The WTO Is Not Passé

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Abstract

The empirical literature on the effect of trade agreements on trade flows has reached a consensus that WTO effects are insignificant or modest at best, especially compared to the robust and strong positive effect of preferential trade agreements (PTAs) on bilateral trade (Rose, 2004; Eicher and Henn, 2011; Baier and Bergstrand, 2007, 2009). We show that previous papers that report "average treatment effects" on trade flows, fail to account for the heterogeneity in effects of trade arrangements over time, leading to an underestimation of the WTO effect on bilateral trade. We present semi-parametric estimates of the impact of WTO membership and PTA membership, allowing for heterogeneity of WTO and PTA effects over time. PTA effects are stronger initially, but in the long-term the WTO effect dominates. Disaggregating PTAs into bilateral, multilateral and deep integration (customs union, common markets, and economic union), we find that the long-term effects of WTO membership dominate bilateral and multilateral PTAs and depending on the specification are almost equivalent to deep integration arrangements. We also show the heterogeneity of WTO effects by level of development (advanced vs. emerging markets), and on the extensive vs. intensive margins of trade.

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1 Introduction

Shortly after his inauguration, US President Donald Trump withdrew from the Trans-Pacific Partnership (TPP), a colossal 12-nation free trade deal designed to boost trade ties between the US and Pacific Rim countries. The fate of the Transatlantic Trade and Investment Partnership (TTIP) designed to reduce trade barriers between the US and European Union remains uncertain. Even NAFTA is being renegotiated. The US withdrawal from the TPP and the UK's Brexit vote were greeted with dismay by heads of state, policymakers, and op-ed writers alike, who lamented the apparent reversal of trade liberalization and economic integration negotiated via bilateral and ever larger regional trade agreements. In an atmosphere of rising hostility towards trade, notably in the US and UK, many reassure themselves that multilateral trade liberalization via WTO remains an option. However, with the Doha round of trade talks frozen and gridlocked, multilateral liberalization via the WTO is seen as a less preferred or perhaps less feasible option (Baldwin, 2016). The WTO has taken a shallow integration approach focusing on market access for mainly traded goods, while preferential trading arrangements are increasingly complex – covering provisions on copyright laws, patent protection, environmental regulations, labor standards, and adjudication of dispute mechanisms – most of which have little to do with trade directly.

While PTAs going beyond market access and formal trade barriers, the consensus among trade economists is that bilateral and regional trading arrangements dominate the multilateral arrangement in terms of their effect on bilateral trade. More precisely, previous work has shown that preferential trading arrangements (PTA) have had a stronger impact on trade than WTO membership since they afford deeper integration. For instance, a meta-analysis by Cipollina and Salvatici (2010) on the trade effects of PTAs report a mean effect of 0.59 and a median effect of 0.38 on logged bilateral trade over 1867 estimates. Baier and Bergstrand (2007) and Anderson and Yotov (2016) use different specifications, OLS on panel data with fixed effects and Poisson pseudo-maximum likelihood (PPML) estimators respectively, to find that a PTA doubles bilateral trade after 10-15 years. In contrast, the empirical literature finds that WTO membership has had a weak or small impact on bilateral trade flows (Rose, 2004; Rose 2005), that the impact is mainly confined to developed countries (Subramanian and Wei, 2007), and that some if not all of the WTO effect on trade can be attributed to PTAs (Eicher and Henn, 2011). Lawrence (1996) argues that this is not surprising, since tariffs are only one of many trade barriers and even if these are removed following WTO accession, the complexity of differing regulatory policies among nations remains. In fact, PTAs that go beyond the border barriers that the WTO purports to address, afford deeper integration via changes in intellectual protection, labor standards, investment measures. These are more suited to the rise of offshoring and global value chains (Baldwin, 2016).

The belief in the greater efficacy of PTAs is reflected in the proliferation of PTAs. In 1991 there were 6 bilateral trading arrangements in Asia. Today there are 166 such arrangements with 60 more being negotiated – a veritable noodle bowl of trade arrangements. Worldwide there are

nearly 400 PTAs prompting Bagwell, Bown and Staiger (2016) to ask whether the WTO is now passé and whether PTAs are a more reliable vehicle for deeper integration.[1]

Headlines following the Brexit vote in 2016 reflected a similar understanding i.e., that Brexit was likely to reduce both trade and welfare. Economists used the gravity model to predict the impact on the UK leaving a large free trade area like the EU. A "hard Brexit," whereby the United Kingdom leaves the Single Market and trades under WTO rules, is predicted to have a strong negative impact on value-added UK exports amounting to almost 18% (Brakman, Garretsen and Kohl, 2017). Similarly, a report by the H. M. Treasury (2016a, b) estimated that leaving the EU and reverting to WTO trade barriers leads to an annual GDP loss equivalent to £5200 for each household. Underlying these gravity models and counterfactual calculations are estimates for WTO and PTA effects.

Our paper examines whether the pessimism about WTO vs. PTA effects on trade flows is indeed warranted. We revisit the magnitude of the impact of WTO and PTAs on bilateral trade. Our approach contrasts with the traditional way researchers have estimated the effect of trade arrangements within a gravity framework – using dummy variables that take the value 1 if both countries in a country-pair are part of a particular trade arrangement (WTO, PTA etc.) and 0 otherwise. This formulation conceptualizes trading arrangements as a simple binary treatment and calculates the average treatment effect of such trading arrangements. While previous work has recognized the heterogeneity of PTA and WTO effects, the focus has been on differential effects for different pairs of countries (advanced vs. emerging, early vs. late joiners of WTO; see Subramanian and Wei, 2007 Eicher and Henn, 2011) different types of trade arrangements (bilateral vs. multilateral vs. economic unions), and different margins of trade (Dutt, Mihov and Van-Zandt, 2011; Baier, Bergstrand and Feng, 2015). Almost all this work essentially imposes homogeneity of impact of trading arrangements over time.[2] However, such an approach starting with Rose (2004) fail to account for heterogeneity in treatment effect over time, that there may be diminishing vs. increasing effects over time for different trading arrangements.

Unlike previous work, we adopt a flexible semi-parametric approach to the effect of trading arrangements and allow these effects to vary over time. First, we measure the number of years a country-pair have been part of a particular trading arrangement (WTO, PTA) as a time-varying pair-specific variable. Think of these as capturing a country-pair's *intensity* of treatment with respect to a particular trading arrangement. Subsequently, we create a set of dummy variables spanning all possible years of membership. For instance, with membership spanning 59 years since the inception of GATT in 1948 (precursor to the WTO), we create 59 separate dummy variables to capture the effect of the WTO. We do the same for PTAs. We estimate separate coefficients on these dummies thereby allowing the effect of WTO and PTA to vary over time, without imposing any structure on the treatment effects over time.

We find that while the effect of the WTO is weak and even negative in initial years, it strengthens more or less monotonically over time. In contrast, while the effect of PTAs is stronger

[1] Their conclusion is that WTO is efficiency enhancing and warrants strong support.

[2] Limão (2016) in a recent survey highlights that the cross-sectional impact of PTA (which arguably captures long-run effects) are much larger than short-term effects based on panel data.

initially, their effects diminish relatively quickly. Overall, WTO effects strengthening over time, eventually dominating PTA effects. These rising effects over time are consistent with the simple empirical regularity of gradual trade liberalization over multiple rounds of multilateral trade negotiations and with increased entry into the WTO by countries over time, which in turn, leads to more efficient trade agreements. Our findings are also consistent with gradualism models of multilateral liberalization (e.g., Maggi and Rodríguez -Claire, 2007; see Bagwell and Staiger 2002, chap. 6 for a review)

Next, we decompose the effect of PTAs into bilateral trade arrangements (e.g., KORUS, the FTA between US and Korea), multilateral arrangements (e.g., ASEAN) and deep trade arrangements (e.g., common market such as the EU). We find that the WTO effects dominate both bilateral and multilateral arrangements in the long-run, are equivalent to Deep PTAs in one specification but fall short in an alternate, more robust specification. To the extent that Deep PTAs are rare, while WTO membership is very common, opting for multilateral trade liberalization under WTO auspices is an effective option for boosting bilateral exports. We also show that WTO effects increase over time regardless of whether a country-pair belongs to a PTA as well. In contrast, PTA effects persist only for country-pairs that also share WTO membership. Our findings question the recent skepticism shown towards the WTO and the recent shift towards negotiating more bilateral and regional trading arrangements.

We also examine the heterogeneity of trading arrangements over time for developed vs. developing countries. Our results suggest that the WTO is most beneficial when the destination in a country-pair is a developing country, regardless of whether the exporter is a developed or developing country. This reflects the fact that developing countries upon joining GATT/WTO initially had far fewer obligations to liberalize tariff barriers but did so only gradually over time. Finally, as in Dutt, Mihov and Van-Zandt (2013) we find that the WTO has a stronger effect on the extensive goods margin over time as compared to the intensive margin, which is consistent with WTO reducing fixed (instead of variable costs) of trade.

The remainder of the paper is organized as follows. Section 2 replicates the traditional gravity parametric specification with binary dummies for various trading arrangements; We use both an OLS specification with a comprehensive set of dummies and the methodology of Santos Silva and Tenreyro (2006), which treats bilateral trade as a count variable and uses Poisson Pseudo-Maximum Likelihood (PPML) to estimate the coefficients. A key advantage of the PPML specification is that it does not throw away the zero observations, so country-pairs that never traded, or ones that stopped trading also contribute to identification of coefficients correcting for both sample selection bias and heteroskedasticity bias. Section 3, the heart of the paper, presents our non-parametric approach; Section 4 presents important sub-sample checks; Section 5 concludes.

2 Trade Arrangements and the Gravity Equation

2.1 Baseline Specification

The gravity equation is the current workhorse for estimating the importance of trade costs and trading arrangements for bilateral trade. There are several theoretical frameworks supporting the gravity specification (see Costinot and Rodriguez-Claire, 2014), with exports from country o (exporter/origin) to country d (importer/destination) at time t, denoted by $\mathrm{X}_{od,t}$, given as

$$\ln X_{od,t} = \theta \ln \tau_{od,t} + \mu_{o,t} + \mu_{d,t} + e_{od,t} \tag{1}$$

$\mu_{o,t}$ and $\mu_{d,t}$ are exporter and importer-year dummies that capture attributes of the exporting- and the importing-country, respectively, including size and multilateral trade resistance terms (Anderson and van Wincoop, 2003). $\tau_{od,t}$ measures bilateral trade costs, with $-\theta$ as the elasticity of exports with respect to trade costs. In the standard equation, $\ln \tau_{od,t}$ is specified in terms of bilateral gravity variables, as shown below.

$$\ln \tau_{od,t} = \textstyle\sum_{m=1}^{M} \gamma_m z_{od,t}^m \tag{2}$$

where $z_{od,t}^m$ are M gravity variables and γ_m are parameters to be estimated. Head and Mayer (2014) perform a meta-analysis and identify as main variables WTO, PTA and currency union (CU) dummies capturing pair-specific, time-varying integration effects, while distance, contiguity, shared language, and colonial links, measure time-invariant geographic, cultural, and historical barriers. Substituting (2) into (1) yields the following estimable specification

$$\ln X_{od,t} = \textstyle\sum_{m=1}^{M} \gamma_m z_{od,t}^m + \mu_{o,t} + \mu_{d,t} + e_{od,t} \tag{3}$$

Eicher and Henn (2011) demonstrate that accounting for multilateral trade resistance with the country-year dummies, unobserved bilateral heterogeneity with the country-pair dummies, and allowing for individual PTA effects negate any WTO trade effects. In fact, they show that the exporter-year and importer-year dummies that account for the multilateral resistance terms are sufficient to render the coefficient on common WTO membership insignificant. Similarly, Baier and Bergstrand (2007) emphasize the importance of accounting for unobserved heterogeneity among country-pairs when estimating the importance of PTAs.[3] More importantly, country-pairs self-select into PTA membership, so PTA membership is not randomly assigned. Baier and Bergstrand (2007) argue that not accounting for such selection may lead to an underestimation of the PTA coefficient when two countries who face unmeasured trade barriers, that inhibit bilateral trade, are more likely to select into and form an FTA. They find that a panel-data approach with country-pair fixed effects accounts for endogeneity of PTA formation and yields a strong role for PTAs in increasing bilateral trade. Others such as Magee (2008) and Krugman (1991) proposed that country-pairs who are natural trading partners are more likely to form bilateral or regional agreements if they already have significant bilateral trade. This would tend to overestimate the effect of PTAs. In either case, omitted variables raise endogeneity concerns leading to biased estimates for the coefficient on the PTA dummy. Magee (2003), Baier and Bergstrand (2007) and Egger, Larch, Staub and Winkelmann (2011) all use instruments to account for selection into trading arrangements in cross-sectional data. However, these rely on assumptions about exclusion restrictions, that these instruments are uncorrelated with the gravity equation error, which may be difficult to justify.

