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A re-assessment of the heterogeneous effect of trade agreements using intra-national trade flows

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ABSTRACT

This paper aims to re-examine the effects on trade of the different types of trade agreements. The extant literature highlights the existence of sizeable different effects of preferential trade agreements (PTAs) on trade along the geographical scope of the member countries, their degree of development, or the nature of the agreements (bilateral, plurilateral...). However, all previous studies investigating these heterogeneous effects suffer from important limitations because they only rely on international trade flows (which is inconsistent with the theory of gravity in international trade), do not control for general globalization trends, and do not properly account for the dynamic adjustment of trade flows. We address all these shortcomings and find that: (i) both PTAs and GATT/WTO have had a positive effect on bilateral trade; (ii) regional PTAs have a significantly larger effect on bilateral trade than interregional PTAs; (iii) South–South PTAs show the biggest trade-enhancing impact; (iv) bilateral agreements do not boost trade; and (v) enlargements of existing PTAs have a larger effect than plurilateral agreements and the agreements between two PTAs or between a PTA and a country.

1. Introduction

The economic effects of preferential trade agreements (PTAs) have been and will likely continue to be a key source of policy reform, as well as an area of great interest in the field of international economics given both the important implications of these agreements and the enormous potential for new research (Limão, 2016).[2] Given the difficulties faced by multilateral trade negotiations through the World Trade Organization (WTO) in the last decades, PTAs have substantially proliferated all over the world. At the same time, these agreements are getting deeper, encompassing not only tariff reductions but also behind-the-border policies, such as regulatory issues, investments, services, competition policy and intellectual property rights.

The extant literature on the impact of PTAs on international trade flows has commonly found that trade agreements boost trade (e.g., Baier and Bergstrand, 2007; Anderson and Yotov, 2016; Egger et al., 2022). However, some remarkable

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[2] In this study, we use the expression "preferential trade agreements" to refer to Free Trade Agreements and Customs Unions. In this regard it is worth noting that Free Trade Agreements and Customs Unions are often notified to the World Trade Organization combined with Economic Integration Agreements as defined in Article V of GATS.

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differences arise when PTAs are grouped following alternative classification criteria, such as their geographical scope (Gil-Pareja et al., 2012), their composition in terms of the stage of development of the member countries (Behar and Cirera-i-Crivillé, 2013), the number of participating countries (Cháfer et al., 2022) or their depth (Baier et al., 2014).

Since the beginning of the 1990s, the economic geography literature has analyzed the theoretical welfare gains and losses from PTAs on the basis of the existence of differences in trade costs between and within continents. Krugman (1991) and Frankel et al. (1995, 1996, 1998), offer a number of predictions about which countries are more likely to experience a rise in trade after signing an agreement. The standard arguments rely on the so-called "natural trading partners" hypothesis, which states that the closer two economies are, the lower their transport costs and, consequently, the higher their volume of trade. Gil-Pareja et al. (2012) motivated by the increasing number of transcontinental PTAs, use this hypothesis to examine whether trade blocks formed along continental lines (those labeled as natural PTAs by the economic geography literature) are more likely to be welfare-improving in terms of trade than those made of countries from different continents. They do not find support for this hypothesis, so they conclude that the proliferation of both types of agreements (continental and intercontinental) has had a positive and significant effect on trade.

Behar and Cirera-i-Crivillé (2013) compare the impact of North–North (NN), North–South (NS), and South–South (SS) trade agreements on bilateral trade. These authors motivate their analysis by arguing that it is not clear that the positive effect of PTAs on trade documented in the literature (Baier and Bergstrand, 2007) systematically applies to trade agreements between developing countries, as well as between developed and developing countries. On the one hand, developing countries can be considered unnatural trading partners because of the similarities in their endowments, their smaller economic size, and higher trading costs. On the other hand, developing countries may share their preferences for similar goods and are more likely to obtain more attractive trade concessions from other developing countries than from developed countries. Their results suggest that all forms of agreements lead to a rise in bilateral trade regardless of whether the signatories are developed or developing countries. Furthermore, despite concerns that developing countries may not be natural trading partners, they find that the percentage increase in bilateral trade is higher for South–South agreements than for North–South agreements.

Cháfer et al. (2022) analyze the potential differential impact on trade of bilateral versus plurilateral trade agreements. The study was motivated by the change in the direction of the trade policy in favor of bilateral agreements, which occurred during the Trump Administration in the US, and also with the Brexit in the UK. The authors argue that plurilateral agreements (those that include three or more partners) are more desirable because they imply a simultaneous and homogeneous opening of several markets, which reduces transaction costs for firms that operate internationally. Moreover, the number of trading partners in the agreement is particularly relevant in a world where global value chains have led to production processes being divided among several countries, as trading partners are more likely to be outside a bilateral agreement than a plurilateral one. Their results give support to those arguments. The authors find that unlike plurilateral trade agreements, which systematically have a positive effect on trade, bilateral agreements have no significant effect on trade.

