "*" superscript indicates that the coding of the variables is mutually exclusive. With the exception of the natural log of bilateral distance, $Distance_{mx}$, all explanatory variables are 0-1 dummies. PTA_{mxt} indicates joint membership in a trade agreement, while GSP_{mt} indicates whether an industrial country importer grants GSP tariff preferences to the developing country exporter in question. $CurrencyUnion_{mx}$ is the dummy for a common currency union.

The remaining dummies are proxies introduced to control for some observed factors that affect a country pair's inclination to engage in trade. These proxies include contemporaneous or historical colonial relationships, $CurColony_{mxt}$ and $EverColony_{mx}$, respectively; common colonizer relationships post-1945, $CommonColonizer_{mx}$; shared official languages, $CommonLanguage_{mx}$; and territorial dependency and contingency, $CommonNation_{mx}$ and $Border_{mx}$. Equation (1) lacks country-year specific regressors (for example, importer/exporter GDP) that are common in canonical gravity equations. These regressors have been absorbed into the time-varying importer/exporter fixed effects that control for multilateral resistance.

Our first extension is to modify (1) by replacing the aggregate PTA vector, PTA_{mxt}, with dummies that allow each PTA to account for its individual effect on bilateral imports. This converts PTA_{mxt} into a matrix and β_4 into a vector of regression coefficients that captures the trade impacts of individual PTAs. We disaggregate the PTA effects in two stages. First, we introduce only PTAs that are contained in SW's and Rose's (2005) aggregate PTA dummy.[11] Then we enlarge the set of PTAs to one suggested by the recent PTA literature (see Ghosh and Yamarik, 2004).[12]

Note that SW's mutually exclusive coding of trade agreements implies that the introduction of additional PTAs in this second stage diminishes the number of "1" entries in the WTO variables. Therefore, the introduction of additional PTAs may influence the WTO/GSP estimates for two reasons: a) by allowing individual PTAs to correct for omitted variable bias, and b) by reducing the WTO entries of PTA observations to "zero." If omitted PTAs are strongly trade creating and PTA members have also joined the WTO, the WTO coefficient in SW would be expected to carry upward bias.

3.1 Results: WTO Trade Impact After Controlling for Multilateral Resistance and Individual PTA Effects (Hierarchical, Mutually Exclusive WTO Coding)

Regressions 1-3 in Table 1 report results for SW's general WTO framework with the addition of individual PTA effects. Regression 1 is an analogue of SW's preferred regression.[13] The corrections to their dataset discussed in Section 2 increase the WTO and PTA coefficients slightly, but their original results are robust. In this specification, only industrialized countries are shown to be profiting from WTO membership through higher import activity. The implied trade benefit is large, 187% (=$e^{1.053}$-1), while there is no significant WTO impact for developing countries. With the exception of a common border and same nation status, all regressors that control for observable bilateral heterogeneity are highly significant; and they remain so throughout.

Regression 1 also indicates a highly significant coefficient associated with the aggregate PTA dummy in the original SW specification. Given the hierarchical, mutually exclusive coding of trade agreements in SW, the identification of the actual average PTA effects is not straightforward, however.

[11] These are: ASEAN Free Trade Area, $AFTA_{mxt}$, the Australia-New Zealand Closer Economic Relations Trade Agreement, $ANZCERTA_{mxt}$, the Central American Common Market, $CACM_{mxt}$, the Caribbean Community/Carifta, $CARICOM_{mxt}$, the European Union (and its predecessor agreements), EU_{mxt}, the Southern Cone Common Market, $MERCOSUR_{mxt}$, the North America Free Trade Agreement, $NAFTA_{mxt}$, the South Pacific Regional Trade and Economic Cooperation Agreement, $SPARTECA_{mxt,}$ and bilateral PTAs, $BilateralPTA_{mxt}$.

[12] The additional PTAs included are: Asia-Pacific Economic Community, $APEC_{mxt}$, the Andean Pact, AP_{mxt}, the European Economic Area, EEA_{mxt}, the European Free Trade Association, $EFTA_{mxt}$, and the Latin America Integration Agreement/Lafta, $LAIA_{mxt}$. EFTA and EEA are unambiguously identified as tariff reducing PTAs. EFTA countries support free trade, but were unwilling to join the EU's predecessor organizations (which would have also required regulatory alignments). EFTA achieved free trade in industrial products among its members as early as 1966. The EEA was formed in 1994 to give EFTA members the opportunity to join the EU's Common Market without becoming EU members (which would have required both regulatory and political alignment). While AP, LAIA, and APEC are frequently included in the PTA literature, their tariff reductions status is ambiguous.

[13] The only difference is that non-member participants are included in the WTO definition as pioneered by TGR. Results for the exact analogue (with only full WTO members) are very similar and are posted at http://faculty.washington.edu/te.

In the SW dataset, trading partners that are PTA members are also likely to be WTO members.[14] Consequently, the aggregate PTA coefficient estimated in equation 1 (and reported in Table 1a) represents the change in bilateral trade generated by *both* PTA and WTO membership. Under mutually exclusive coding, the pure PTA effects in Table 1 can be obtained by calculating a composite coefficient that subtracts the WTO coefficient from its PTA counterpart. The direct regression output for PTA coefficients needed in this calculation is presented in Table 1a (standard errors are calculated using the Delta Method, see Greene 2003).

The SW regressions (regression 1, Table 1a) imply that bilateral imports increase 234% (=$e^{1.205}$-1) for the average PTA and the average PTA member. The "pure" PTA effect, net of any WTO effects, is provided in Table 1, regression 1 for industrialized and developing countries. Here we find that bilateral trade increases at a dramatically different rate for industrialized and developing country PTA members. Industrialized countries see their trade increase by a meager 16% (=$e^{0.152}$-1) while developing country trade increases 214% (=$e^{1.143}$-1).

Regression 2 (Table 1), allows for individual PTA effects. We find that all multilateral trade dummies are heavily impacted, confirming the suspicion of potential upward bias in regression 1. Most notably, we find that the economic and statistical significance of WTO membership for industrialized countries was reduced by an order of magnitude. WTO induced trade creation for industrialized countries falls from 187% in regression 1 to 80% (=$e^{0.588}$-1) in regression 2. This suggests that the sizable trade creation that was attributed to WTO membership in regression 1 is more accurately associated with individual PTAs. The precision of the individual PTA estimates together with the F-Statistic (which rejects regression 1 in favor of regression 2) supports the suspicion that regression 1 suffers from substantial omitted variable bias.

The effects of individual PTAs are all trade creating and highly statistically significant (with the exception of the EU, a case we will discuss at length below). PTAs promote trade strongly, but unevenly. Their magnitudes differ dramatically, ranging from 770% (=$e^{2.162}$-1) for NAFTA to 76% (=$exp^{0.568}$-1) for the ASEAN free trade agreement (AFTA). Regression 3 controls for additional PTAs that were not included in SW (or Rose 2005), but feature prominently in the empirical PTA literature.[15] EFTA, EEA, LAIA, and APEC are all shown to be highly trade creating. Once we account for the individual PTA effects with the most comprehensive set of PTAs, we find that the SW result of positive WTO effects in industrial countries vanishes completely.