[3] Hummels and Levinsohn (1995) were among the first to account for country-pair instead of exporter and importer effects, and this is increasingly the preferred approach.

Baier and Bergstrand (2004, 2007) question the plausibility of these exclusion restrictions, highlight the instability of the estimated treatment effects, and instead recommend using time-invariant country-pair dummies in a panel data setting. Therefore, all our specifications include time-invariant country-pair dummies ϵ_{od} in addition to exporter-year and importer-year dummies.[4] These also absorb all time-invariant gravity variables such as distance, contiguity, shared language, and colonial links. Our baseline specification is as follows:

$$\ln X_{od,t} = \theta\gamma_{WTO} WTO_{od,t} + \theta\gamma_{PTA} PTA_{od,t} + \theta\gamma_{CU} CU_{od,t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od} + e_{od,t} \quad (4)$$

where $\beta_{WTO} = \theta\gamma_{WTO}$, $\beta_{PTA} = \theta\gamma_{PTA}$, and $\beta_{CU} = \theta\gamma_{CU}$ are the coefficients of interest.

We estimate this equation using data on bilateral trade flows and the bilateral gravity variables. For bilateral trade flows, our primary data source is the CEPII database from Head and Mayer (2014) that provides data on aggregate bilateral exports (fob) and imports (cif) from 205 exporters to 186 importers over the period 1948-2006. Our measure of bilateral trade is the log of cost-including-freight of imports reported by the destination from the origin. $WTO_{od,t}$ access is captured by a dummy variable that takes the value 1 if both trading partners are members of the GATT/WTO at time t and 0 otherwise. $PTA_{od,t}$ takes the value 1 if both trading partners are members in a PTA at time t and 0 otherwise. $CU_{od,t}$ is analogously defined for pairs that are part of the same currency union. Data on WTO membership and PTAs are from the CEPII and updated via the WTO website (www.wto.org). Data on currency unions are from Rose and Glick (2016). Our baseline specification includes 10,834 exporter-year dummies, 9,242 importer-year dummies and 28,134 country-pair dummies.[5] Standard errors are adjusted for clustering on country-pairs.

Helpman, Melitz and Rubinstein (2008) and Haveman and Hummels (2004) highlight the prevalence of zero bilateral trade flows. For the bilateral data used here, 22% of all possible bilateral trade flows show a zero value. Unobserved trade costs can endogenously create zeros and taking logs removes them from the sample, creating selection bias. Santos Silva and Tenreyro (2006) also show that log-linear specification of the gravity model in the presence of heteroskedasticity leads to inconsistent estimates. If the error term in the standard log specification is heteroskedastic, which is well-established in trade data, its log is not orthogonal to the log of the regressors, leading to inconsistent estimates of the gravity elasticities. Following them, we treat bilateral trade as a count variable and use the Poisson Pseudo-Maximum Likelihood (PPML) to estimate the following equation.

$$X_{od,t} = \exp[\theta\gamma_{WTO} WTO_{od,t} + \theta\gamma_{PTA} PTA_{od,t} + \theta\gamma_{CU} CU_{od,t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od}] + e_{od,t} \quad (5)$$

[4] Baltagi et al (2003) argue that one should control for as much heterogeneity as possible and set up the most general within estimator to come up with reliable parameter estimates.

[5] Tomz et al. (2007) updated the standard definition of WTO membership to include both de jure and de facto WTO membership where the latter have observer status. Compared to Rose (2004), they found positive WTO trade effects on bilateral trade. We use the de jure definition since this makes it less likely that we will find a positive role for the WTO. More importantly, since our data is until 2006, many countries transited from de facto to de jure membership after 1999, the year where the Tomz et al analysis ends.

Since the dependent variable is trade, rather than the log of trade, it not only eliminates the heteroskedasticity bias but also allows us to include zeros in the trade matrix.

Column 1 of Table 1 shows the empirical results from estimating (4). We obtain a coefficient of 0.16 for WTO membership, 0.41 for PTA membership, and 0.38 for a currency union, all of which are significant at 1%. The last two estimates are in line with the meta-analysis presented in Head and Mayer (2014). We find that WTO matters for bilateral trade with membership increasing bilateral trade by 17.2%. At the same time in line with Baier and Bergstrand (2007) and Glick and Rose (2016), we find a stronger role for PTAs and currency unions - PTA membership increases bilateral trade by 50%, while currency unions boost trade by 46.6%. In fact, the estimated coefficient for β_{PTA} and β_{CU} are close to those in the preferred specification in the above two papers.

The estimates for equation (5) using PPML are shown in Column 2 of Table 1 which includes country-year and country-pair effects. Here we find that the coefficients on PTA and currency union declines, but now the coefficient on the WTO dummy turns negative and significant. These results confirm the existing findings in the literature that PTA membership dominates WTO membership in boosting bilateral exports.

Table 1: Effect of Trading Arrangements with Comprehensive Fixed-Effects

	OLS: Baseline	PPML: Baseline	OLS: Pair-specific linear trend	PPML: Pair-specific linear trend
	(1)	(2)	(3)	(4)
Both in WTO	0.128***	-0.185**	0.019	-0.303***
	(0.031)	(0.087)	(0.030)	(0.075)
Both in PTA	0.423***	0.233***	0.161***	0.111***
	(0.029)	(0.039)	(0.026)	(0.024)
Both in Currency Union	0.286***	0.149***	0.290***	0.041
	(0.070)	(0.052)	(0.058)	(0.038)
Country-year dummies	Yes	Yes	Yes	Yes
Country-pair dummies	Yes	Yes	Yes	Yes
Country-pair trends	No	No	Yes	Yes
Number of observations	585,328	947,403	585,328	947,403
Number of pairs	26,828	28,808	26,828	28,808
F/ chi-square statistic	83.05***	45.29***	19.75***	47.64***
R^2	0.87	0.99	0.91	0.99

Standard errors adjusted for clustering on country-pair in parentheses; * $p<0.1$; ** $p<0.05$; *** $p<0.01$

2.2 A More Demanding Specification

Our baseline estimate in Column 1 of Table 1 uses country-year fixed effects that absorb any effects that are particular to changes in variables at the exporter-year level and the importer-year level (e.g., investment in ports and trade infrastructure, regulations that facilitate or impede trade,

number of PTAs that the exporter participates in, number of years the exporting (and importing) country has been part of the WTO etc.). We also account for unobserved time-invariant dyadic effects by including country-pair fixed effects. The use of dyadic fixed effects eliminates the need to choose controls for equations (3) and (4), thereby alleviating the criticism of Ghosh and Yamarik (2004) that researcher's prior beliefs influence the exact results presented and accounts for the fragility of estimated FTA treatment effects. While Ghosh and Yamarik (2004) focus on PTA treatment effects, their criticism extends to the impact of the WTO as well. Head et al. (2010) find that within a dyadic fixed effect specification, there is a rise in the effect of GATT/WTO while the coefficient on PTA is halved. Time-invariant dyadic effects are also the main source of selection bias where countries select into PTAs (Baier and Bergstrand, 2007).

However, since these dyadic effects are time-invariant, they immunize us to endogeneity concerns only to the extent that any omitted variables are time-invariant (Limão, 2016). To the extent that time-varying dyadic effects affect both the likelihood of trade arrangements and the volume of trade, endogeneity concerns persists (Bergstrand et al, 2015). For instance, country-pairs with rising ties, via flows of capital (Di Giovanni, 2005) and/or immigration (Head and Reis, 1998), may observe not just an increase in trade but also an increased likelihood of a bilateral PTA. To the extent that PTAs are anticipated, trade may decline or be delayed in the run up to implementation so that the increase in trade may not be entirely attributable to a PTA. Therefore, we adopt an even more demanding specification whereby we also include pair-specific linear time-trends, one for every country-pair. This is the most demanding specification accounting for not just the exporter and importer-year terms and the time-invariant characteristics at the dyadic level as before, but also for any unobserved country-pair specific variables that evolve in a linear fashion. Since trade arrangements take time to be implemented and trade costs decline over time, the pair-specific trends will account for a secular decline in all unobserved trade costs at the country-pair level.[6]

We estimate the following gravity specifications:

$$\ln X_{od,t} = \theta\gamma_{WTO}WTO_{od,t} + \theta\gamma_{PTA}PTA_{od,t} + \theta\gamma_{CU}CU_{od,t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od} * t + e_{od,t} \quad (4')$$

$$X_{od,t} = \exp[\theta\gamma_{WTO}WTO_{od,t} + \theta\gamma_{PTA}PTA_{od,t} + \theta\gamma_{CU}CU_{od,t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od} * t] + e_{od,t} \quad (5')$$

Column 3 in Table 1 estimates equation $(4')$ and shows that adding the pair-specific trends leads to a substantive decline in the coefficient for both the WTO dummy and the PTA dummy as compared to the specification in Column 1. The former declines by 84% while the latter declines by 88%. In fact, this more comprehensive specification is sufficient to render the coefficient on the WTO dummy insignificant.[7] In Column 4 ,with the PPML methodology we find that the WTO dummy remains negative and significant and the PTA dummy remains positive and significant. Overall, these results show that PTA membership is more effective in raising bilateral trade than WTO membership, in line with the deeper integration emphasized earlier. In fact, our findings are

[6] Note that country-pair fixed-effects are subsumed within the country-pair trends. Inclusion of *ij* fixed effects interacted with year dummies is infeasible since these would be perfectly collinear with trade flows.

[7] If we replace the dyadic linear trends with dyadic log-linear trends and shows that the magnitude of the coefficient and standard-errors estimated remain almost identical.

stronger than the original Rose (2004) paper which found a negligible impact of WTO membership on the volume of bilateral trade flows and questioned its raison d'être as promoter of world trade.

3 Heterogeneity in WTO and PTA Effects Over Time

If we think of membership in a trading arrangement as a treatment à la Baier and Bergstand (2009), then implicit in equations (4) and (5) is the assumption of a homogeneous treatment effect. Essentially, in our formulation, we switch on a dummy variable for a trading arrangement, which assumes that the treatment effect is constant across country-pairs and more importantly over time. This is a relatively strong assumption. Previous work has highlighted the heterogeneous effects of trading arrangements across industries, (Anderson and Yotov, 2016), across countries, and by trading arrangement (Eicher and Henn 2011). Anderson and Van Wincoop (2004) highlight the implausibly strong assumption of common coefficients imposed on the trade cost function so that the effect of trade arrangements is assumed to be uniform for all members. Subramanian and Wei (2007) demonstrate that the effect of the WTO varies across country-pairs - that the WTO matters strongly for developed countries but less so for developing countries, and when both countries in a dyad liberalized trade. Our contention here is that there is heterogeneity in the treatment effect over time as well.

Most trading arrangements are phased in slowly over time. Tariffs are slowly phased out, quotas modified, and regulations adjusted over time. For example, the ASEAN FTA announced in 1992, incorporated an "inclusion list" of goods on which each country agreed to reduce tariffs to 0–5 percent within ten years for some and within five to eight years for others. The agreement also specified a temporary "exclusion list" where countries were permitted to delay tariff reduction on certain goods. Three years after membership, countries had to gradually transfer the goods to the inclusion list (Feridhanusetyawan, 2005). To the extent that we work with aggregate bilateral trade flows, we would expect the impact to vary over time. Another reason for heterogeneity over time may be gradual adjustments of trade flows to terms-of-trade changes, following a trade arrangement (Bergstrand, Larch and Yotov, 2015). In multilateral preferential trade agreements, an additional source of heterogeneity is staggered ratification by member countries over time. Baier and Bergstrand (2007) use 5-year and 10-year lags to show that accounting for these lags doubles the effect of a PTA.