The studies that classify PTAs by groups according to the regional area, level of development, and number of trading partners, have three important shortcomings. The first is that they only rely on international trade flows, thereby ignoring intra-national trade flows, despite the fact domestic trade flows are featured in all theory-grounded gravity models (e.g., from Anderson (1979) to Arkolakis et al. (2012)). This omission is not surprising because the use of domestic flows in estimating gravity models has been uncommon partly due to the lack of appropriate data. Thus, Yotov (2022) states that most gravity applications only include international trade flows.[3] Yotov (2022) enumerates 15 reasons why gravity equations should be estimated with data that not only include international but also domestic trade flows and demonstrates that the use of domestic trade flows leads to significant differences in the estimates of bilateral trade policies. Fortunately, nowadays there are a number of publicly available datasets that offer consistently constructed international and intra-national trade flows.

The second important limitation of the previously cited studies, which is also related with the non-inclusion of domestic trade flows, is that they cannot control for general globalization trends as suggested by Bergstrand et al. (2015).[4] This is so because to capture these effects it is necessary to include a vector of dummy variables in the model that are equal to one for international trade flows and equal to zero for intra-national trade flows for each year t. Therefore, the use of domestic flows allows us to include this vector of dummies that, in a fixed effect panel approach, permit to isolate the impact of PTAs on bilateral trade to determine by how much a PTA actually increases two member's trade once we account for any possible declining trend in unobservable bilateral trade costs that may have increased international relative to intranational trade.

[3] Notwithstanding, it is worth noting that an increasing number of studies in recent years have estimated gravity equations of international trade including also domestic trade flows (see, for example, Yotov, 2012; Dai et al., 2014; Bergstrand et al., 2015; Anderson and Yotov, 2016; Borchert and Yotov, 2017; Beverelli et al., 2018; Felbermayr et al., 2018; Baier et al., 2019; Esteve-Pérez et al., 2020b; Heid et al., 2021; Egger et al., 2022; Borchert et al., 2022). Yet, none of these studies has examined the heterogeneous impact of PTAs.

[4] These authors argue that traditional estimates of economic integration agreements using the gravity equation may be biased upwards because they may be capturing the effects of globalization. Adapting a related idea from Yotov (2012), to account for the impact of globalization, Bergstrand et al. (2015) specify an empirical gravity model that includes domestic trade flows, and where the effects of globalization are captured by a series of time-varying indicator variables for international borders. The approach of Bergstrand et al. (2015) to capture globalization trends has also been followed by Larch et al. (2018, 2019), Baier et al. (2019), and Egger et al. (2022). A detailed explanation of this approach for addressing globalization effects (including the Stata commands) can be found in Yotov et al. (2016, pp. 53–54).

The third shortcoming of previous studies is that they do not properly account for the dynamic adjustment of trade flows in response to trade policy changes because they do not use data pooled over consecutive years. Considering data at intervals has been a common practice in the gravity equation literature of international trade to address the concern regarding the time required for the dependent and independent variables to adjust to trade policy fluctuations (Trefler, 2004 and Cheng and Wall, 2005). However, Egger et al. (2022) recommend using all available data, that is, data pooled over consecutive years, and including leads and lags to properly account for the dynamic adjustment process.

The aim of this paper is to re-examine the potential differential effect of PTAs on bilateral trade flows by type of agreement addressing all the aforementioned shortcomings. Our empirical analysis takes into account all the best practices and recommendations for estimating gravity equations suggested by Yotov et al. (2016) and Yotov (2022). These best practices include, in addition to consider theory-motivated intra-national trade flows, the need to use panel data techniques (to account for unobserved bilateral heterogeneity and endogeneity), the inclusion of controls for multilateral resistance terms, and the use of the PPML estimator to deal with econometric problems resulting from heteroskedastic residuals and the prevalence of zeros in bilateral trade flows.

To preview our results, we find that previous estimates of PTAs' partial effects by regional area, level of development, and number of trading partners are biased due to the omission of domestic trade flows. After including domestic trade flows and controlling for general globalization trends, some interesting results stand out. First, we find that both PTAs and GATT/WTO have a positive effect on bilateral trade. Second, according to the geographical scope of the agreements, we find that regional PTAs have a remarkable larger effect than interregional PTAs on bilateral trade, even though both types of PTAs boost trade. Third, South–South PTAs show the biggest positive impact on trade, followed by North–South PTAs and, at a greater distance, by North–North PTAs. Fourthly, while bilateral agreements show a positive effect on trade when no globalization dummies are introduced, this effect vanishes once globalization trends are included. Finally, we find that enlargements of existing PTAs have a larger impact on trade than both plurilateral agreements and agreements between two PTAs or between a PTA and a country.