[14] In our dataset 1,593 of the 55,831 observations are country pairs that are contemporaneous members of a common PTA; of these 1,593 observations, in 1,369 cases the importer is also a WTO member.

[15] For our broadest PTA set, 3,253 of the 55,813 observations are country pairs that are also members of a common PTA. Of these 3,253 observations, 2,700 of the importers are also contemporaneous WTO members.

Allowing for individual PTA effects also generates seemingly bleak insights for developing countries. The effects of WTO membership are estimated to be either non-existent (regressions 1, 2) or negative and statistically significant (-21% = $e^{-0.235}$-1 in regression 3). On the upside, however, PTA coefficients indicate strong trade creation for *all* PTAs involving developing countries. It may well be the case that developing countries reoriented their import activity considerably towards PTA partners after joining PTAs. This reorientation might produce trade creation, but it might also include some trade diversion that redirected trade from WTO trade partners to fellow PTA members. If this is a common pattern among developing countries, such a reorientation would have a negative impact on the WTO estimate for developing countries, given the hierarchical, mutually exclusive coding of SW.[16] The largest levels of trade creation in regression 3 are observed for PTAs that consist of developing nations (CACM, CARICOM, MERCOSUR, NAFTA-Developing and SPARTECA-Developing) where PTA-internal trade is estimated to be roughly 350% (=$e^{1.5}$-1) greater than PTA-external trade.

3.2 Hierarchical, Mutually Exclusive Coding and SW's "*Implicit Industrialized PTA Dummy*"

The results from our specifications that allow for individual PTA effects suggest that PTA trade creation is not homogeneous across countries. To the contrary, bilateral PTA trade is estimated to be significantly larger for PTAs that consist of developing countries than it is for PTAs among industrialized nations. Ignoring these trade creation differentials, introduces a specific type of omitted variable bias into SW style regressions. This section discusses the specific bias and shows its particular effect on the estimate for industrialized countries' WTO trade creation.

We will show that the industrialized WTO coefficient in SW's preferred regression (regression 1) functions simply as an error-correction term. The term allows for an implicit split of SW's aggregate PTA coefficient into one for industrialized countries' PTAs (with low trade creation) and one for developing countries' PTAs (with high creation). The mechanics of this implicit split requires additional explanation. In effect, an *implicit industrialized PTA dummy* is generated by the interaction between a) SW's coding convention, b) the nature of industrialized countries' WTO/PTA accession, and c) multilateral resistance controls (time-varying importer dummies). To clarify this interaction, it is important to understand that all industrialized importers in the dataset joined WTO *before* joining a PTA. Given SW's coding convention, this implies that after WTO accession, all industrialized importer observations feature the value "1" for either the WTO/GSP dummy, or the PTA dummy. This

[16] Consider a developing country that is a member of the WTO and of a PTA. For imports from PTA-partners, only the PTA dummy takes the value of "1", while for imports from non-PTA members the developing WTO dummy takes the value of "1". If PTA membership generally causes a shift in imports (due to trade creation and diversion) towards PTA members, the WTO dummy shows a negative coefficient.

implies that, for industrialized countries, the linear combination of these two dummies is perfectly collinear with the time-varying importer dummy.

To confirm, we can perform a quick experiment by explicitly partitioning the aggregate PTA dummy into two: one for industrialized and another for developing importer observations featuring PTA relationships. The experiment, reported in regression 1a, results in perfect multicollinearity forcing the industrial PTA dummy to be dropped from the regression. The results of regression 1a are exactly identical to those in regression 1. The only difference is that it is possible to directly identify industrialized PTA trade creation in regression 1a (from the WTO importer dummy, since it is perfectly collinear with the industrialized PTA dummy).[17]

For regression 1, the collinearity between the time-varying importer dummies and the linear combination of the industrialized countries' WTO and PTA dummies has important implications. Since only two (WTO and time-varying importer) of the three dummies are included, the third is implied. Given the nature of industrialized countries' WTO accession, the omitted dummy happens to be identical to all industrialized countries that entered a PTA. This is the source of the implicit industrialized PTA dummy in regression 1. Regression 1's industrialized WTO coefficient *does not* reveal WTO trade creation, but trade creation that is due to industrialized PTAs.

Note also, that there is a flipside to the implied industrialized PTA dummy. Regression 1a proves that developing countries' PTA effects *exclusively* determined the "aggregate PTA" effect in regression 1 (aggregate in quotations, since we now know that this effect has been purged of all industrialized countries' effects, which are accounted for by the "WTO coefficient" in regression 1). This of course is nothing more than the flipside of our insight that industrialized PTA effects are *entirely* expressed through the industrialized WTO dummy.

4. Individual PTA Effects, Multilateral Resistance, and Unobserved Bilateral Heterogeneity

There exits substantial evidence that trade agreements tend to form between trading partners whose bilateral trade has been "naturally" elevated all along, due to unobserved characteristics (see e.g. Baier and Bergstrand, 2007). This implies that some trade with the agreement may be caused by "natural" trade-promoting characteristics and is independent of the agreement. SW attempted to control for such country-pair specific characteristics with the inclusion of a number of control variables. When the included controls do not account for all unobserved bilateral heterogeneity, and when omitted variables favor trade, the WTO and PTA coefficients are biased upwards.

[17] The WTO dummy exhibits the inverse sign because of the mutually exclusive SW coding.

The PTA literature has long considered the AP, LAIA and APEC estimates suspiciously high relative to the small tariff reductions associated with these agreements (e.g. Frankel, 1992; Frankel and Wei, 1993; Frankel, Stein and Wei, 1995; Frankel, 1997). Given that our estimates in Table 1 (regressions 1-3) are of similar magnitude as those found in the previous literature, our results confirm that such magnitudes are robust to the inclusion of both the individual PTA effects and multilateral resistance. Egger and Pfaffermayr (2003) and Cheng and Wall (2005) have previously confirmed that implausibly large estimates can be lowered in the canonical gravity equation by taking unobserved bilateral heterogeneity into account (neither study includes GSP or WTO effects).

To fully account for unobserved bilateral heterogeneity relationships in equation (1), we control for all time-invariant bilateral heterogeneity by introducing country-pair fixed effects. This can be achieved by replacing the intercept in equation (1) by a country-pair specific one, α_{mx}:

$$\begin{aligned} \log\left(Imports_{mxt}\right) &= \alpha_{mx} + \delta_{mt} + \lambda_{xt} + \beta_1 WTOIndustrial^*_{mt} + WTODeveloping^*_{mt} \\ &+ \beta_3 GSP^*_{mt} + \beta_4 PTA_{mxt} + \beta_5 CurrencyUnion_{mxt} + \beta_6 CurColony_{\mathrm{mxt}} + \varepsilon_{\mathrm{mxt}} \end{aligned} . \qquad (2)$$

Equation (2) features fewer explanatory variables than equation 1 because all time-invariant regressors are now absorbed into the pair specific fixed effects.