The effect of WTO membership may also take time to manifest itself. Maggi and Rodriguez-Claire (2007) model both the terms-of-trade (TOT) and domestic-commitment motivation for joining a trade agreement and show that trade liberalization typically occurs in a gradual manner. Initially, there is an immediate decline in tariffs, which reflects the TOT motive highlighted first by Bagwell and Staiger (1999, 2002), followed by a gradual tariff reduction, which reflects the domestic-commitment motive used by the government to close the door to importer lobbies. This means that tariff levels decline over time. Second, differences in level of development among WTO members led to Special & Differentiated Treatment provisions that allowed developing countries to bring down their tariffs gradually over time, as compared to industrialized countries. Third, Handley (2014) emphasizes that binding commitments under WTO should be thought of as reducing trade policy uncertainty and inducing entry of exporters. Handley and Limão (2017) show that China's

export boom soon after WTO accession in 2001 eliminated the annual threat of reversion by the US to high tariffs and this explains 22-30% of increase in Chinese exports. The mechanism here is that exporters firms respond not just to changes in the applied levels of trade barriers, but also to changes in the probability that trade barriers might be raised in the future. However, to the extent that such uncertainty declines with the onset of WTO membership, we should expect a strong immediate impact of WTO membership and a smaller effect over time. Finally, Burstein and Melitz (2013) model firm dynamics and endogenous innovation in response to trade liberalization and show that the long-run trade elasticities with respect to trade costs are substantially higher than corresponding short-run elasticities. However, this should not affect differentially affect WTO vs. PTA membership. To summarize, there are multiple mechanisms and channels via which we may expect that the impact of trade of trading arrangements, whether PTAs or WTO, to change over time.

Implicit in equations (4′) and (5′) is also the assumption of a linear relation between trading arrangements and (log) bilateral trade. In fact, such a parametric specification is almost universally used in prior research, with Baier and Bergstrand (2009) and Chang and Lee (2011) as notable exceptions. Both these papers rely on non-parametric matching methods to identify the effect of PTAs in the case of Baier and Bergstrand (2009) and of WTO in Chang and Lee (2011). Matching in this context compares bilateral trade of a treatment pair (where both countries are members of WTPO/PTA) with a control pair (where at least one is not in WTO/PTA), so identification relies on cross-sectional comparisons. It implicitly assumes that the effect of a treatment is constant over time. In Baier and Bergstrand (2009), matches are for the same year for different dyads and they perform their analyses separately for each year to estimate long-run effects of PTAs. As a result, this method is not suited to uncovering the short-run vs. long-run effects of trading arrangements.[8]

We adopt a flexible semi-parametric approach. We conceptualize the number of years that a dyad has been part of a particular trading arrangement as the intensity of treatment of the country-pair for that trading arrangement, with the treatment intensity increasing in the number of years that the country-pair continue to be members of the same trading arrangement. We code separate dummy variables for this intensity of treatment, one each for the number of years a country-pair has been part of a trading arrangement. We estimate separate coefficients for each of these dummy variables, which allows us to eschew any functional form assumptions on the effect of trading arrangements and allows us to check for heterogeneity in treatment effects for a particular trading arrangement over time. In other words, we can check if the effect of WTO/PTA increase or decrease over time.[9] With such a comprehensive set of dummies, we let the data inform us of the differential impacts over time without resorting to somewhat ad-hoc choices in previous work that membership in trading arrangements works with a 5-10-year lag.

Consider the following gravity specification

[8] Chang and Lee (2011) use panel data but do not impose restrictions on matches in their baseline results. They allow matched dyads to be from the same dyad but from different years, from different dyads in the same year, and different dyads in different years.

[9] A non-parametric approach would be a fully saturated model that interacts each of the dummies for WTO experience with all the PTA experience dummies. However, easy interpretation of the coefficients is no longer feasible.

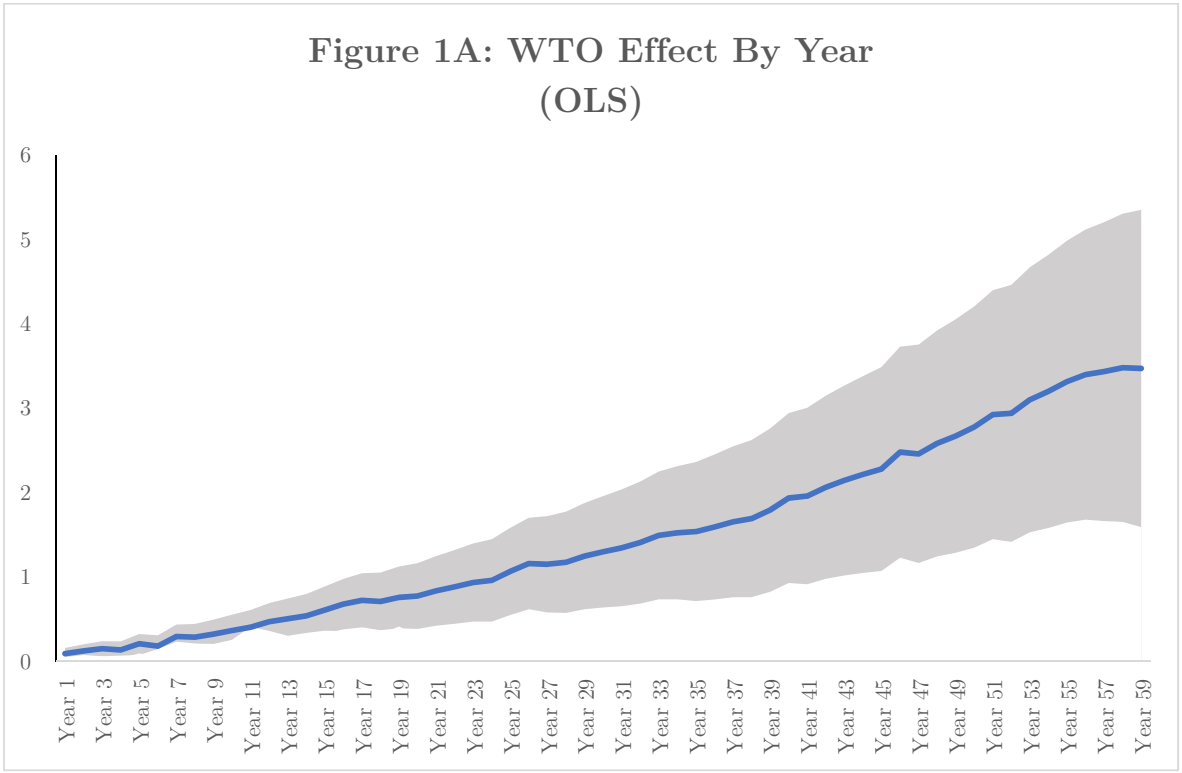
$$\ln X_{od,t} = \sum_{\tau=1}^{59} \beta_{WTO,\tau} WTO_{od,\tau t} + \sum_{\tau'=1}^{49} \beta_{PTA,\tau'} PTA_{od,\tau' t} + \theta \gamma_{CU} CU_{od,t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od} * t + e_{od,t} \quad (6)$$

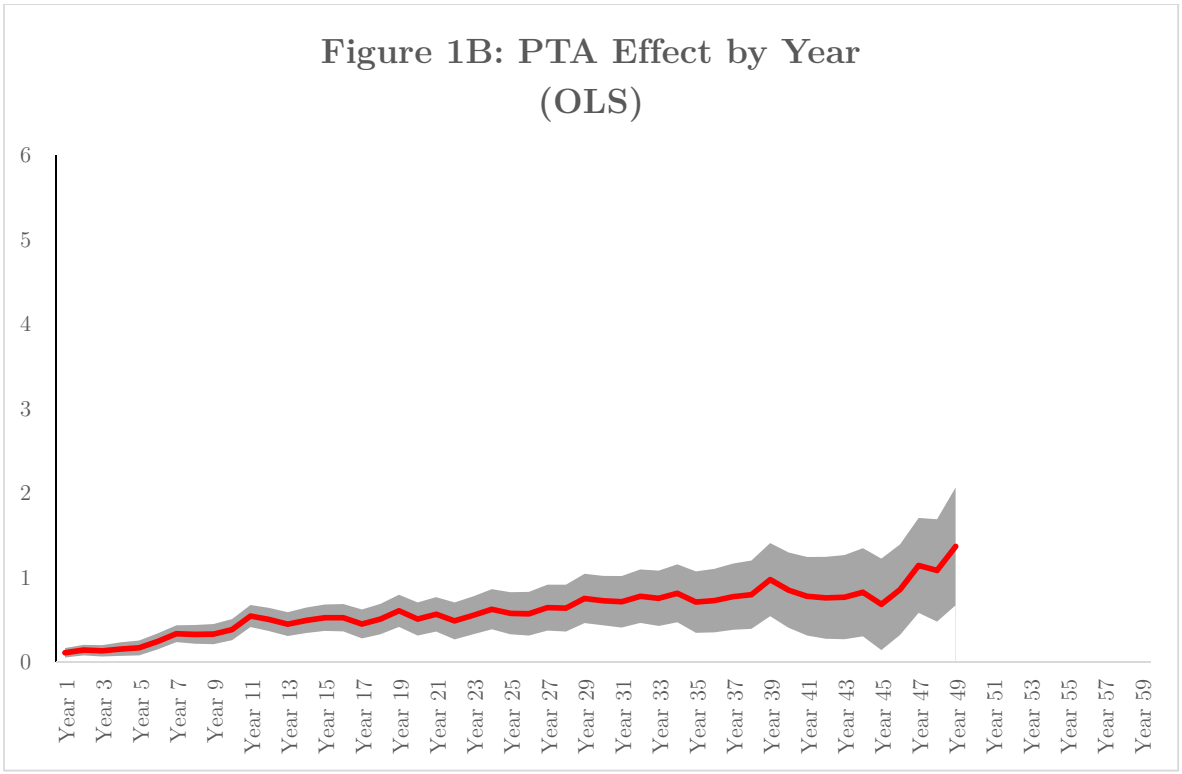
where $WTO_{od,\tau t}$ is a dummy that takes the value 1 if both countries in a country-pair od have been in the WTO for τ years in year t. With data spanning 1948-2006, we measure the time dimension of WTO experience with 59 dummies, allowing the effect of the WTO to vary over time. The omitted category is $\tau = 0$ – country-pairs that have been in the WTO for 0 years. Therefore, each of the $\beta_{WTO,\tau}$ coefficients measure the impact of membership in WTO for $\tau > 0$ years compared to country-pairs that are not both WTO members. Similarly, we create 49 dummies capturing experience in PTAs, and estimate 49 unrestricted coefficients $\beta_{PTA,\tau'}$ allowing its effect to change over time. The oldest customs union in our data is the European Economic Community, established in 1958, so the longest span of a PTA is 49 years.[10] As before, we include country-year, country-pair fixed effects, and pair-specific trends.

Figures 1A and 1B plot the coefficients for the 59 WTO dummies and 49 PTA dummies respectively from estimating equation (5) along with the 95% confidence interval (shaded region around the coefficient estimate). From Figure 1A, we first see that each of the WTO dummies is significant at the 5% level. In fact, all WTO experience dummies, except for τ =1, are significant at the 1% level. Similarly, all the PTA experience dummies are also significant at the 5% level. Second, we observe that the positive effect of the WTO on trade (compared to a control dyad that do not share WTO membership) fluctuates between 10% and 20% for the first six years of common membership and then steadily increases over time. While the impact of the PTA also increases over time, the increase is far more pronounced for WTO membership. Comparing the two, we see that for the first 12 years, PTA membership has a stronger impact on bilateral trade, but the WTO effect is bigger from year 12 onwards. 49 years of WTO membership raises bilateral trade by 1344% while an identical 49 years of PTA tenure raises bilateral trade by 292%. Finally, an extra year of WTO membership increases bilateral exports on average by 6.1% while an extra year of PTA membership increases bilateral exports on average by 3.1% increases Overall, the impact of the WTO increases with time and quickly overtakes the impact of PTAs.[11]

[10] The Southern African Customs Union (SACU) between Botswana, Lesotho, Namibia, South Africa and Swaziland was also established earlier, in 1910. However, data on trade between these countries are missing.

[11] Previous work has highlighted that trade may increase prior to WTO membership. We tested for this by creating a lead variable for WTO membership. This did not change the WTO membership coefficients while the variable itself was not significant. As a robustness check, we also estimated the WTO effect over time in a specification that also estimates individual PTA effects over time. Here we find that the WTO effect is marginally stronger with an extra year of WTO membership increasing bilateral exports on average by 6.9% (not shown).