The conclusions of the paper are robust to considering the existence of a dynamic adjustment process by including different leads and lags of the PTAs' variables to capture anticipation and phasing-in effects and to address endogeneity issues as Egger et al. (2022) suggest. Our results are also robust to the use of data at time-intervals, rather than pooled over consecutive years.

The remainder of the paper is organized as follows. After this Introduction section, Section 2 briefly outlines the empirical methodology and describes the data sources. Section 3 presents and discusses the main findings. Section 4 concludes.

2. Methodology and data

The gravity model of trade is one of the most popular and successful frameworks in international economics.[5] The gravity equation has been extensively used to investigate the determinants of international trade flows and, in particular, to quantify the effects on bilateral trade flows of both PTAs (e.g., Baier and Bergstrand, 2007; Baier et al., 2014; Bergstrand et al., 2015 or Anderson and Yotov, 2016), and the multilateral trade system (e.g., Rose, 2004; Tomz et al., 2007; Larch et al., 2019; or Esteve-Pérez et al., 2020a).[6]

We rely on the latest developments both on theoretical grounds, and on the empirical gravity literature to specify an econometric model that allows us to estimate the overall impact PTAs on trade, as well as the potential differential impact by type of agreements. In particular, we estimate the gravity model (1) in multiplicative form (instead of logarithmic form) with the Poisson Pseudo Maximum Likelihood (PPML) estimator.[7] We further estimates variations of Eq. (1) for the different classifications of PTAs considered in this paper.

Considering the specification for estimating the overall impact of PTAs on trade as reference, our econometric model takes the following form:

$$X_{ij,t} = \exp\left(\alpha PTA_{ij,t} + \beta_1 GATT/WTO_{ij,t} + \sum_t \beta_t INTER_{ij,t} + \eta_{ij} + \chi_{i,t} + \lambda_{j,t}\right) \times \epsilon_{ij,t} \quad (1)$$

where the dependent variable is the nominal value of bilateral trade flows (in levels) from a country i (exporter) to a country j (importer) at time t. The panel dimension of $X_{ij,t}$ improves estimation efficiency and following the recommendation by Yotov (2022), the dependent variable includes both international and intra-national trade flows. $PTA_{ij,t}$ is an indicator variable that takes the value of one when i and j are members of the same Preferential Trade Agreement in

[5] Initially, the gravity equation lacked theoretical foundations. However, since the end of the 1970s, the gravity model of trade has also become a structural model with solid theoretical foundations. Anderson (1979) is the first to provide a theoretical basis for the gravity model of international trade. Eaton and Kortum (2002) and Anderson and van Wincoop (2003) offer the two most prominent theoretical foundations of the structural gravity model. For a review of alternative theoretical foundations of the structural gravity model see Head and Mayer (2014) and Yotov et al. (2016).

[6] See Limão (2016) and Gil-Pareja et al. (2016) for a comprehensive review of the empirical literature on the effect of PTAs and GATT/WTO on trade, respectively.

[7] Following the recommendations of Santos Silva and Tenreyro (2006) we estimate the gravity equations using the PPML estimator because, in addition to deal with heteroskedasticity in trade data, it takes advantage of the information that is contained in zero trade flows.

force at time t, and it is equal to zero otherwise. Similarly, $GATT/WTO_{ij,t}$ is an indicator variable that takes the value of one when i and j belong the GATT (until 1994) or WTO (from 1995) in year t, and zero otherwise.[8] As suggested by Bergstrand et al. (2015), we include a set of time-varying border dummy variables ($INTER_{ij,t}$) to account for common globalization effects.[9] Moreover, following the recommendations of Baltagi et al. (2003), Baier and Bergstrand (2007) and Baldwin and Taglioni (2007), our econometric model includes three additional types of fixed effects (country-pair fixed effects (η_{ij}), exporter-time fixed effects (χ_{it}) and importer-time fixed effects (λ_{jt})) in order to deal with two sources of omitted variables bias. On the one hand, country-pair fixed effects absorb and control for the impact of any observed (distance, common language, contiguity, colonial ties, etc.) or unobserved time-invariant determinant of bilateral trade that may be correlated with the regressors and mitigate endogeneity concerns with respect to our policy variable of interest ($PTA_{ij,t}$). On the other hand, country-year fixed effects (both for the exporting and for the importing countries) deal with the omission of the unobservable multilateral resistance (price) terms established by Anderson and van Wincoop (2003).[10]