4.1 WTO Trade Impact: Controlling for Multilateral Resistance, Unobserved Bilateral Heterogeneity and Individual PTA Effects (Hierarchical/Mutually Exclusive WTO Coding)

Regressions 4-6 in Table 1 present analogues of regressions 1-3 above. The only differences are the added country-pair specific fixed effects that constitute comprehensive controls for unobserved bilateral heterogeneity in regressions 4-6. Two areas are the focus of our interest: a) whether WTO trade effects are influenced by unobserved bilateral heterogeneity, and b) whether PTA effects are reduced to plausible ranges.

Regression 4 is a replication of the original SW specification (2007, their Table 4, regression 4) with the addition of country-pair fixed effects.[18] The results show a substantial reduction of the WTO's economic and statistical significance for industrialized countries. WTO trade creation falls from 178% in regression 1 to 48% (=$e^{0.393}$-1) for industrialized countries in regression 4, and its significance fails to reach the 1% level. The inclusion of specific PTA trade effects in regressions 5 and 6 also negates all WTO trade effects for industrialized countries. Regression 5 even shows that the simple disaggregation of SW's own aggregate PTA dummy into individual agreements is sufficient to neutralize any industrialized WTO trade effects, once we account for heterogeneity in bilateral

[18] The only differences to the original SW dataset are the corrections and the TGR-style coding discussed in Section 2. See Eicher and Henn (2008) for results based on the original SW dataset (without TGR but with country-pair fixed effects).

relationships. For developing countries, in sharp contrast, regressions 4-6 illustrate that the GSP and WTO effects are hardly impacted by unobservable heterogeneity. Their estimates are closely aligned to those in regressions 1-3.

The F statistics confirm the importance of the inclusion of comprehensive country-pair fixed effects as well as individual PTA effects at significance levels that exceed 0.001%. The added controls also generate reduced (and more plausible) trade impacts for individual PTAs. This provides evidence that unobserved bilateral heterogeneity is generally trade-enhancing. Average trade creation across PTAs drops from 234% in regression 1 to 123% in regression 4 (Table 1a). Most individual trade agreements see their trade effects at least halved in regressions 5 and 6. In contrast, trade creation in the EU increases, and the EU coefficient is now estimated with considerable precision.

Before we present a detailed discussion of individual PTA trade effects in Section 6, we conduct a robustness analysis. The expanded SW results that have been presented in regressions 1-6 give rise to the question as to whether the absence of WTO effects may be an artifact of the hierarchical, mutually exclusive coding in SW. As discussed above, when increases in trade flows are attributed to PTAs rather than to both, WTO and PTA membership, one may suspect that the SW coding convention underestimates WTO trade effects. In the next section, we apply alternative, *mutually inclusive* WTO coding (as in Rose, 2004) to allow for separate identification of WTO and PTA effects. This robustness analysis has two purposes. Not only will this settle whether the SW coding convention is driving the results, but it is also a substantive extension of Rose (2004, 2005), because we extend his specification to introduce both disaggregated PTAs as well as comprehensive multilateral resistance controls.

5. Individual PTA Trade Effects, Multilateral Resistance, and Unobserved Bilateral Heterogeneity (Mutually Inclusive WTO Coding)

Rose (2004 and 2005) controlled for unobserved bilateral heterogeneity through country-pair fixed effects. Nevertheless, SW lamented that he did not control fully for multilateral resistance. By introducing comprehensive controls for multilateral resistance to Rose’s dataset, we unify the SW and Rose approaches. Our approach controls for all three key determinants of trade under both coding conventions: unobserved bilateral heterogeneity, multilateral resistance, and individual PTA effects. The unified approach allows us to highlight whether any results are due to mutually inclusive (Rose) or mutually exclusive (SW) coding of WTO dummies. To allow for a comparison between Rose and SW coding results, we split Rose’s inclusive WTO-dummy into SW-style indicators for industrialized and developing importers’ WTO membership.

Our robustness analysis reexamines regressions 1-6 using inclusive trade agreement coding. Our first set of regressions, which includes multilateral resistance but excludes country-pair fixed effects, is then given by

$$\begin{aligned}\log\left(Imports_{mxt}\right) &= \alpha + \delta_{mt} + \lambda_{xt} + \beta_1 WTOIndustrial^{**}_{mxt} + WTODeveloping^{**}_{mxt} + \beta_3 GSP^{**}_{mxt} + \beta_4 PTA_{mxt} \\ &+ \beta_5 CurrencyUnion_{mxt} + \beta_6 CurColony_{\mathrm{mxt}} + \beta_7 EverColony_{\mathrm{mx}} + \beta_8 CommonColonizer_{\mathrm{mx}} \\ &+ \beta_9 CommonLanguage_{\mathrm{mx}} + \beta_{10} CommonNation_{\mathrm{mx}} + \beta_{11} Border_{\mathrm{mx}} + \beta_{12}\mathrm{Distance}_{\mathrm{mx}} + \varepsilon_{\mathrm{mxt}}\end{aligned} \quad (1')$$

The only difference between (1) and (1') is the coding convention, where inclusive coding is denoted by a "**" superscript.[19] WTO^{**}_{mxt} indicates that both trading partners are WTO members and GSP^{**}_{mxt} identifies industrial countries' GSP imports. Crucial is that under Rose's coding convention *both* WTO^{**}_{mxt} and GSP^{**}_{mxt} take the value "1" when the two conditions are fulfilled. In addition, when the same trading partners are members in a common PTA, inclusive coding assigns the value "1" to all three dummies. For comparison purposes, it is important to point out that inclusive coding delivers coefficient estimates that represent pure PTA effects, while pure PTA effects had to be established via composite coefficients in SW's coding convention (as discussed in Section 3, Table 1 and 1a.)

We proceed again in stages. First we provide results based on equation (1'), and then we incorporate country-pair fixed effects to control for all time-invariant bilateral heterogeneity. Inclusion of country-pair effects again converts the constant *α* to a pair-specific one, α_{mx}:

$$\begin{aligned}\log\left(Imports_{mxt}\right) &= \alpha_{mx} + \delta_{mt} + \lambda_{xt} + \beta_1 WTOIndustrial^{**}_{mxt} + WTODeveloping^{**}_{mxt} + \beta_3 GSP^{**}_{mxt} \\ &+ \beta_4 PTA_{mxt} + \beta_5 CurrencyUnion_{mxt} + \beta_6 CurColony_{\mathrm{mxt}} + \varepsilon_{\mathrm{mxt}}\end{aligned}. \quad (2')$$

5.1 WTO Trade Impact: Controlling for Multilateral Resistance, Unobserved Bilateral Heterogeneity and Individual PTA Effects (Mutually Inclusive WTO Coding)

Regression 7 in Table 2 establishes a baseline regression that represents our closest analogue to Rose's default regression (2004, Table 1). Regression 7 is a robustness test of Rose's findings that examines whether a comprehensive account of multilateral resistance affects his original results. At the same time, regression 7 also provides a robustness check of SW's preferred regression (Table 1, regression 1) to examine whether results are affected by the coding convention.