Next, we use the PPML methodology and estimate the following gravity equation in levels within a Poisson specification.

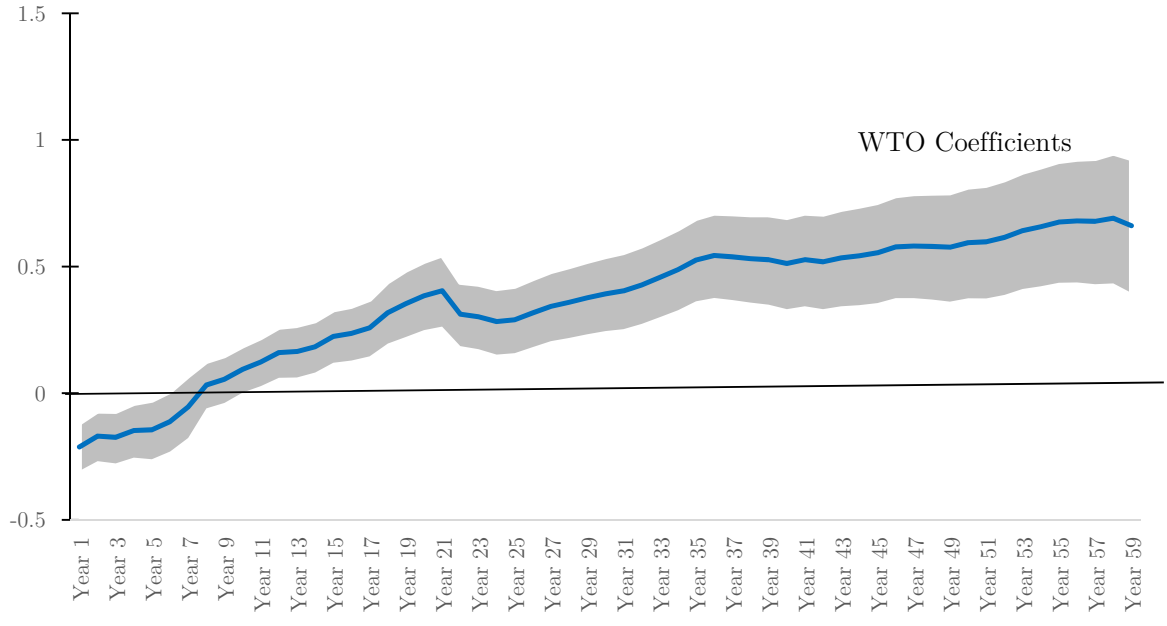
$$X_{od,t} = \exp\left[\sum_{\tau=1}^{59} \beta_{WTO,\tau} WTO_{od,\tau t} + \sum_{\tau'=1}^{49} \beta_{PTA,\tau'} PTA_{od,\tau' t} + \theta\gamma_{CU} CU_{od,t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od} * t\right] + e_{od,t} \quad (7)$$

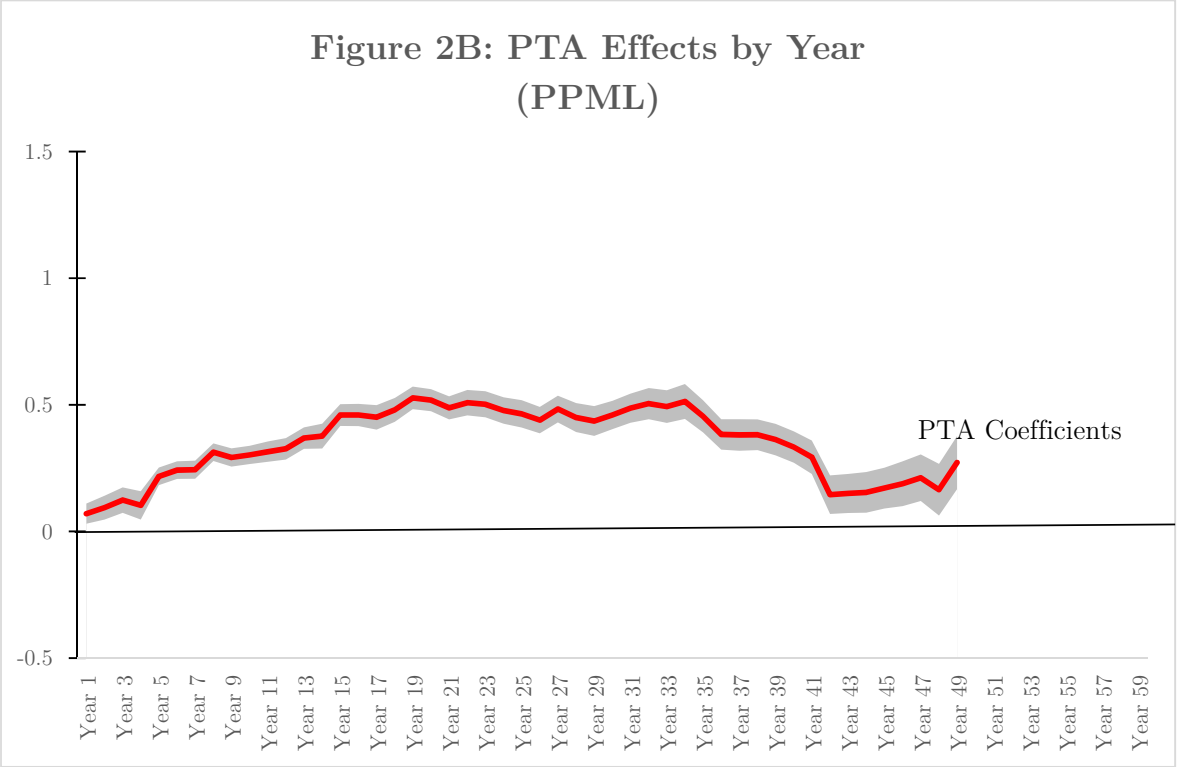
The estimates for the WTO and PTA coefficients along with the 95% confidence intervals are shown in Figures 2A and 2B. In Figure 2A, we see that the initial impact of the WTO, for the first 7 years, is negative, insignificant from years 8-10, and becomes positive and significant only from year 11 onwards. From year 11 onwards, the WTO effect rises more or less steadily to reach a peak in year 58. By contrast, in Figure 2B we see that the effect of PTA is stronger in initial years, rising to a peak for 34 years of PTA membership and then declines subsequently. WTO membership raises trade on average by 1.5% per year while PTA membership raises trade by 0.5%. 49 years of WTO membership increases bilateral trade by 81%. The comparable effect for PTA membership is 31%.

Interestingly, Figure 2A also shows that the initial impact of WTO membership is negative and significant for the first five years. Given that the average number of years of WTO co-membership in the sample used to estimate equation (7) is 6 years, the negative coefficient on the PPML estimate in Column (4) of Table (1) makes sense.

These magnitude of the PPML estimates are considerably less compared to the OLS specification. Bergstrand, Larch and Yotov (2015) who also report a decline of about 30% in the magnitude of PTA effects when using the PPML estimator. Regardless of the estimation methodology used, we find that in the most demanding specification, and allowing for heterogeneity in WTO and PTA effects over time, WTO impact increases more or less monotonically over time and eventually dominates the PTA effect.

Figure 2A: WTO Effect By Year (PPML)





While we do not test the exact mechanisms, the strong effects of the WTO over time are consistent with models of gradual trade liberalization that combine the terms-of-trade with the domestic-commitment motivation. In fact, as more and more countries join the WTO, it strengthens these motives and predicts the phenomena witnessed – of multilateral liberalization over multiple rounds of trade talks.

4 Heterogeneity by Depth of Trade Arrangements, Level of Development and Margins of Trade

4.1 Heterogeneity by Type of PTAs

One criticism of our earlier finding is that we treat all preferential trade arrangements in a homogenous fashion, eliding over differences in their depth of integration. Therefore, a single PTA dummy may not suffice in capturing the heterogeneity across PTAs. One option would be to have separate time-specific PTA dummies for each PTA. However, this leads to a proliferation of dummies and loss of precision in the coefficient estimates (Baier, Bergstrand, Clance, 2015). Therefore, we follow Baier, Bergstrand and Clance (2015) and use a four-fold classification of PTAs -- one-way trade agreements where the importing country grants unilateral non-reciprocal access to

the exporter [12], two-way bilateral PTAs, multilateral PTAs that have more than one country in a PTA, and Deep PTAs for country-pairs in customs unions, common markets and/or currency unions. The data are from Jeffery Bergstrand's website. The expectation is that deeper PTAs such as the EU are likely to have biggest trade impact and may even exceed the WTO in its importance for trade.

We estimate the following specification by OLS

$$\ln X_{od,t} = \sum_{\tau=1}^{59} \beta_{WTO,\tau} WTO_{od,\tau t} + \sum_{j=1}^{4} \sum_{\tau'=1}^{49} \beta^{j}_{PTA,\tau'} PTA^{j}_{od,\tau' t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od} * t + e_{od,t} \qquad (8)$$

where $j \in \{$*Unilateral, Bilateral, Multilateral, Deep*$\}$ are the four types of PTAs. As before, we report the OLS coefficients from estimating equation (8) and the 95% confidence intervals in Figure 3A and Figure 3B. Figure 3A compares WTO membership effect to Deep PTAs while Figure 3B shows the trade impact of Bilateral and Multilateral PTAs. [13] For ease of interpretation, for one of the estimates we show the 95% confidence interval as a shaded region for one of the estimates, and as bars for the other estimate.

Figure 3A shows that the impact of both Deep PTAs and WTO membership are remarkably similar in the long-run. The dummies for number of years of WTO membership are again significant for all years as are the dummies for Deep PTA membership. 49 years of WTO membership raises bilateral trade by 626% (3.9% on average per year) while 49 years of Deep PTA, membership raises bilateral trade by 740% (4.0% on average each year). However, for the first 40 years of membership, Deep PTAs have a stronger impact compared to WTO membership.[14]

[12] These include mainly Generalized System of Preferences(GSP). Our previous PTA dummy did not include GSP or any other one-way arrangements.

[13] Unilateral PTAs have an insignificant impact on trade for the first decade and a negative impact subsequently (not shown).

[14] If we re-classify the Deep PTA dummies only for customs unions and common markets but not currency unions, we get very similar results.

Figure 3A: WTO and Deep PTA Effects By Year (OLS)

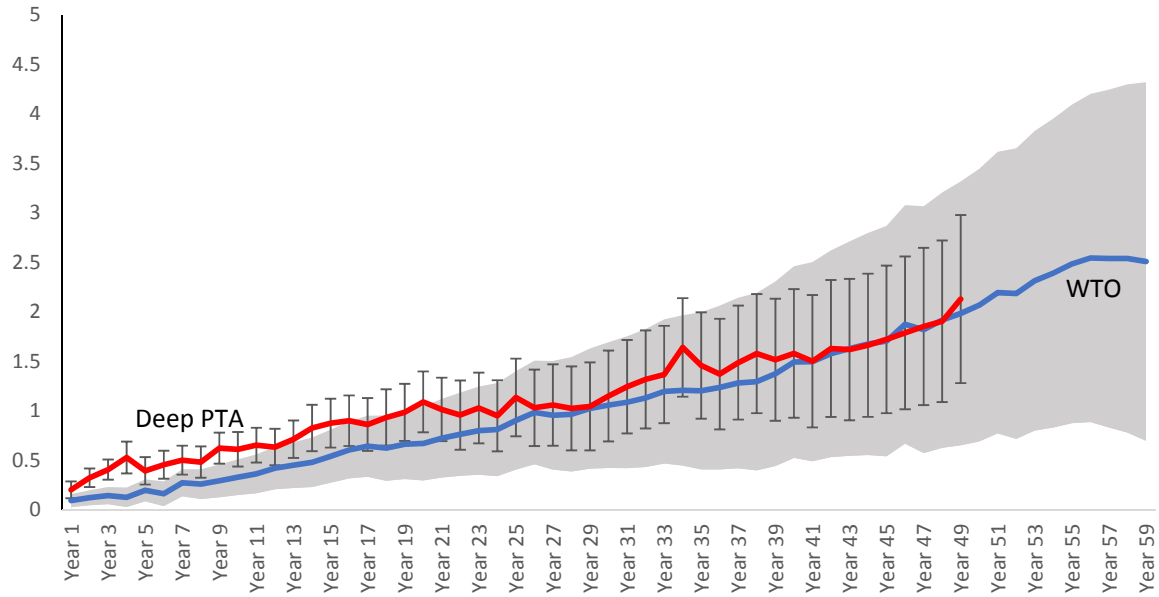


Figure 3B: Bilateral PTA and Multilateral PTA Effects By Year (OLS)