Finally, following Egger et al. (2022) we use data for consecutive-years to better capture dynamic-adjustment effects. These dynamic effects may arise when firms need time to adjust to new trade-facilitation agreements. In this situation, delayed responses of trade flows to those trade policy changes would be observed. Delayed responses may also be expected when PTAs involve different phase-in periods for full implementation. Trefler (2004) and Cheng and Wall (2005) recommend using panel data with intervals instead of data pooled over consecutive years to allow for adjustment in trade flows in response to changes in trade policy. According to this recommendation, researchers have used panel data with time intervals rather than data on consecutive years to estimate the partial effect of PTAs on trade.[11] However, Egger et al. (2022) have challenged the common practice of using interval data to estimate the impact of trade policy effects in gravity equation and recommend using data pooled over consecutive years to better understanding the specific features of the dynamic adjustment process for two main reasons. First, they argue that the direct trade response to PTAs is highly non-linear. Second, they further point out that the use of time-interval data does not allow capturing the pattern of response times to detect the phases of the adjustment process, leading to biases of the estimated short-run and long-run effects. According to their results, the larger positive effects occur between three and six years after the PTA's entry into force and full potential is reached after seven years. To capture these potential dynamic-adjustment effects, we include lagged values of PTAs variables.

Furthermore, following Baier and Bergstrand (2007), Yotov et al. (2016), and Egger et al. (2022), we examine the potential problem of reverse causality between PTAs and international trade flows, which would cause endogeneity problems. This happens when, all else equal, the probability that one country liberalizes its trade with another country is greater when the latter is already a significant trade partner. We include leads of PTAs' variables to measure an anticipation effect of the future PTA on trade. A positive and significant coefficient could hint at an endogeneity problem or could capture anticipation effects if trade flows increase in anticipation of PTAs. Alternatively, a negative and significant coefficient would indicate that trade flows decrease in anticipation of the benefits of the new PTA.

Hence, to control for the dynamic effect of PTAs on trade, specification (1) is modified to include a set of leads and lags of PTAs' variables. We start by estimating the model using lags and leads up to two years because some PTAs are recent and their effects cannot be observed at longer lagged levels and, consequently, they cannot be fully captured. Alternatively, following Egger et al. (2022), we generate longer lagged and lead values.

$$X_{ij,t} = \exp\left(\alpha PTA_{ij,t} + \sum_{s} \alpha_s PTA_{ij,t+s} + \sum_{k} \alpha_k PTA_{ij,t-k_{ij,t}} + \beta_1 GATT/WTO_{ij,t} + \sum_{t} \beta_t INTER_{ij,t} + \eta_{ij} + \chi_{i,t} + \lambda_{j,t}\right) \times \epsilon_{ij,t} \quad (2)$$

Notice that subscripts s and k stand for leads and lags, respectively. They take the values 1 and 2 to include one- and two-year leads and lags. As a robustness check, s and k take values from 1 to 8 to include up to eight-year leads and lags.

[8] Spurred by the influential work of Rose (2004), several studies have re-assessed the effect of GATT/WTO on bilateral trade and most of them have found, in line with conventional wisdom, that the GATT/WTO has had a trade-promoting effect (see, for example, Tomz et al., 2007; Helpman et al., 2008; Liu, 2009; Chang and Lee, 2011; Herz and Wagner, 2011; Dutt et al., 2013; Cheong et al., 2014; Kohl and Trojanowska, 2015; Kohl, 2015; Gil-Pareja et al., 2016; or Larch et al., 2019).

[9] This set of dummy variables are created by interacting a time-invariant dummy variable, $INTER_{ij}$, which takes the value 1 for international trade flows ($i \neq j$) and the value 0 for intra-national trade ($i = j$), with a binary indicator for each year t (D_t) to obtain $INTER_{ij,t}$.

[10] Anderson and van Wincoop (2003) emphasized that bilateral trade flows depend not only on bilateral trade barriers between any two countries (distance, language, adjacency, etc.) but also on trade barriers of each country with the rest of the trading partners (i.e., the multilateral resistance to trade). Exporter-time and importer-time fixed effects also control for changes in GDPs, as well as all other country-specific time-varying variables (country's business cycle, the cultural, political or institutional characteristics, etc.) that may impact bilateral trade on the exporter or on the importer side.

[11] Cheng and Wall (2005), Baier and Bergstrand (2007), Vicard (2009), Eicher and Henn (2011), Behar and Cirera-i-Crivillé (2013), Kohl (2014), Limão (2016) and Esteve-Pérez et al. (2020a) use data at five-year intervals in this way. Dai et al. (2014), Bergstrand et al. (2015), Anderson and Yotov (2016), and Gil-Pareja et al. (2014, 2016) use intervals of four years. Trefler (2004) and Olivero and Yotov (2012) employ data at three-year intervals while Larch et al. (2018) and Esteve-Pérez et al. (2020a) check the robustness of their results using two-year time intervals instead of consecutive years.