[19] Strictly speaking, there exists one additional discrepancy between mutually inclusive and exclusive coding of multilateral trade agreements. Mutually exclusive coding assigns a "1" to any WTO importer observation (and no PTA or GSP relationship), while inclusive coding assigns a "1" only when *both* importer and exporter are WTO members. The reason is the collinearity between inclusive WTO-dummies and our multilateral resistance controls. That is, for WTO member countries the inclusive WTO dummy takes the value "1" for all observations that relate to the countries' imports in a given year. However, the importer-year dummy that controls for multilateral resistance in the same year also takes the value "1" for exactly the same observations. By construction, this collinearity is avoided in mutually exclusive coding of the WTO variable, because WTO importers are not considered WTO members for observations where the WTO importer is in a PTA or GSP relationship with the exporter.

Rose's preferred regressions (2004, Table 1) report insignificant WTO effects throughout. The insertion of multilateral resistance controls does not change Rose's conclusions regarding WTO effects. Regression 7 shows that trade creation due to WTO membership for both industrialized and developing countries is insignificant. Even when the WTO dummies in regression 7 are aggregated to one WTO dummy (for industrial and developing countries), the combined effect is insignificant.[20] The only result that does change is that Rose's GSP effect is now eliminated.

The comparison of regressions 1 and 7 highlights that the coding convention matters to the insights derived from the individual regressions, but it does not affect the conclusions. Mutually inclusive coding renders the WTO effect statistically and economically insignificant even when individual PTA effects are not introduced. On the other hand, mutually exclusive coding delivered insignificant WTO effects only after individual PTA effects have been fully taken into account. The reason lies in our discussion in Section 3.2. PTA coefficients under mutually inclusive coding provide *net effects,* which implies that the industrialized WTO dummy cannot function as a error-correction term. It is not possible to implicitly split the aggregate PTA variable into one for North-North PTAs (with net lower trade creation) and one for South-South PTAs (with higher net trade creation) as we had seen in Sections 3 and 4. As a result, mutually inclusive coding in Table 2 never delivers significant WTO coefficients.

The crucial insight is that when variables are coded to represent only their *net effects* on trade (as in Rose, 2004), the risk of omitted variable bias is greatly reduced. Under mutually exclusive coding, however, estimated PTA coefficients include *both* PTA and WTO effects. This is the reason why the individual PTA effects in Tables 1 and 2 are strikingly similar, while the "gross" PTA effects in Table 1a exhibit little resemblance to those in Table 2. Mutually exclusive coding thus holds the danger that WTO dummies are biased when the following two conditions hold: (1) industrialized and developing PTAs differ considerably in their trade effects and (2) individual PTA effects are constrained to an average coefficient associated with one aggregate PTA dummy.

Regressions 8 and 9 (the inclusive-coding analogues of regressions 2 and 3) introduce individual PTA effects and represent two further robustness tests. The first test is whether Rose's (2005) results of a small, positive WTO effect are robust to controlling for multilateral resistance. At the same time, regressions 8 and 9 represent a second robustness test that examines whether SW's WTO effect vanishes only because of their coding convention. Recall that under mutually exclusive

[20] The regression is not reported here, but can be obtained from the authors.

coding the introduction of additional PTAs reduces the number WTO observations, which is not the case under Rose's mutually inclusive coding.

Regressions 8 and 9 overturn Rose's (2005) result of a statistically significant WTO effect when individual PTA effects are considered.[21] Hence Rose's (2005) finding of small (but significant) WTO effects came about only because he did not control comprehensively for multilateral resistance. The regressions that allow for distinct effects across preferential trade agreements also highlight that the vanishing WTO effect in SW – after we controlled for individual PTA effects – was indeed only due to SW's hierarchical and mutually exclusive coding. It is thus essential to validate our WTO results by using the most comprehensive set of controls in both datasets.

Regressions 10-12 are the analogs to regressions 4-6, where the only difference in the datasets is the coding convention. With inclusive coding we find no WTO trade effects in either of these regressions. Regressions 12 and 6 represent our preferred specifications overall, since they contain all three key controls: multilateral resistance, natural trading partner effects and individual PTA effects Both regressions confirm the absence of trade gains from WTO membership independent of the coding convention and these regressions are also clearly favored by the F-statistics. More generally, we find that, without exception, the inclusion of individual PTA trade effects *always* improves the estimation no matter which set of controls is selected.

6. Individual PTA Trade Effects: Sensitivity to Unobserved Bilateral Heterogeneity and Multilateral Resistance Controls

The byproduct of the thorough investigation of WTO trade effects above is a set of estimates for individual PTA effects produced with the use of the most comprehensive set of controls to date. Given the voluminous literature on the effects of PTAs on trade flows, these estimates are important in their own right. In our discussion of the individual PTA effects below, our main focus will be on our preferred specification, regression 12. Regression 12 features the most comprehensive set of controls and its econometric specification is identical to regression 6. The two regressions differ only in terms of their coding convention and produce virtually identical results. PTA estimates in regressions 12 and 6 generally do not differ by more than one standard deviation. We will use regression 9 as a reference to regression 12 in order to highlight the importance of bilateral heterogeneity controls.

Before we start our discussion of specific PTA effects, it is important to recall the exact interpretation of the PTA coefficients in regression 12. They indicate how much PTA-internal trade

[21] Rose's result also persists when only *de jure* WTO membership is considered; see Eicher and Henn (2008).

has increased *relative to* trade with non-members after the agreement was instituted. The percentage increases below are thus mixtures of trade creation and trade diversion.[22] While we find no statistically significant negative net trade effects from PTA membership, even insignificant PTA estimates do not imply that the PTA was necessarily ineffective in creating trade flows. It could simply indicate that PTA-internal trade grew at the rate of external trade (as, for example, in the case of the export oriented ASEAN countries).

The individual trade effects of PTAs in regression 12 are the most "reasonable" among all our regressions, in the sense that the net trade creation for most PTAs is estimated to range between 30% and 80%. Curiously, the Central and Latin American Trade Agreements (CACM, CARICOM, MERCOSUR and LAIA) show by far the largest increases in relative trade. They are also the only PTAs that report net increases in trade creation of over 100% (with the exception of SPARTECA, which reports an increase of 124% = $e^{0.807}$-1).

Most notable is the reduction in the estimated net trade creation for most PTAs, after we control for omitted variable bias. Comparing regression 9 to 12 reveals that, with the exception of the EU, CACM and LAIA, all PTA estimates are substantially reduced when we include country-pair fixed effects. In other words, our results suggest strongly that PTAs are formed between countries that have all along been sharing characteristics favorable to mutual trade. In this case, tariff reduction may simply be an afterthought. Controlling for unobserved bilateral heterogeneity also improves the precision of the estimates in all cases but NAFTA. The suspiciously large net trade creation of NAFTA (230%) in regression 9 is reduced to insignificance after we control for unobserved bilateral heterogeneity.