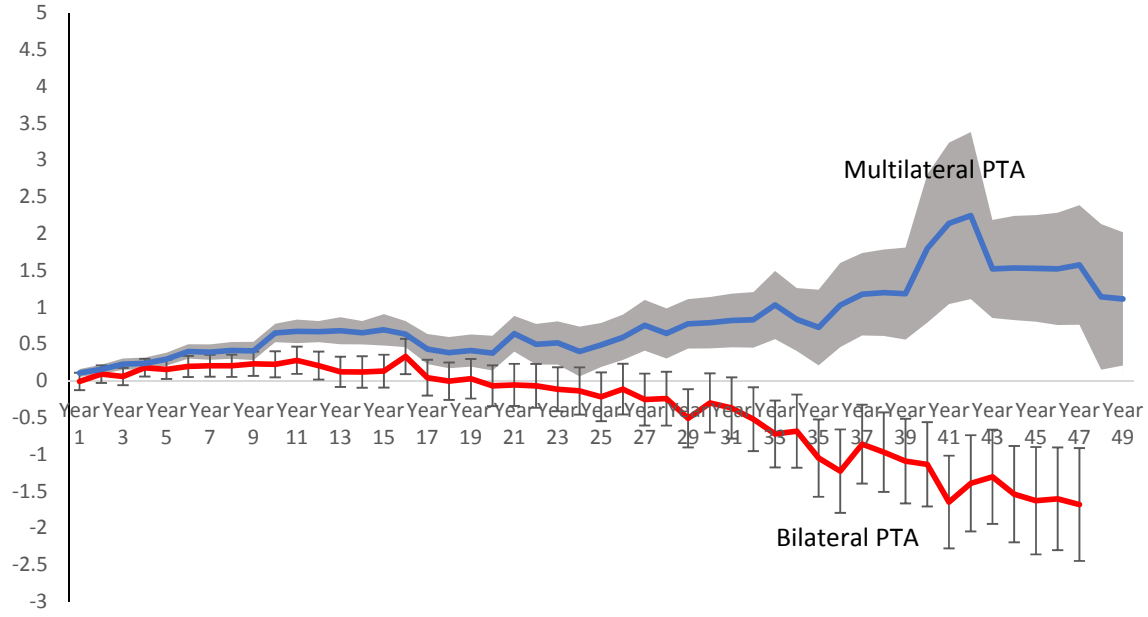
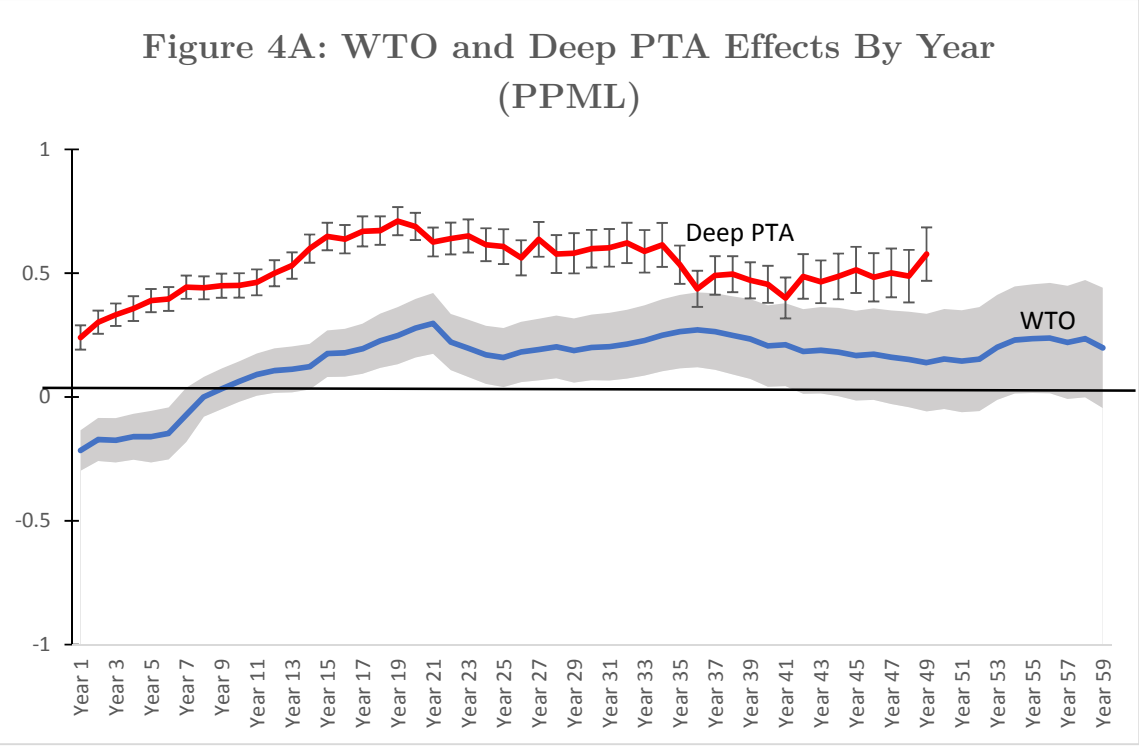


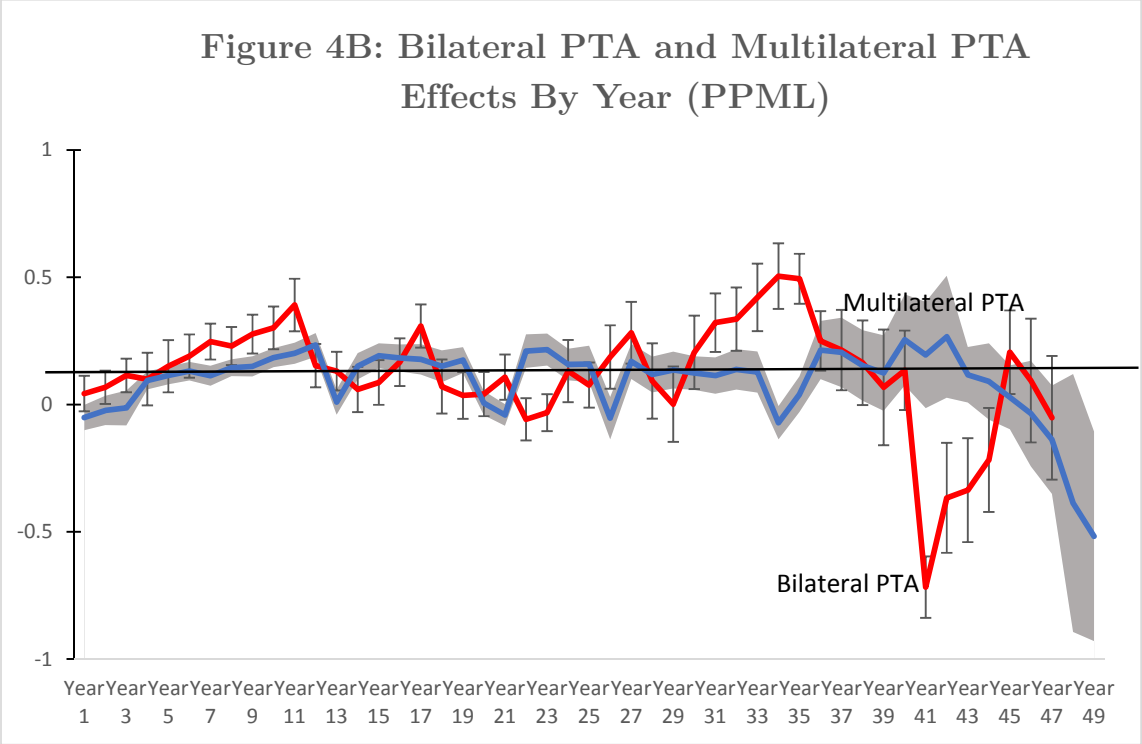
Figure 3B presents estimates for bilateral and multilateral PTAs. While multilateral PTAs consistently have a positive impact on trade, the effect of bilateral PTAs is significant only from year 4 to year 12. In fact, bilateral PTA effects turn negative and significant by year 32. Comparing WTO effects to multilateral PTAs, we find that by year 20, WTO dominates multilateral PTA in terms of effect on bilateral trade. While the WTO increases trade by 3.9% per year on average, multilateral PTAs increase trade by 2% per year on average. Overall, we find that the WTO effect always dominates bilateral PTAs, dominates multilateral PTAs in the long-run, and matches Deep PTAs in the long-run. In short, the WTO strongly increases trade over time. Further, if countries take a sufficiently long-term perspective, WTO membership matches or dominates PTAs regardless of the depth of economic integration.

Next, we estimate the PPML specification

$$X_{od,t} = \exp\left[\sum_{\tau=1}^{59} \beta_{WTO,\tau} WTO_{od,\tau t} + \sum_{j=1}^{4}\sum_{\tau'=1}^{49} \beta^{j}_{PTA,\tau'} PTA^{j}_{od,\tau'} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od} * t\right] + e_{od,t} \quad (9)$$

and show the coefficient estimates in Figures 4A and 4B.





Figures 4A and 4B show that while WTO membership over time dominates Multilateral and Bilateral PTAs, it is now dominated by Deep PTAs. On average, an extra year in a Deep PTA raises bilateral exports by 1.35% while an extra year of WTO membership raises bilateral exports by 0.75%. By contrast, an additional year of multilateral PTA raises exports by only 0.29% per year. Unilateral PTAs (not shown) consistently have a negative and significant impact on bilateral trade.

Overall, regardless of specification, over time WTO effects are stronger than unilateral, bilateral and multilateral PTAs. Regardless of specification, WTO effects fall short of Deep PTAs in the short to medium term. In the long-term, the relative magnitude of WTO membership over time compared to Deep PTAs depends on the specification we use. Since PPML is the preferred specification accounting for both zeros and heteroskedasticity, Deep PTAs do have a stronger effect on trade. We should keep in mind that Deep PTAs include various combinations of common currency, common markets and even labor mobility. More importantly, enthusiasm for Deep PTAs should also be tempered by the fact that they are relatively rare - less than 2% of our observations, and less than 3.5% of the country-pairs are part of a Deep PTA. By contrast, 61% of the country-pairs share WTO membership. In 2006, for instance, only 2.75% of country-pairs were members of a Deep PTA. The corresponding number for WTO membership was 50%. Overall, while WTO effects may fall short of Deep PTAs, it's role in facilitating bilateral trade flows should not be discounted, especially when compared to the vast number of PTAs in existence.