This paper uses data from different sources. The dependent variable comes from the Structural Gravity Manufacturing Database (Monteiro, 2020), which provides consistent data on bilateral international and domestic trade of manufactured goods, for 186 trading partners over the period 1980–2016. In this dataset, international flows are measured by export flows, expressed as free on board (FOB) that have been complemented by mirrored import data flows after adjusting for insurance and freight costs (CIF). Moreover, domestic trade flows are computed as the difference between gross output and exports of manufacturing goods.

With regard to the explanatory variables, data on membership in GATT/WTO come from the World Trade Organization. We use data on regional trade agreements drawn from World Bank's Trade Agreements Database (Horizontal Depth) described in Hofmann et al. (2017). This database covers 279 agreements signed by 189 countries between 1958 and 2015, which reflects the entire set of preferential trade agreements in force and notified to the World Trade Organization as of 2015. We follow the World Bank classification to classify a PTA as *Regional,* when all its member countries belong to the same region, or as *Interregional*, when it includes countries from more than one region. We consider the following six regions: East Asia, South Asia and Pacific; Europe and Central Asia; Latin America and Caribbean; Middle East and North Africa; North America; and Sub-Saharan Africa. According to this criterion, 158 of these 279 agreements (63.1 per cent) are regional. Regarding the classification of PTAs by income levels of their partners (North–North, South–South and North–South) we follow the World Bank analytical classification of countries at the date of entry into force of each specific agreement. We classify a PTA as a North–North PTA (*N-N PTA*) when all member countries are classified by the World Bank as *high income* at the date of entry into force (for example, ANZCERTA). Similarly, we classify an agreement as a South–South PTA (*S-S PTA*) when all partners are either *Low income*, *Lower middle income* or *Upper middle income* at that year (for example, the bilateral agreement between Chile and China). Finally, a PTA is classified as a North–South PTA (*N-S PTA*) when it consists of countries belonging to both groups (for example, ASEAN-Australia-New Zealand). According to this classification, 15.8 per cent of the agreements are North–North, 41.6 per cent are North–South, and 42.7 per cent are South–South. Finally, with regard to the classification of PTAs according to their nature, we split PTAs into four categories: bilateral agreements (56.6 per cent of the agreements in the World Bank's database are of this kind), plurilateral agreements (13.3 per cent), agreements consisting in the adhesion of a country to an existing PTA (5 per cent), and agreements between an existing PTA and a country or between two existing PTAs (25.1 per cent).

3. Results

As suggested by the structural gravity theory of international trade, the proper estimation of the gravity equation requires data not only on international trade flows but also on intra-national trade flows (Yotov, 2022). However, as a benchmark and for comparison purposes with previous studies that do not include domestic trade flows, we begin with the estimation of the overall effect of PTAs on trade, as well as their effects by type of agreements, using a restricted sample with international trade flows only. Likewise, for comparison purposes with previous work, we initially estimate the model without considering common globalization effects. Then, we first carry out the estimations using both domestic and international trade flows, and then we further add controls for global trends in international trade through the inclusion of the $INTER_{ij,t}$ dummies (defined as the product of the year dummies, D_t, and the time invariant binary variable $INTER_{ij}$).

It is worth pointing out that in all the specifications of the gravity model in this paper the dependent variable is defined in levels, and that we use the PPML estimator with exporter- and importer-time fixed effects as well as country-pair time-invariant fixed effects, which constitutes the best estimator and specification to obtain unbiased and theory-consistent estimates (even when we only rely on international trade flows, i.e., with no intra-national trade flows).

The estimation results for the overall PTA effect on trade using only international trade flows appear in column 1 of Table 1. The point estimates for both PTAs and GATT/WTO are very close to zero and the estimated coefficients of both variables are not statistically significant at conventional levels. The lack of a positive and significant effect is consistent with the results found by and Larch et al. (2019) and Esteve-Pérez et al. (2020b) for similar sample periods (1980–2016 and 1983–2013, respectively) in those specifications for which the authors only include international trade flows.[12] The next three columns of Table 1 present the results when we classify the agreements according to the following criteria: (i) by their geographical scope, distinguishing between regional and interregional agreements (column 2); (ii) by the income level of the trading partners, grouping them as North–North, North–South and South–South (column 3); and, (iii) by their "nature", splitting them into bilateral (e.g., Canada-Peru), plurilateral (e.g., ASEAN), whether they consist of the adhesion of a country to an existing PTA (e.g., EC enlargements), and agreements between an existing PTA and a country (e.g., ASEAN-Korea) or between two existing PTAs (e.g., EC-CARIFORUM).[13]

In line with the overall result (pooled PTAs in col. 1), when we split PTAs according to their regional scope, the point estimates are smaller in magnitude, and they are not statistically significant. These results contrast with those reported by Gil-Pareja et al. (2012), who conclude that both continental and intercontinental trade agreements boost trade. However, it is worth noting that these authors estimate a log-linear version of the gravity equation, and therefore do not deal for both heteroskedastic residuals and the presence of zeros in bilateral trade flows, which may lead to biased estimates.