Controlling for unobserved bilateral heterogeneity also *increased* trade creation for three PTAs (EU, EFTA and CACM). Given these PTA member countries' characteristics, their actual trade flows are not *large enough* relative to the prediction of the gravity model. For example, in the case of CACM, all countries share a common language, colonizer, and very low distance. The introduction of country-pair fixed effects resolves the systematic overprediction of the gravity model and allows a better assessment of the impact of PTA accession.

It may initially be surprising that predicted trade volumes also exceed observed levels in the EU. The fact that the EU trade impact is underestimated in both the traditional and multilateral

[22] Multicollinearity does not allow for separate trade creation and diversion effects in the presence of multilateral resistance controls. For a given year, a typical PTA member country's import observations are *partitioned* into a) imports originating from fellow PTA members and b) imports from non-members. The linear combination of two separate dummy variables for each type of import would be perfectly collinear with time-varying importer dummies that control for multilateral resistance.

resistance-augmented versions of the gravity equation is, however, well known (e.g., Aitken, 1973; Soloaga and Winters, 2001; and Rose, 2004). Our estimates show a statistically significant 37% (= $e^{0.312}$-1) increase in trade due to EU accession, once we control for unobserved bilateral heterogeneity. In the case of the EU, it is likely that the large market and the strong harmonization efforts allowed firms to overcome trade fixed costs that subsequently lead to strong trade creation between both member and nonmember countries (e.g. Freund, 2000; Melitz, 2003). The indisputable increase in absolute trade volume among EU members is then relatively small compared to the trade increase with non-members. It is also important to note that EU members automatically reaped another 34% trade benefit when they became members of the EEA in 1994 (since the overwhelming majority of EEA members are EU countries).

Another trade agreement that has been the subject of great interest in the PTA literature is APEC. The highly significant and truly exorbitant APEC trade creation estimate (around 300%) is common in gravity models, although the agreement is only a consultative forum without implications for tariffs (see e.g. Frankel and Wei, 1993; Frankel, Stein and Wei, 1995; Frankel, 1997). Regression 9 indicates that the inclusion of multilateral resistance lowers values for the APEC coefficient substantially to 123% (=$e^{0.802}$-1). The additional inclusion of unobserved bilateral heterogeneity controls shows that much of the trade creation originally attributed to APEC has actually been due to bilateral unobservables. While this has been the suspicion of Frankel and coauthors all along, their quest to identify these unobservable drivers has largely been unsuccessful. In our preferred regression 12, which controls for multilateral resistance, unobserved bilateral heterogeneity and individual PTA effects, APEC's trade creation estimate drops to a meager 28% (=$e^{0.244}$-1).

7. Conclusion

This paper establishes robust estimates of the impact of WTO and PTA accession on bilateral trade flows. We control for omitted variable bias in three dimensions: individual PTA effects, multilateral resistance, and unobserved bilateral heterogeneity. Our results show a clear absence of WTO trade effects, and our estimates are nearly identical across the different coding conventions of the WTO dummy (Rose, 2004; Subramanian and Wei, 2007; or Tomz, Goldstein and Rivers, 2007). Our comprehensive account for omitted variable bias allows us to unify the previous WTO and PTA literatures. Our analysis highlights, that previously diverging results regarding WTO effects on bilateral trade flows (most prominently in Rose, 2004, 2005; Subramanian and Wei, 2007; and Tomz, Goldstein and Rivers, 2007) may have been generated by omitted variable bias. F-Tests indicate that the most extensive specification, which controls for all three dimensions of omitted variable bias, is preferred.

The magnitude of the resulting individual PTA estimates resolves a number of empirical puzzles. Most notably, the non-tariff reducing APEC is shown to exert comparatively little trade impact, and the strongly tariff reducing EU is shown to be trade creating. Trade theory motivates the inclusion of comprehensive multilateral resistance controls to pick up variations in relative trade costs. These controls are shown to be insufficient to generate unbiased estimates of trade agreements' impacts on trade flows. Of crucial importance are also country-pair fixed effects that control for unobserved bilateral characteristics. While a significant share of trade is shown to be country-pair specific, the importance of such characteristics is not fully addressed in current trade theories.

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Table 1: WTO and PTA Effects: (Hierarchical, Mutually Exclusive Coding)