4.2 Disentangling WTO and PTA Effects

WTO and PTA memberships frequently overlap. Subramanian and Wei (2007) argue that bilateral, and multilateral preferences involve different degrees of liberalization, hence defining them as we

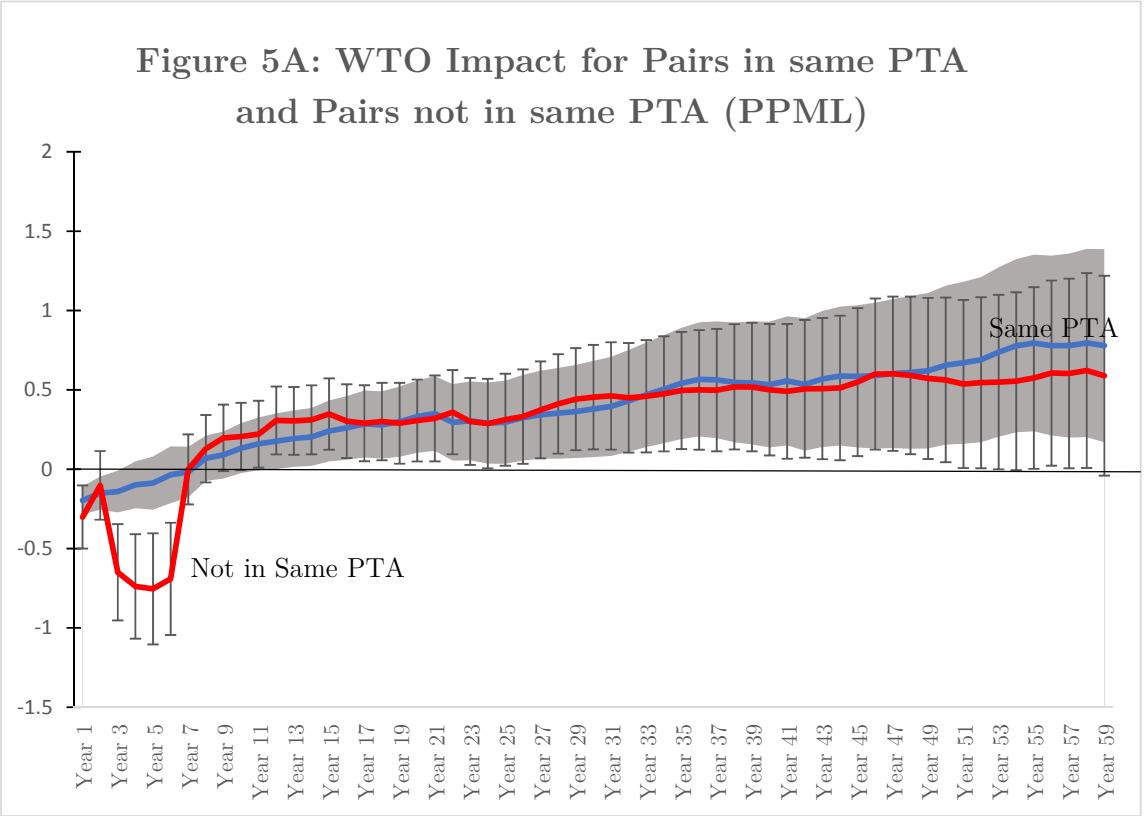
have done so far contaminates the estimates and recommend that these be defined in a mutually exclusive fashion to disentangle the two. However, Eicher and Henn (2011) show that Subramanian and Wei's hierarchical classification of dummies, with PTAs at the top and WTO at the bottom of the classification hierarchy, assumes that PTA membership represents the culmination of trade integration, and produces a WTO effect that is actually a PTA effect. They adopt the Rose (2004) mutually inclusive coding (as we have done so far) that identifies net effects of WTO and PTA membership. Therefore, to disentangle WTO and PTA effects, we use an alternate specification and estimate distinct WTO effects over time, for country-pairs that are members of common PTA and for members that do not share a PTA. We estimate the following specification using PPML:

$$X_{od,t} = \exp\Bigg[\sum_{\tau=1}^{58}\beta_{WTO-PTA,\tau}WTO_{od,\tau t}Pref_{od,t} + \sum_{\tau=1}^{58}\beta'_{WTO-PTA,\tau}WTO_{od,\tau t}(1-Pref_{od,t}) + \sum_{\tau=1}^{58}\beta_{PTA-WTO,\tau}PTA_{od,\tau t}Both_{od,t} + \sum_{\tau=1}^{49}\beta'_{PTA-WTO,\tau}PTA_{od,\tau t}(1-Both_{od,t}) + \theta\gamma_{CU}CU_{od,t} + \mu_{o,t} + \mu_{d,t} + \epsilon_{od}*t\Bigg] + e_{od,t} \quad (10)$$

That is, we interact the dummies for number of years of WTO membership with two dummy variables defined mutually exclusively: the first $Pref_{od,t}$, that takes the value 1 if o and d are members of the same PTA at time t, the second is $(1 - Pref_{od,t})$ which takes the value 1 if o and d are *not* members of the same PTA at time t. The coefficients $\beta_{WTO-PTA,\tau}$ estimate the effect of WTO membership for country-pairs that share PTA membership while $\beta'_{WTO-PTA,\tau}$ show the effect of number of years of WTO membership for country-pairs that are not part of any PTA. The latter yields an estimate of a pure-WTO effect over time uncontaminated by PTA membership while the former shows the effect of WTO membership on country-pairs that are also part of the same PTA.

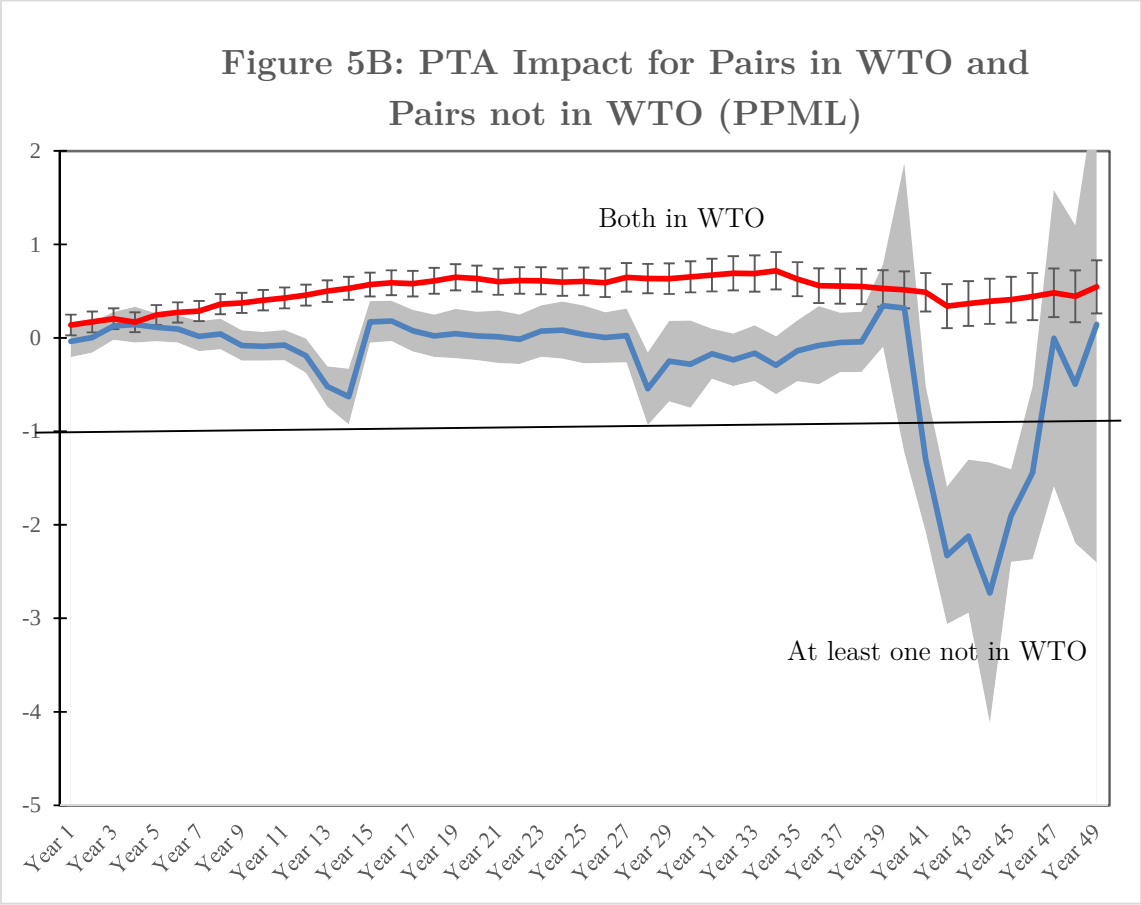
WTO membership coefficients are plotted in Figure 5A. Figure 5A shows that except for the first 7 years[15], the two WTO effects more or less coincide with each other, over the first 48 years of WTO membership. From year 49 onwards, the WTO effect is marginally stronger for pairs that also share PTA membership. Overall, WTO membership effects are equally strong over time, regardless of whether the country-pair shares PTA membership.

[15] Interestingly, as in Eicher and Henn (2011) we do find evidence for a negative impact of WTO membership in initial years, but this is regardless whether the country-pair shares PTA membership.



Symmetrically, in equation (7) we also estimate separate PTA effects over time for country-pairs that are also WTO members (the coefficients $\beta_{PTA-WTO,\tau}$ on the interaction between number of years in a PTA with a dummy $Both_{od,t}$ that takes the value 1 if both are WTO members) and for those where at least one country in a pair is not a WTO member (the coefficients $\beta'_{PTA-WTO,\tau}$ on the interaction between number of years in a PTA with the dummy $(1 - Both_{od,t})$ that takes the value 1 if at least one country is not a WTO member). These estimates are shown in Figure 5B below.

In Figure 5B we observe a significant and consistent impact of years of PTA membership only for countries that are also part of the WTO. Where at least one country is not a WTO member, the effect of years of PTA membership is negative. These estimates also suggest that PTA membership effect is positive and stable only when both countries in a trading pair are also WTO members.



4.3 Heterogeneity by Level of Development

Developed countries undertook far greater trade liberalization under the auspices of the GATT reducing their average tariffs from 15% in 1947 to about 4.5% (Subramanian and Wei, 2007). In contrast, pre-Uruguay Round, developing countries had far fewer obligations to liberalize tariff barriers under the Special and Differentiated (S&D) treatment.[16] This asymmetry implies that we should expect differential effects for GATT/WTO membership for developed vs. developing countries, as well as pre-vs post Uruguay Round. To the extent that the destination country is a developing economy that reduced trade barriers slowly over time, we would expect a rising WTO effect over time. If the destination country is an advanced economy that quickly lowered trade barriers or had low barriers to begin with, we should expect a small role for WTO membership over time. On the other hand, to the extent that WTO membership is a commitment device and is

[16] Tang and Wei (2009) show that for the subset of developing countries who were eligible to join the GATT under Article XXVI 5(c) without having to promise reforms, WTO accession did not exhibit increases in either growth or investment after accession. Almost all Article XXVI 5(c)-eligible countries joined the GATT by 1994 without making extensive reform commitments

primarily about reducing trade policy uncertainty, we should expect the biggest impact in the short-run (and a smaller one in long-run) when the destination country is an emerging country.

We start with Subramanian and Wei's (2007) classification of countries as advanced vs. developing economies. These are 25 countries who were OECD members on or before 1973. To this list, we add countries classified as High-Income by the World Bank in 1970. These include 5 major oil exporting countries (Brunei, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates), Israel, Liechtenstein, and 8 small rich island nations.

We estimate equation (7) using PPML for four subsets of country-pairs. Figure 6A shows the PTA and WTO effects over time when both the origin and the destination are advanced economies; In Figure 6B, both countries in a country-pair are developing countries; in Figure 6C, the exporter is an advanced country while the destination is a developing country; in Figure 6D, the exporter is a developing country while the destination is an advanced economy.

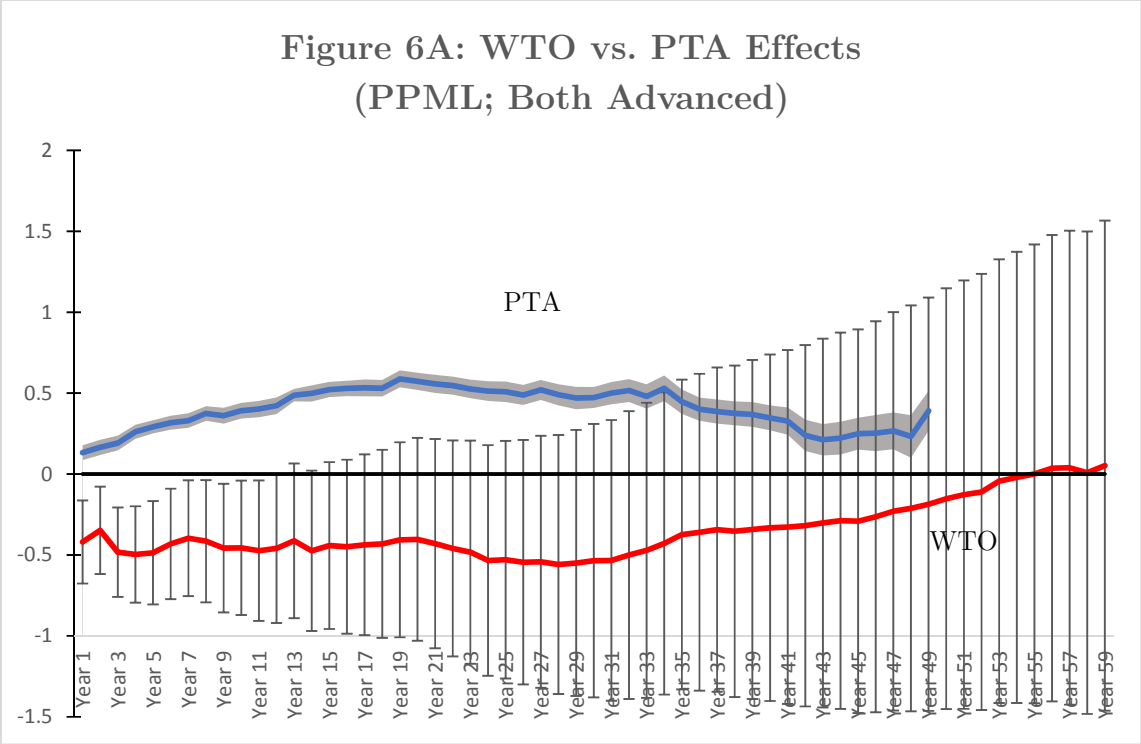


Figure 6A shows that a negative and insignificant impact of WTO membership when both countries in a pair are advanced economies, regardless of the number of years of WTO membership. However, most of the OECD countries are either founding members of GATT or joined soon after the formation of GATT[17] so their WTO membership is collinear with the country-year effects. Identification essentially relies on the variation in years of WTO co-membership where one of the trading partners is one of the small island nations or a major oil producer. This makes it difficult to identify WTO membership effect over time when both trading partners are advanced economies.