[12] Larch et al. (2018), in their study about the trade effects of joining the euro, also find that the effect of the euro and of PTAs are both economically and statistically insignificant when the results are obtained only with data on international trade flows.

[13] Table A.1 of Appendix presents summary statistics for each one of the variables (GATT/WTO, PTA and PTAs by type of agreement).

Table 1
The impact on trade of preferential trade agreements by type of agreement. PPML estimates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	International trade only				International and intra-national trade			
PTA	0.046				0.544			
	(0.039)				(0.048)***			
GATT/WTO	0.058	0.058	0.060	0.061	0.570	0.567	0.567	0.595
	(0.069)	(0.069)	(0.070)	(0.070)	(0.068)***	(0.068)***	(0.069)***	(0.061)***
Regional PTA		0.068				0.579		
		(0.053)				(0.064)***		
Interregional PTA		0.015				0.500		
		(0.047)				(0.074)***		
N-N PTA			0.005				0.376	
			(0.043)				(0.045)***	
N-S PTA			0.051				0.597	
			(0.045)				(0.050)***	
S-S PTA			0.143				0.558	
			(0.036)***				(0.046)***	
Bilateral PTA				−0.057				0.185
				(0.067)				(0.077)**
Plurilateral PTA				0.176				0.700
				(0.039)***				(0.058)***
PTA-Country				0.111				0.886
(enlargement)				(0.032)***				(0.054)***
PTA-PTA/Country				0.062				0.395
(new agreement)				(0.034)*				(0.033)***
Constant	22.934	22.928	22.931	22.903	26.011	26.009	26.012	25.976
	(0.064)***	(0.065)***	(0.064)***	(0.063)***	(0.022)***	(0.023)***	(0.022)***	(0.019)***
No observations	891 698	891 698	891 698	891 698	895 255	895 255	895 255	895 255

Notes. The regressand is the value of bilateral exports (for columns 1 to 4) and the value of bilateral exports plus domestic trade flows (for columns 5 to 8), measured by dyad-year. Robust standard errors, clustered by dyad are in parentheses. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. All regressions include country-pair fixed effects, as well as exporter-time and importer-time fixed effects. The fixed effects are not reported for brevity. The sample includes annual data for consecutive years over the period 1980–2015.

With regard to the effect by income levels (column 3), we only find a positive and moderate effect for South–South agreements. Again, the difference with the results reported by Behar and Cirera-i-Crivillé (2013), who find a positive effect in all three groups but particularly in South–South PTAs, can be partly explained because these authors also estimate log-linear specifications of the gravity equation. Finally, in line with Cháfer et al. (2022)'s results on a sample that covers 211 countries and territories over the period 1948–2013, we find that bilateral agreements have no significant effect on trade, whereas plurilateral agreements show the highest pro-enhancing trade effects. The other two types of PTAs also have a moderate positive impact on trade. This similarity in the results with those reported by Cháfer et al. (2022) is expected because these authors also use the PPML estimator with the three sets of fixed effects (exporter-time, importer-time and country-pair fixed effects).

Next, we are going to check how the inclusion of both international and intra-national trade flows observations affects the results (columns 5 to 8 of Table 1). Interestingly, the picture that emerges substantially changes when we estimate a fully grounded-in-theory gravity model including internal trade. Again, in line with the previously cited papers by Larch et al. (2018, 2019) and Esteve-Pérez et al. (2020b), once intra-national trade flows are introduced, we obtain a positive (0.544) and highly statistically estimate for the partial trade effect of PTAs. Regarding the estimates for the GATT/WTO variable, the point estimate is also positive and highly statistically significant, which is also consistent with Larch et al. (2019), and similar in magnitude (0.570) to that found for our point estimate of the PTA variable.

In accordance with the change in the overall PTAs effect when we consider domestic (in addition to international) trade flows, the analysis of the results by type of agreements (columns 6 to 8) also reveals significant differences with respect to those reported in columns 2 to 4. On the one hand, both regional and interregional trade agreements have a positive and statistically significant effect (the estimated coefficients are 0.579 and 0.500, respectively) and the difference between the estimated coefficients is not statistically significant at conventional levels. On the other hand, the three types of trade agreements according to the income levels of their members boost bilateral trade, especially the agreements that include developing countries. Yet, the difference in the estimated coefficients for *N-S PTAs* (0.597) and *S-S PTAs* (0.559) is not statistically significant. Finally, along with the increase in the estimated coefficients of the variables for plurilateral PTAs, for enlargements of existing PTAs (which shows the largest estimated coefficient), and for new agreements in which participate PTAs already in force (with another PTA or with another country), the inclusion of domestic flows also unveils a positive and significant coefficient for the bilateral PTAs.