	Dependent variable: bilateral imports							
Regression #	**1**	**1a**	**2**	**3**	**4**	**5**		**6**
Country-Pair FE	No	No	No	No	Yes	Yes		Yes
Adj R^2	0.7411	0.7411	0.7415	0.7430	0.8747	0.8751		0.8760
F Stat vs. Regr.#			# 1		# 1	# 2	# 4	# 3
Prob>F:			0.00		0.00	0.00	0.00	0.00
GSP $_{mt}$	-0.209 ***	-0.209 ***	-0.202 ***	-0.202 ***	-0.242***	-0.233***		-0.181 ***
(ind. imp. grants)	(0.041)	(0.041)	(0.041)	(0.040)	(0.049)	(0.049)		(0.047)
WTODev $_{mt}$	0.062	0.062	-0.045	-0.235 ***	0.210	-0.207		-0.254 ***
(dev. imp.)	(0.134)	(0.134)	(0.131)	(0.075)	(0.147)	(0.148)		(0.082)
WTOInd $_{mt}$	1.053 ***	-0.152 ***	0.588 ***	-0.035	0.393 **	0.124		-0.068
(ind. imp.)	(0.141)	(0.056)	(0.195)	(0.092)	(0.165)	(0.189)		(0.092)
PTA $_{mxt}$ *ind. composite*	0.152 ***				0.361 ***			
(aggregate)	(0.056)				(0.055)			
PTA $_{mxt}$ *dev. composite*	1.143 ***	1.143 ***			0.545 ***			
(aggregate)	(0.073)	(0.073)			(0.082)			
BilateralPTA $_{mxt}$			0.072	0.351 ***		-0.169 *		-0.054
(ind. importer)			(0.109)	(0.085)		(0.101)		(0.084)
BilateralPTA $_{mxt}$			0.705 ***	0.551 ***		0.161 *		0.132 *
(dev. importer)			(0.085)	(0.080)		(0.086)		(0.180)
NAFTA $_{mxt}$			1.529 ***	1.276 ***		0.155		0.257
(ind. importer)			(0.188)	(0.161)		(0.139)		(0.169)
NAFTA $_{mxt}$			2.162 ***	1.476 ***		0.485 ***		0.443 **
(dev. importer)			(0.216)	(0.172)		(0.158)		(0.176)
EU $_{mxt}$			0.065	-0.139 **		0.473 ***		0.306 ***
			(0.056)	(0.067)		(0.062)		(0.068)
CACM $_{mxt}$			1.346 ***	1.509 ***		1.907 ***		1.938 ***
			(0.191)	(0.173)		(0.253)		(0.242)
CARICOM $_{mxt}$			1.437 ***	1.446 ***		1.071 ***		1.070 ***
			(0.143)	(0.143)		(0.253)		(0.253)
MERCOSUR $_{mxt}$			1.530 ***	1.552 ***		0.982 ***		1.068 ***
			(0.197)	(0.202)		(0.227)		(0.243)
AFTA $_{mxt}$			0.568 ***	0.391 **		-0.035		0.049
			(0.159)	(0.172)		(0.196)		(0.207)
ANZCERTA $_{mxt}$			1.875 ***	1.647 ***		0.747 **		0.770 ***
			(0.123)	(0.135)		(0.293)		(0.297)
SPARTECA $_{mxt}$			0.824 ***	1.238 ***		0.587 ***		0.742 ***
(ind. importer)			(0.236)	(0.224)		(0.207)		(0.178)
SPARTECA $_{mxt}$			1.457 ***	1.438 ***		0.917 ***		0.927 ***
(dev. importer)			(0.210)	(0.217)		(0.176)		(0.170)
EFTA $_{mxt}$				0.491 ***				0.200 ***
				(0.091)				(0.075)
EEA $_{mxt}$				0.508 ***				0.342 ***
				(0.096)				(0.105)
AP $_{mxt}$				0.638 ***				0.677 ***
				(0.183)				(0.223)
LAIA $_{mxt}$				0.267 **				1.277 ***
				(0.105)				(0.191)
APEC $_{mxt}$				0.651 ***				0.107
(ind. importer)				(0.086)				(0.092)
APEC $_{mxt}$				0.851 ***				0.293 ***
(dev. importer)				(0.070)				(0.079)
CU $_{mxt}$	0.615 ***	0.615 ***	0.616 ***	0.643 ***	0.291 **	0.310 ***		0.317 ***
(Currency union)	(0.082)	(0.082)	(0.082)	(0.082)	(0.113)	(0.114)		(0.114)
CurColony $_{mxt}$	0.760 ***	0.760 ***	0.765 ***	0.765 ***	0.376 ***	0.356 ***		0.377 ***
(Current colony)	(0.145)	(0.145)	(0.145)	(0.145)	(0.137)	(0.137)		(0.137)
EverColony $_{mx}$	1.164 ***	1.164 ***	1.156 ***	1.161 ***				
(Ever colony)	(0.065)	(0.065)	(0.065)	(0.065)				
ComColonizer $_{mx}$	0.578 ***	0.578 ***	0.567 ***	0.573 ***				
(Common colonizer)	(0.050)	(0.050)	(0.051)	(0.051)				
ComLang $_{mx}$	0.142 ***	0.142 ***	0.141 ***	0.125 ***				
(Common lang.)	(0.031)	(0.031)	(0.031)	(0.032)				
ComNat $_{mx}$	-0.522	-0.522	-0.529	-0.544				
(Same nation)	(0.544)	(0.544)	(0.545)	(0.544)				
Border $_{mx}$	0.024	0.024	0.027	0.040				
(Common border)	(0.065)	(0.065)	(0.065)	(0.065)				
Dist $_{mx}$	-0.965 ***	-0.965 ***	-0.963 ***	-0.932 ***				
(Log of distance)	(0.017)	(0.017)	(0.017)	(0.017)				

Notes: *, **, *** are 10%, 5%, 1% significance levels; standard errors in parenthesis, fixed effect coefficients are suppressed. GSP and PTA coefficients are composite coefficients that report GSP and PTA effects net of WTO effects and are calculated by the Delta method (the original regression output is in Table 1a). All regressions include time-varying importer and exporter fixed effects.

Table 1a: Raw Regression Output
GSP and PTA Coefficient Estimates *including* WTO Effects
(Mutually exclusive coding, corresponding to results in Table 1)

	Dependent variable: bilateral imports						
Regression #	**1**	**1a**	**2**	**3**	**4**	**5**	**6**
Country-Pair FE	No	No	No	No	Yes	Yes	Yes
GSP_{mt} (ind. imp. grants)	0.844 *** (0.142)	-0.360*** (0.115)	0.385 ** (0.194)	-0.237 ** (0.093)	0.151 (0.166)	-0.110 (0.187)	-0.249 *** (0.095)
PTA_{mxt} *Ind./Dev* (aggregate)	1.205 *** (0.131)				0.755 *** (0.157)		
PTA_{mxt} *Dev. only* (aggregate)		1.205 *** (0.131)					
$BilateralPTA_{mxt}$			0.660 *** (0.164)	0.316 *** (0.095)		-0.045 (0.167)	-0.122 (0.097)
$NAFTA_{mxt}$			2.117 *** (0.258)	1.241 *** (0.148)		0.279 (0.215)	0.189 (0.152)
EU_{mxt}			0.652 *** (0.199)	-0.174 * (0.097)		0.596 *** (0.196)	0.238 ** (0.107)
$CACM_{mxt}$			1.301 *** (0.168)	1.274 *** (0.166)		1.700 *** (0.244)	1.684 *** (0.239)
$CARICOM_{mxt}$			1.391 *** (0.209)	1.211 *** (0.165)		0.864 *** (0.288)	0.817 *** (0.264)
$MERCOSUR_{mxt}$			1.485 *** (0.246)	1.317 *** (0.198)		0.776 *** (0.271)	0.814 *** (0.233)
$AFTA_{mxt}$			0.523 *** (0.188)	0.156 (0.154)		-0.241 (0.237)	-0.204 (0.194)
$ANZCERTA_{mxt}$			2.463 *** (0.227)	1.612 *** (0.132)		0.870 ** (0.347)	0.702 ** (0.295)
$SPARTECA_{mxt}$			1.412 *** (0.199)	1.203 *** (0.207)		0.710 *** (0.178)	0.674 *** (0.164)
$EFTA_{mxt}$				0.455 *** (0.122)			0.132 (0.114)
EEA_{mxt}				0.472 *** (0.069)			0.275 *** (0.065)
AP_{mxt}				0.404 ** (0.166)			0.423 ** (0.214)
$LAIA_{mxt}$				0.032 (0.110)			1.023 *** (0.185)
$APEC_{mxt}$				0.616 *** (0.090)			0.039 (0.098)

Notes: *, **, *** are 10%, 5%, 1% significance levels. Standard errors clustered by country-pairs in parentheses. Coefficients of Fixed Effect controls are suppressed. Remaining coefficients (WTO regressors and historical/geographical controls) are as in corresponding regressions in Table 1. F-Statistics for the inclusion of additional PTAs cannot be computed due to the mutually exclusive coding of the WTO dummies. All regressions include time-varying importer and exporter fixed effects.