[17] By 1968 all the original OECD were members of the GATT.

For PTA membership, there is sufficient variation within country-pairs over time to identify a strong PTA effect over time as shown above.

Figure 6B shows the effect of WTO and PTA membership over time when both countries in a pair are developing countries. The WTO effect on bilateral trade gradually rises over time, rising to a peak after 55 years, with bilateral exports higher by 159% compared to a pair that have zero years of WTO membership. WTO membership has a small negative effect in initial years but quickly turns positive and significant after a decade. The effect of PTA membership is also positive, peaking at 23 years, but declines thereafter. The instability in the coefficient for PTA membership again reflects that identification relies on a very few developing country-pairs with long-lasting PTA membership.[18]

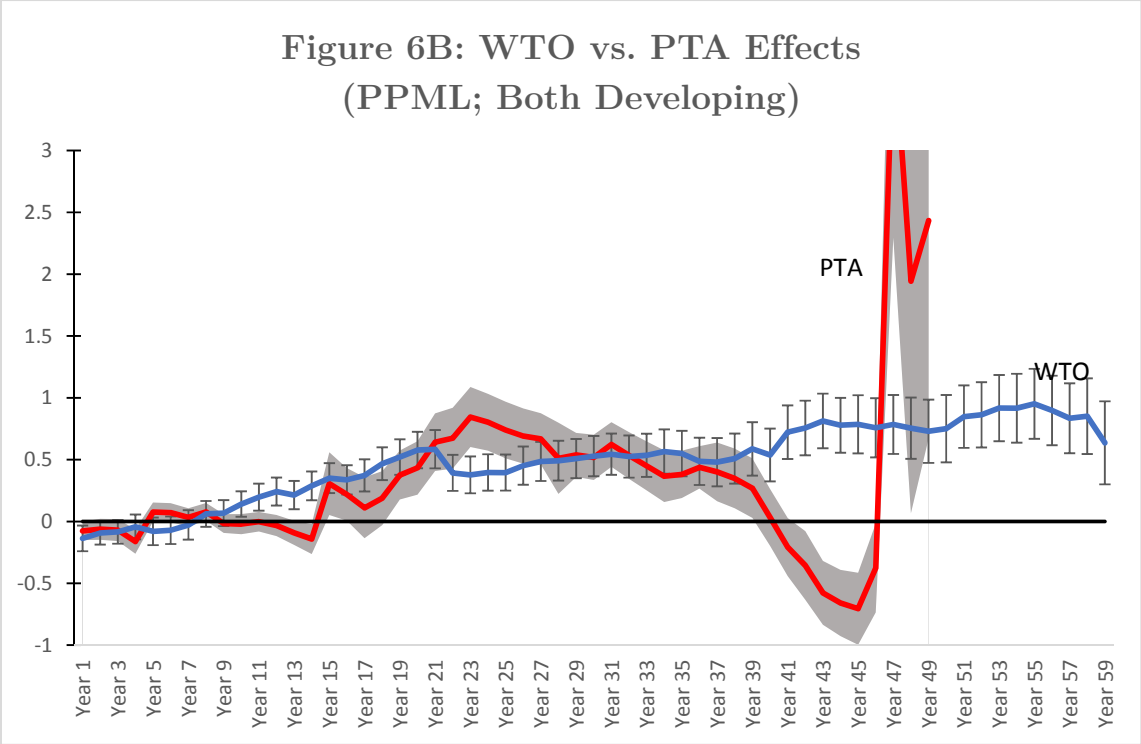
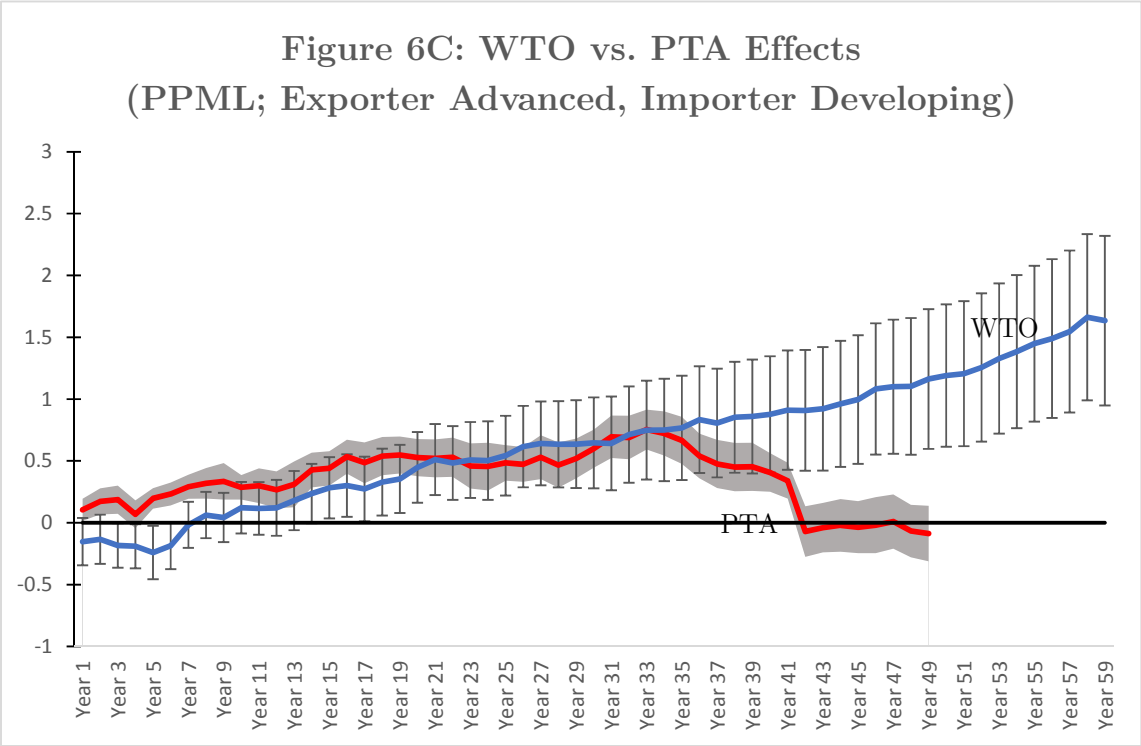


Figure 6C shows that the strongest effect of WTO membership over time is observable when the exporter is an advanced economy while the importer is a developing economy. While PTA

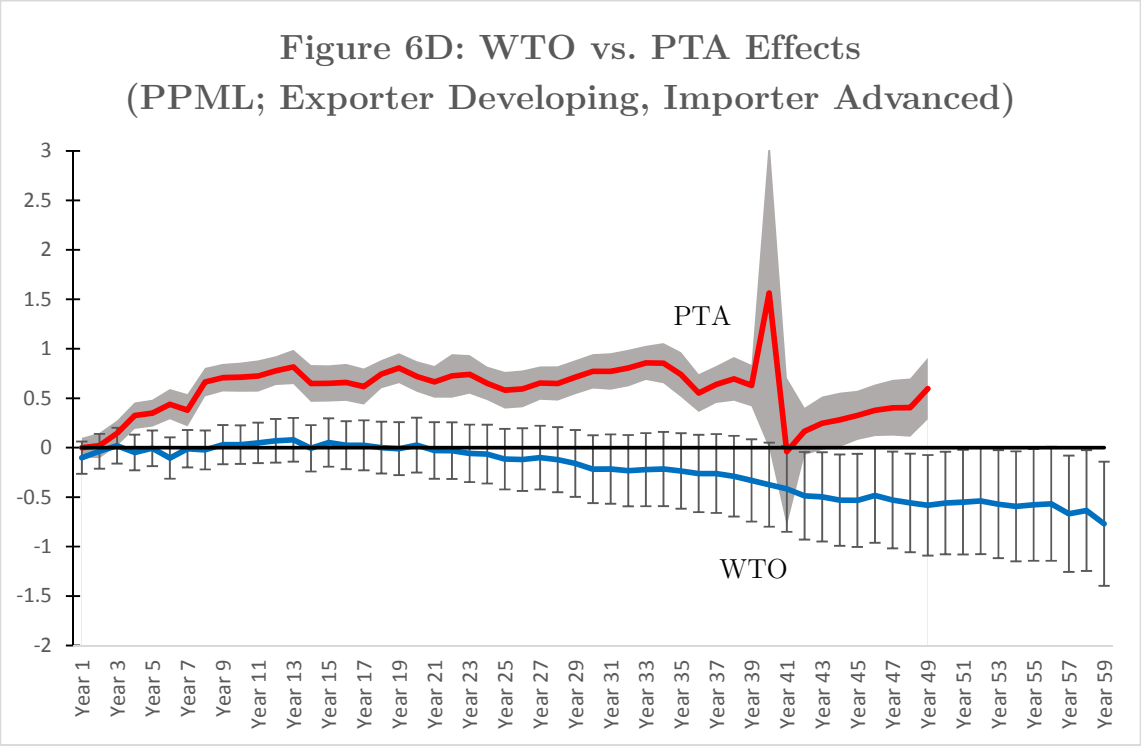
[18] There are three PTAs between developing countries that have existed for more than 40 years: 1) the 1960 Central American Common Market, a PTA between El Salvador, Guatemala, Honduras and Nicaragua. 2) The 1973 Caribbean Community and Common Market (CARICOM) agreement between island nations in the Caribbean. 3) The 1969, South African Customs Union between South Africa, Botswana, Lesotho, Namibia and Swaziland. Identification for PTA effects after 40 years uses 22 observations from these three PTAs in our estimates.

membership dominates initially, in terms of magnitude, it is overtaken by WTO membership by year 20.



Comparing Figures 6B and 6C, we see that for the first 20 years WTO membership is stronger when the exporter is a developing country. The average difference between the coefficient estimates $\beta^{Em,Em}_{WTO,\tau} - \beta^{Ad,Em}_{WTO,\tau}$ for $\tau = 1, ...\, 20$ is 0.08. Beyond 20 years the magnitude of the WTO effect is stronger when the exporter is a developed country with the average of $\beta^{Ad,Em}_{WTO,\tau} - \beta^{Em,Em}_{WTO,\tau}$ for $\tau = 21, ...\, 59$ equal to 0.31, where $\beta^{Em,Em}_{WTO,\tau}$ to the WTO coefficients in Figure 6B and $\beta^{Ad,Em}_{WTO,\tau}$ refers to the WTO coefficients in Figure 6C.

Figure 6D shows the effects of WTO vs. PTA membership when the exporter is a developing country and the importer is an advanced economy. This is the only scenario where we find a stronger positive effect of PTA membership and an insignificant effect of WTO membership over time. This is consistent with the fact that advanced economies had low tariff barriers to begin with and extended unilateral preferences to many developing countries.