Importantly, the results reported in Table 1 are obtained without including the set of time-varying border dummy variables ($INTER_{ij,t}$) that Bergstrand et al. (2015) propose to account for common globalization effects. We have done so to properly compare (without no other differences in the specification) the results obtained when we exclude domestic trade

Table 2
The impact on trade of preferential trade agreements by type of agreement with globalization trends. PPML estimates.

	(1)	(2)	(3)	(4)
PTA	0.198 (0.035)***			
GATT/WTO	0.265 (0.054)***	0.256 (0.054)***	0.268 (0.055)***	0.288 (0.049)***
Regional PTA		0.278 (0.048)***		
Interregional PTA		0.089 (0.044)**		
N-N PTA			0.073 (0.039)*	
N-S PTA			0.229 (0.038)***	
S-S PTA			0.370 (0.037)***	
Bilateral PTA				−0.019 (0.060)
Plurilateral PTA				0.250 (0.043)***
PTA-Country (enlargement)				0.411 (0.045)***
PTA-PTA/Country (new agreement)				0.170 (0.033)***
INTL_BRDR_1980	−1.150 (0.052)***	−1.154 (0.052)***	−1.109 (0.051)***	−1.120 (0.051)***
INTL_BRDR_1981	−1.124 (0.051)***	−1.130 (0.052)***	−1.126 (0.051)***	−1.097 (0.049)***
INTL_BRDR_1982	−1.146 (0.050)***	−1.150 (0.051)***	−1.147 (0.051)***	−1.117 (0.049)***
INTL_BRDR_1983	−1.103 (0.050)***	−1.109 (0.050)***	−1.103 (0.050)***	−1.075 (0.048)***
INTL_BRDR_1984	−1.020 (0.051)***	−1.030 (0.052)***	−1.016 (0.052)***	−0.992 (0.050)***
INTL_BRDR_1985	−0.985 (0.053)***	−0.995 (0.054)***	−0.982 (0.053)***	−0.955 (0.051)***
INTL_BRDR_1986	−1.028 (0.050)***	−1.037 (0.050)***	−1.028 (0.050)***	−1.001 (0.048)***
INTL_BRDR_1987	−1.003 (0.050)***	−1.011 (0.050)***	−1.004 (0.050)***	−0.975 (0.049)***
INTL_BRDR_1988	−0.921 (0.049)***	−0.930 (0.049)***	−0.922 (0.050)***	−0.896 (0.048)***
INTL_BRDR_1989	−0.858 (0.052)***	−0.867 (0.053)***	−0.857 (0.052)***	−0.833 (0.051)***
INTL_BRDR_1990	−0.728 (0.046)***	−0.736 (0.046)***	−0.727 (0.047)***	−0.705 (0.045)***
INTL_BRDR_1991	−0.714 (0.046)***	−0.723 (0.046)***	−0.714 (0.046)***	−0.693 (0.045)***
INTL_BRDR_1992	−0.704 (0.045)***	−0.713 (0.045)***	−0.705 (0.046)***	−0.684 (0.044)***
INTL_BRDR_1993	−0.660 (0.047)***	−0.670 (0.046)***	−0.659 (0.047)***	−0.642 (0.046)***
INTL_BRDR_1994	−0.591 (0.043)***	−0.593 (0.044)***	−0.587 (0.043)***	−0.594 (0.043)***
INTL_BRDR_1995	−0.562 (0.046)***	−0.563 (0.046)***	−0.522 (0.044)***	−0.564 (0.045)***
INTL_BRDR_1996	−0.549 (0.045)***	−0.551 (0.045)***	−0.510 (0.043)***	−0.551 (0.044)***
INTL_BRDR_1997	−0.431 (0.042)***	−0.432 (0.042)***	−0.394 (0.039)***	−0.433 (0.041)***
INTL_BRDR_1998	−0.359 (0.039)***	−0.360 (0.040)***	−0.320 (0.037)***	−0.36 0(0.039)***
INTL_BRDR_1999	−0.360 (0.040)***	−0.361 (0.041)***	−0.322 (0.038)***	−0.362 (0.040)***
INTL_BRDR_2000	−0.202 (0.041)***	−0.202 (0.041)***	−0.167 (0.038)***	−0.204 (0.040)***
INTL_BRDR_2001	−0.213 (0.034)***	−0.212 (0.034)***	−0.178 (0.031)***	−0.216 (0.033)***
INTL_BRDR_2002	−0.205 (0.036)***	−0.204 (0.037)***	−0.169 (0.034)***	−0.207 (0.036)***
INTL_BRDR_2003	−0.231 (0.039)***	−0.229 (0.039)***	−0.194 (0.036)***	−0.233 (0.038)***
INTL_BRDR_2004	−0.180 (0.036)***	−0.181 (0.036)***	−0.183 (0.036)***	−0.189 (0.036)***
INTL_BRDR_2005	−0.145 (0.034)***	−0.147 (0.034)***	−0.149 (0.034)***	−0.152 (0.034)***
INTL_BRDR_2006	−0.079 (0.032)**	−0.081 (0.032)**	−0.083 (0.032)***	−0.085 (0.032)***
INTL_BRDR_2007	−0.088 (0.033)***	−0.091 (0.033)***	−0.093 (0.033)***	−0.095 (0.033)***
INTL_BRDR_2008	−0.057 (0.027)**	−0.061 (0.027)**	−0.062 (0.028)**	−0.066 (0.028)**
INTL_BRDR_2009	−0.144 (0.022)***	−0.147 (0.022)***	−0.148 (0.022)***	−0.151 (0.022)***
INTL_BRDR_2010	−0.069 (0.021)***	−0.073 (0.021)***	−0.073 (0.021)***	−0.075 (0.021)***
INTL_BRDR_2011	−0.019 (0.019)	−0.022 (0.019)	−0.022 (0.019)	−0.025 (0.019)
INTL_BRDR_2012	−0.020 (0.015)	−0.021 (0.015)	−0.020 (0.015)	−0.021 (0.015)
INTL_BRDR_2013	−0.024 (0.012)**	−0.025 (0.012)**	−0.025 (0.012)**	−0.027 (0.012)**
INTL_BRDR_2014	−0.017 (0.008)**	−0.017 (0.009)*	−0.017 (0.009)**	−0.019 (0.009)**
Constant	26.224 (0.021)***	26.221 (0.022)***	26.220 (0.022)***	26.201 (0.019)***
No observations	895 255	895 255	895 255	895 255