Table 2: WTO and PTA Effects (Inclusive Coding)

	dependent variable: bilateral imports					
Regression #	**7**	**8**	**9**	**10**	**11**	**12**
Country-Pair FE	No	No	No	Yes	Yes	Yes
Adj R^2	0.7401	0.7415	0.7431	0.8747	0.8751	0.8760
F Statistic vs. Regr.#		# 7	# 8	# 7	# 8 | # 10	# 9 | # 11
Prob>F:		0.00	0.00	0.00	0.00 | 0.00	0.00 | 0.00
GSP_{mt} (ind. imp. grants)	-0.127 *** (0.040)	-0.183 *** (0.040)	-0.181 *** (0.039)	-0.252 *** (0.048)	-0.228 *** (0.049)	-0.187 *** (0.048)
$WTODev_{mt}$ (dev. imp.)	-0.103 (0.065)	-0.118 * (0.065)	-0.109 * (0.065)	-0.051 (0.069)	-0.054 (0.069)	-0.035 (0.068)
$WTOInd_{mt}$ (ind. imp.)	0.058 (0.065)	0.069 (0.065)	0.071 (0.065)	-0.028 (0.068)	-0.026 (0.068)	-0.002 (0.066)
Ind./dev. PTA_{mxt} (aggregate)	0.629 *** (0.052)			0.473 *** (0.045)		
$BilateralPTA_{mxt}$		0.453 *** (0.069)	0.470 *** (0.070)		0.070 (0.068)	0.059 (0.068)
$NAFTA_{mxt}$		1.755 *** (0.145)	1.194 *** (0.153)		0.323 ** (0.155)	0.150 (0.171)
EU_{mxt}		0.072 (0.056)	-0.146 ** (0.064)		0.506 *** (0.060)	0.312 *** (0.068)
$CACM_{mxt}$		1.316 *** (0.163)	1.372 *** (0.164)		1.788 *** (0.238)	1.789 *** (0.238)
$CARICOM_{mxt}$		1.447 *** (0.144)	1.454 *** (0.143)		1.065 *** (0.254)	1.061 *** (0.254)
$MERCOSUR_{mxt}$		1.540 *** (0.197)	1.402 *** (0.196)		0.984 *** (0.228)	0.879 *** (0.229)
$AFTA_{mxt}$		0.551 *** (0.156)	0.189 (0.154)		-0.043 (0.195)	-0.161 (0.194)
$ANZCERTA_{mxt}$		1.877 *** (0.124)	1.514 *** (0.124)		0.747 ** (0.292)	0.623 ** (0.291)
$SPARTECA_{mxt}$		1.310 *** (0.206)	1.350 *** (0.208)		0.814 *** (0.168)	0.807 *** (0.167)
$EFTA_{mxt}$			0.473 *** (0.091)			0.199 *** (0.075)
EEA_{mxt}			0.489 *** (0.067)			0.294 *** (0.069)
AP_{mxt}			0.385 ** (0.167)			0.424 * (0.217)
$LAIA_{mxt}$			0.189 * (0.098)			1.190 *** (0.182)
$APEC_{mxt}$			0.798 *** (0.063)			0.244 *** (0.071)
CU_{mxt} (Currency union)	0.618 *** (0.082)	0.627 *** (0.082)	0.654 *** (0.082)	0.290 ** (0.113)	0.312 *** (0.114)	0.318 *** (0.114)
$CurColony_{mxt}$ (Current colony)	0.755 *** (0.144)	0.762 *** (0.145)	0.762 *** (0.145)	0.370 *** (0.137)	0.358 *** (0.137)	0.382 *** (0.137)
$EverColony_{mx}$ (Ever colony)	1.173 *** (0.066)	1.159 *** (0.065)	1.162 *** (0.064)			
$ComColonizer_{mx}$ (Common colonizer)	0.605 *** (0.050)	0.584 *** (0.051)	0.589 *** (0.054)			
$ComLang_{mx}$ (Common language)	0.148 *** (0.031)	0.137 *** (0.031)	0.121 *** (0.032)			
$ComNat_{mx}$ (Same nation)	-0.503 (0.545)	-0.532 (0.547)	-0.547 (0.546)			
$Border_{mx}$ (Common border)	0.014 (0.066)	0.027 (0.065)	0.042 (0.065)			
$Dist_{mx}$ (Log of distance)	-0.968 *** (0.017)	-0.961 *** (0.017)	-0.930 *** (0.017)			

Notes: *, **, *** are 10%, 5%, 1% significance levels. Standard errors clustered by country-pairs in parentheses. Coefficients of Fixed Effect controls are suppressed. All regressions include time-varying importer and exporter fixed effects.

Table A1 Membership in considered Preferential Trading Arrangements

Abbreviation	Name of PTA	Start	Member countries
ANZCERTA	Australia – New Zealand Closer Economic Relations Trade Agreement	1983	Australia, New Zealand
APEC	Asia Pacific Economic Community	1989	Australia, Brunei, Canada, China (1991), Chile (1994), Taiwan (1991), Hong Kong (1991), Indonesia, Japan, South Korea, Malaysia, Mexico (1993), New Zealand, Papua New Guinea (1993), Peru (1998), Philippines, Singapore, Thailand, United States, Vietnam (1998).
AP	Andean Community / Andean Pact	1969	Bolivia, Colombia, Ecuador, Peru, Venezuela (1973), Former: Chile (1969-76)
AFTA	Association of South East Asian Nations (ASEAN) Free Trade Area	1967	Brunei (1984), Cambodia (1998), Indonesia, Laos (1997), Malaysia, Myanmar (1997), the Philippines, Singapore, Thailand, Vietnam (1995).
CACM	Central American Common Market	1960	Costa Rica (1963), El Salvador, Guatemala, Honduras, Nicaragua.
CARICOM	Caribbean Community/ Carifta	1968	Antigua and Barbuda, Bahamas (1983), Barbados, Belize (1995), Dominica (1974), Guyana (1995), Grenada (1974), Jamaica, Montserrat (1974), St. Kitts and Nevis, St. Lucia (1974), St. Vincent and the Grenadines, Suriname (1995), Trinidad and Tobago.
EEA	European Economic Area	1994	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Luxembourg, Iceland, Italy, Ireland, Liechtenstein, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom.
EFTA	European Free Trade Association	1960	Iceland, Liechtenstein (1991), Norway (1986), Switzerland Former: Denmark (1960-72), United Kingdom (1960-72), Portugal (1960-85), Austria (1960-94), Sweden (1960-94), Finland (1986-94).
EU	European Union	1958	Austria (1995), Belgium, Denmark (1973), Finland (1995), France, Germany, Greece (1981), Luxembourg, Ireland (1973), Italy, Netherlands, Portugal (1986), Spain (1986), Sweden (1995), United Kingdom (1973).
LAIA/LAFTA	Latin America Integration Agreement	1960	Argentina, Bolivia (1967), Brazil, Chile, Colombia (1961) Ecuador (1961), Mexico, Paraguay, Peru, Uruguay, Venezuela (1966).
MERCOSUR	Southern Cone Common Market	1991	Argentina, Brazil, Paraguay, Uruguay
NAFTA	Canada-US Free Trade Arrangement / North America Free Trade Agreement	1988	Canada, United States, Mexico (1994).
SPARTECA	South Pacific Regional Trade and Economic Cooperation Agreement	1981	Covers trade relations between the Cook Islands, Fiji, Kiribati, Marshall Islands, Micronesia, Nauru, Niue, Palau, Papua-New Guinea, Salomon Islands, Samoa, Tonga, Tuvalu, Vanuatu, on the one hand, and Australia and New Zealand on the other
BilateralPTA	Bilateral Preferential Trade Agreements		All bilateral agreements considered are listed in Table A2.