To summarize our findings, WTO effects dominate PTA effects in the long-run, as long as the destination country in a pair is a developing country. The fact that in the short-run WTO effects are either negative or insignificant for the first 10 years when the importer is a developing country suggests that WTO is less about a commitment device that reduces trade policy uncertainty. At the same time, we observe the strongest WTO effect when the exporter is an advanced economy and the importer is a developing country. This is consistent with developing countries gradually reducing tariff barriers over time. At the same time, we find that developing countries manage to increase exports to both advanced and developing countries following WTO membership.

4.4 Heterogeneity at the Margins

Much of the growth of world trade has been on the extensive margin or the new goods margin, especially over longer time horizons. Kehoe and Ruhl (2013) show that this is especially true for significant trade liberalizations such as NAFTA and China's access to the WTO. Dutt et al., (2013) find that WTO membership affects mainly the extensive margin, while Baier, Bergstrand and Fang (2015) show that PTA membership increases both the extensive and intensive product margins. However, both use the traditional dummy variable for membership in a trading arrangement. Since both WTO and PTA membership entail significant trade policy changes, we look at their effect over time on the extensive and intensive product margins of international trade. We decompose

bilateral exports as the product of an extensive margin and an intensive margin, using the methodology of Hummels and Klenow (2005) and Feenstra and Kee (2008).

Define $J_{od,t}$ as the set of products exported from origin o to destination d in year t and let $J_{Wd} \equiv \cap_{o,t} J_{od,t}$ be the set of all products exported to d from any country in any year in our sample. The index W stands for "World", i.e., the collection of origin countries. Define $\overline{X}_{Wd}(j)$ as the average value of exports from the world (summed over all exporting countries and averaged across years) of product j to d from the world. This is the weight given to product j for bilateral exports from any origin country o to d. The extensive margin of exported goods from origin to destination is defined as the fraction of goods sold by the exporter in the destination weighing each product by its importance in world exports to this destination, averaged over time. It is defined as

$$XM_{od,t} = \frac{\sum_{j \in J_{od,t}} \overline{X}_{Wd}(j)}{\sum_{j \in J_{Wd}} \overline{X}_{Wd}(j)}$$

As in Feenstra and Kee (2008) we use time-invariant weights so that the extensive margin changes over time only when there is a change in the set of goods the origin sells in the destination ($J_{od,t}$). The denominator is destination-specific and constant across exporting countries and time.

The intensive margin of exported goods from o to d is given by

$$IM_{od,t} = \frac{\sum_{j \in J_{od,t}} X_{od,t}(j)}{\sum_{j \in J_{od,t}} \overline{X}_{Wd}(j)}$$

where $X_{od,t}(j)$ is the value of exports from country o to country d of good j at time t. The intensive margin equals o's nominal exports relative to W's average exports in those categories in which o exports to d at time t ($J_{od,t}$). Thus, it measures the overall market share country o has within the set of categories in which it exports to d. Note that the product of the two margins is

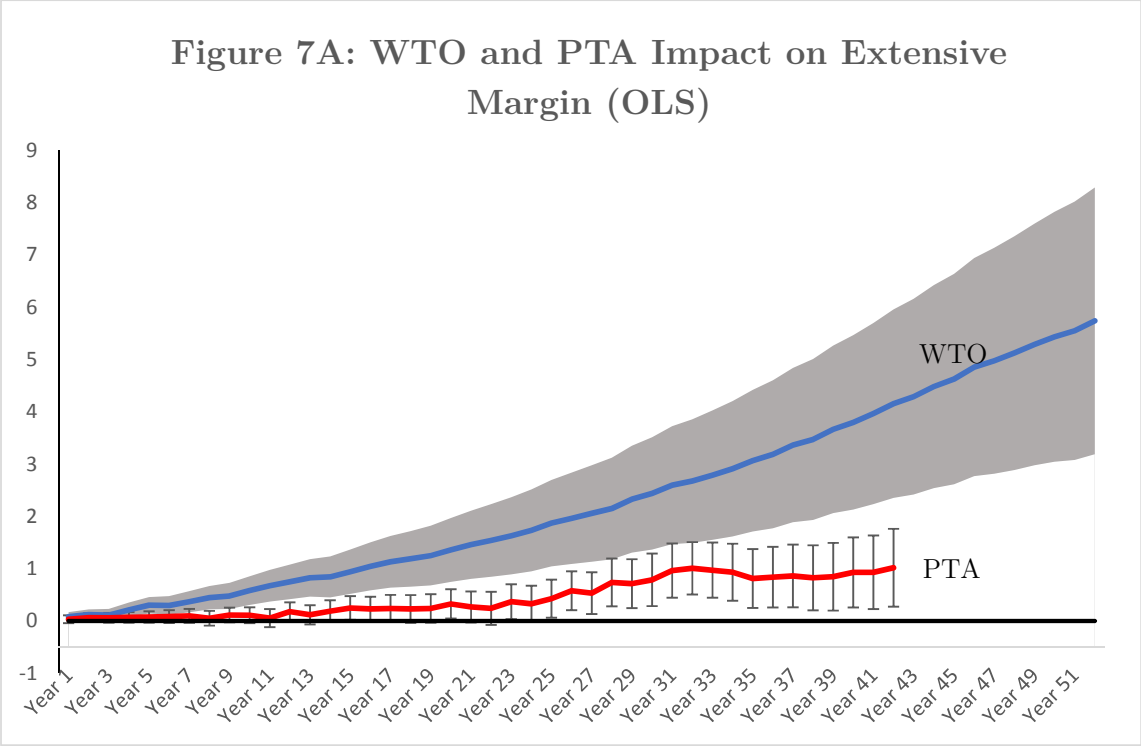
$$XM_{od,t} * IM_{od,t} = \frac{\sum_{j \in J_{od,t}} X_{od,t}(j)}{\sum_{j \in J_{Wd}} \overline{X}_{Wd}(j)} = \frac{X_{od,t}}{\overline{X}_d}$$

which equals total bilateral exports from o to d in year t as a fraction of country d's average imports. This implies that in a log-specification for the margins, adding the coefficients on the extensive and intensive margins will yield the traditional gravity coefficients once we include importer country fixed effects.[19]

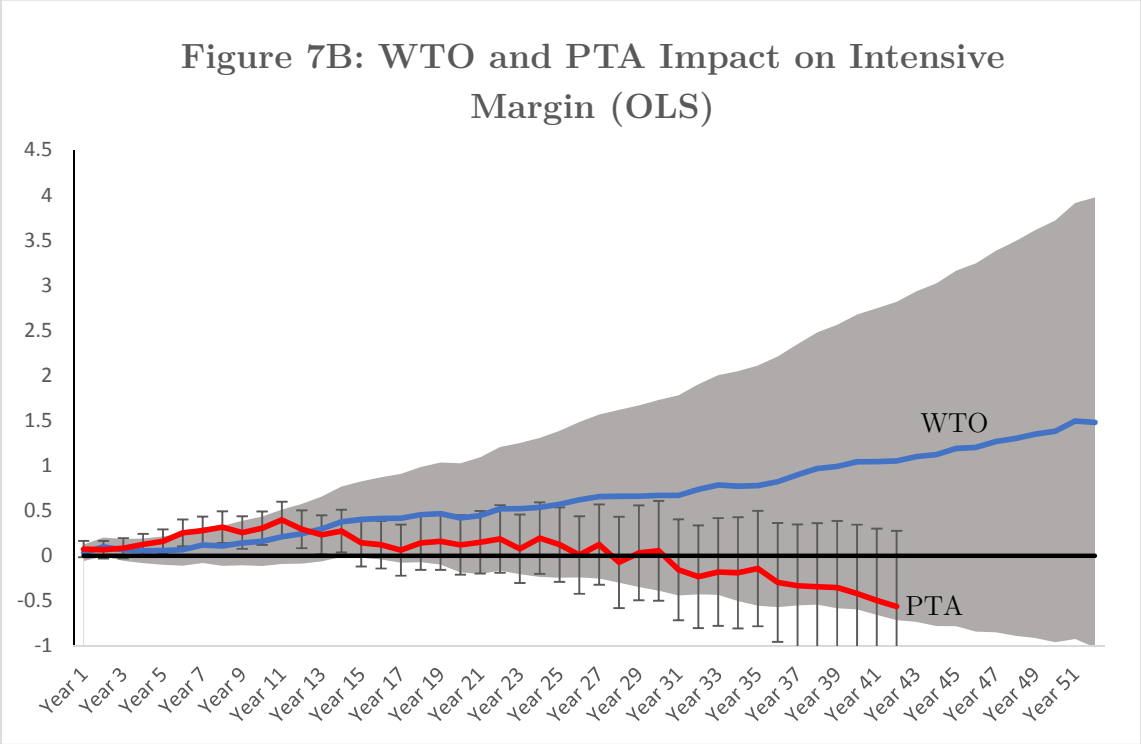
To ensure that we have sufficient coverage over time and across countries, we use data from the World Trade Flows Database from Feenstra et al., (2005). This database contains information on bilateral exports for more than 150 countries over the period 1962-1999. The data are based on the 4-digit Standard International Trade Classification, Rev. 2, with 790 4-digit categories and

[19] Note that the importer-year fixed effects that we use in every specification will subsume importer fixed effects.

account for 98 percent of all world trade.[20] Finally, since these measures are not defined for zero trade flows, we estimate the WTO and PTA effects for the two margins for only positive trade flows in an OLS specification. These estimates are shown in Figure 7A for the extensive margin and in Figure 7B for the intensive margin.



[20] While the HS-6 data from UNCTAD are at a finer level of disaggregation, coverage starts for a sufficient set of countries only in 1992.



Several interesting results and implications emerge from this decomposition. First, Figures 7A and 7B both indicate that the effect of WTO increases over time. Furthermore, as in Dutt et al., (2013) we find that the WTO has a stronger effect on the extensive margin of trade. To the extent that growth in world trade has been along the extensive margin, the WTO clearly seems to have played a key role. For the intensive margin, we do not find a significant impact on the intensive margin. The increase in the extensive margin for the WTO indicates that WTO membership must reduce the fixed costs of trade.

Second, PTA effects are stronger on the intensive margin compared to the extensive margin for the first 14 years of membership. In fact, initially PTA membership has no effect on the extensive margin of trade. This is consistent with PTAs manifesting themselves as reducing primarily the variable costs of trade. The initial strong impact on the intensive margin is in line with Baier, Bergstrand and Fang (2014) who examine PTA effects up to a 5-year lag. Beyond 14 years, PTA membership increases only the extensive margin while the effect peters out for the intensive margin.

Comparing WTO to PTA, we find that for the extensive margin, WTO effects are stronger than PTA effects, regardless of the number of years of membership. For the intensive margin, PTA dominates WTO membership for the first decade, while beyond that – in the longer term – the WTO plays a stronger role.

5 Conclusion

This paper examines the heterogeneity of trading arrangements over time. We find that while the effect of the WTO is initially small and even negative, in the long-run it dominates the PTA effect

on bilateral exports. PTAs on the other hand, exhibit diminishing returns for trade over time. In our preferred and most demanding specification, an additional year of WTO membership raises bilateral exports on average by 1.5% per year, while PTA membership raises trade by 0.5%. Ignoring this heterogeneity and relying on parametric estimate for trading arrangements via indicator variables for membership in trading arrangements underestimates the WTO effect over time and overestimates the PTA effect over time. Our results are consistent with models of gradual trade liberalization over time, and declining tariffs under WTO auspices over time.

We combine this heterogeneity over time with other sources of heterogeneity – by type of PTA, by levels of development, and for the extensive and intensive product margins of trade. We also show that WTO effects dominate unilateral, bilateral and multilateral PTAs while fall short of Deep PTAs. We find that these effects are strongest when the importer is a developing country regardless of whether the exporter is a developed or a developing economy. For the margins, WTO effects are stronger for the extensive margin while PTA effects are stronger for the intensive margin. This is consistent with WTO membership reducing not just variable trade costs but also the fixed costs of trade.

Given the rising WTO effect over time, the fact that the WTO matters regardless of whether a country-pair shares PTA membership, the WTO dominance over most types of PTAs, and the strong effect on the extensive margin, suggest that the current scepticism towards expanding trade via multilateral trade liberalization, is not warranted. The WTO is definitely not passé. Recent political decisions to re-negotiate PTAs (e.g., Brexit, NAFTA) in various countries, while disruptive, may not have such a severe impact on bilateral exports over longer time horizons provided WTO rules remain in place.

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