Source: Eicher, Henn and Papageorgiou (2007).

Table A2: Bilateral Preferential Trade Agreements considered in *BilateralPTA$_{mx}$*

US - Israel	Slovak Republic – Turkey
Turkey - Slovenia	Papua New Guinea - Australia Trade & Commercial Relations Agreement (PATCRA)
EC - Slovenia	EC - Tunisia
EC - Lithuania	Estonia – Turkey
EC - Estonia	Slovenia – Israel
EC - Latvia	Poland – Israel
Chile - Mexico	Estonia - Faroe Islands
Mexico - Israel	Czech Republic – Estonia
Georgia - Armenia	Slovak Republic – Estonia
Georgia - Azerbaijan	Lithuania – Turkey
Georgia - Kazakhstan	Israel – Turkey
Georgia - Turkmenistan	Romania – Turkey
Georgia - Ukraine	Hungary – Turkey
Latvia - Turkey	Czech Republic – Israel
Turkey - former Yugoslav Rep. of Macedonia	Slovak Republic – Israel
EC - South Africa	Slovenia – Croatia
EC - Morocco	Hungary – Israel
EC - Israel	CEFTA accession of Romania
EC - Mexico	CEFTA accession of Slovenia
Estonia - Ukraine	Poland – Lithuania
Poland - Turkey	Slovak Republic – Latvia
EFTA - Morocco	Slovak Republic – Lithuania
Bulgaria - former Yugoslav Rep. of Macedonia	Canada – Chile
Hungary - Latvia	Czech Republic – Latvia
Hungary - Lithuania	Czech Republic – Lithuania
Poland - Latvia	Slovenia – Estonia
Poland - Faeroe Islands	Slovenia – Lithuania
Kyrgyz Republic - Moldova	EC - Faeroe Islands
Kyrgyz Republic - Ukraine	Canada – Israel
Kyrgyz Republic - Uzbekistan	EFTA – Estonia
Bulgaria - Turkey	EFTA – Latvia
Czech Republic - Turkey	EFTA – Lithuania
EAEC	EC – Turkey
CEFTA accession of Bulgaria	

Source: Subramanian and Wei (2007).

Table A3: List of Countries in sample and year of WTO accession

Industrialized Countries			
Australia (1948)	France (1948)	Japan (1955)	Spain (1963)
Austria (1951)	Germany (1951)	Luxembourg (1948)	Sweden (1950)
Belgium (1948)	Greece (1950)	Netherlands (1948)	Switzerland (1966)
Canada (1948)	Iceland (1968)	New Zealand (1948)	United Kingdom (1948)
Denmark (1950)	Ireland (1967)	Norway (1948)	United States (1948)
Finland (1950)	Italy (1950)	Portugal (1962)	
Developing Countries and Territories			
Albania (2000)	Djibouti (1994)	Libyan Arab Jamahiriya	Senegal (1963)
Algeria	Dominica (1993)	Lithuania (2001)	Seychelles
Angola (1994)	Dominican Republic (1950)	Macedonia	Sierra Leone (1961)
Antigua and Barbuda (1987)	Ecuador (1996)	Madagascar (1963)	Singapore (1973)
Argentina (1967)	Egypt (1970)	Malawi (1964)	Slovak Republic (1993)
Armenia	El Salvador (1991)	Malaysia (1957)	Slovenia (1994)
Azerbaijan	Equatorial Guinea	Maldives (1983)	Solomon Islands (1994)
Bahamas, The	Estonia (1999)	Mali (1993)	Somalia
Bahrain, Kingdom of (1993)	Ethiopia	Malta (1964)	South Africa (1948)
Bangladesh (1972)	Fiji (1993)	Mauritania (1963)	Sri Lanka (1948)
Barbados (1967)	Gabon (1963)	Mauritius (1970)	St. Kitts and Nevis (1994)
Belarus	Gambia, The (1965)	Mexico (1986)	St. Lucia (1993)
Belize (1983)	Georgia (2000)	Moldova (2001)	St.Vincent & The Grenadines (1993)
Benin (1996)	Ghana (1957)	Mongolia (1997)	Sudan
Bermuda (1948)	Grenada (1994)	Morocco (1987)	Suriname (1978)
Bhutan	Guatemala (1991)	Mozambique (1992)	Swaziland (1993)
Bolivia (1990)	Guinea (1994)	Myanmar (1948)	Syrian Arab Republic
Botswana (1987)	Guinea-Bissau (1994)	Namibia (1992)	Tajikistan
Brazil (1948)	Guyana (1966)	Nepal	Tanzania (1961)
Bulgaria (1996)	Haiti (1950)	Nicaragua (1950)	Thailand (1982)
Burkina Faso (1963)	Honduras (1994)	Niger (1963)	Togo (1964)
Burundi (1965)	Hungary (1973)	Nigeria (1960)	Tonga
Cambodia	India (1948)	Oman (2000)	Trinidad and Tobago (1962)
Cameroon (1963)	Indonesia (1950)	Pakistan (1948)	Tunisia (1990)
Cape Verde	Iran, Islamic Republic of	Panama (1997)	Turkey (1951)
Central African Rep. (1963)	Iraq	Papua New Guinea (1994)	Turkmenistan
Chad (1963)	Israel (1962)	Paraguay (1994)	Uganda (1962)
Chile (1949)	Jamaica (1963)	Peru (1951)	Ukraine
China (2001)	Jordan (2000)	Philippines (1979)	United Arab Emirates (1994)
China, Hong Kong SAR (1986)	Kazakhstan	Poland (1967)	Uruguay (1953)
Colombia (1981)	Kenya (1964)	Qatar (1994)	Uzbekistan
Comoros (1948)	Kiribati	Réunion (1948)	Vanuatu
Congo, Dem. Rep. of (Zaire) (1971)	Korea (1967)	Romania (1971)	Venezuela, Rep. Bol. (1990)
Congo, Republic of (1963)	Kuwait (1963)	Russia	Vietnam
Costa Rica (1990)	Kyrgyz Republic (1998)	Rwanda (1966)	Yemen, Republic of
Côte d'Ivoire (Ivory Coast) (1963)	Lao People's Dem.Rep	Samoa	Yugoslavia, Soc. Fed. R. of (1966)
Croatia (2000)	Latvia (1999)	São Tomé & Príncipe	Zambia (1982)
Cyprus (1963)	Lesotho (1988)	Saudi Arabia	Zimbabwe (1948)
Czech Republic (1993)	Liberia		

Source: Subramanian and Wei (2007).