Notes. The regressand is the value of bilateral exports plus domestic trade flows, measured by dyad-year. Robust standard errors, clustered by dyad are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. All regressions include country-pair fixed effects, as well as exporter-time and importer time-fixed effects. The fixed effects are not reported for brevity. INTL_BRDR_i stands for international border dummy variables for years i = 1980…2014. The international border dummy for 2015 (INTL_BRDR_2015) is omitted (reference group) to avoid perfect collinearity. The sample includes annual data for consecutive years over the period 1980–2015.

flows to those obtained if they are considered. Indeed, we cannot obtain estimates of the time-varying *INTER* variables from a sample that does not include intra-national trade. The results including the time-varying dummies for international trade are displayed in Table 2.[14] It is worth noting that, consistent with the estimates reported by Bergstrand et al. (2015) and Larch et al. (2019), the decreasing estimates in absolute values of the time-varying *INTER* variables capture the impact of globalization on international trade. Moreover, the inclusion of this set of $INTER_{ij,t}$ dummies has also an effect on our variables of interest. In this regard, four comments are in order. First, the magnitude of the estimated coefficients for both PTAs and GATT/WTO are lower but remain statistically significant at the 1 per cent level of statistical significance. Second,

[14] It is worth noting that due to perfect collinearity with the rest of the fixed effects included in the specification, it is impossible to estimate the international border dummies ($INTER_{ij,t}$) for all the years in the sample. For this reason, we removed the international border dummy for the year 2015 (INTL_BRDR_2015) from the specification. As a result, the estimated coefficients of the other international border dummy variables (INTL_BRDR_1980-INTL_BRDR_2014) must be interpreted relative to the corresponding estimate for 2015.

regional PTAs have a significantly larger effect than interregional PTAs on trade, although we find that both of them boost trade. Third, S-S PTAs show the largest positive effect on trade, N-S PTAs has the second largest and then, N-N PTAs has a much lower effect on trade. Besides, the latter estimate is statistically significant only at the 10 per cent level. Finally, once globalization trends are introduced, the coefficients for plurilateral PTAs, enlargements of existing PTAs, and new agreements in which participate PTAs already in force remain positive and statistically significant, while the coefficient for the bilateral PTAs turns out to be statistically non-significant. Again, the dummy for enlargements of existing PTAs shows the largest estimated coefficient.[15]

Following Egger et al. (2022) suggestion, in Table 3 we include leads and lags of PTAs to account for possible reverse causality between trade agreements and trade flows, and to capture the possibility that the impact on trade changes over time, respectively (specification 2). We include one- to two-year leads and lags. Compared with Table 2, the results do not change in any significant way. In line with those results, and with the only exception of bilateral agreements, the contemporaneous effect of our variables of interest are positive and statistically significant for the different types of trade agreements Additionally, even though the estimated coefficients are slightly lower, the relative magnitude of the estimated coefficients within the alternative groupings remains unaltered. The cumulative effects (calculated as the sum of contemporaneous and lagged effects) are all positive and statistically significant, except for bilateral agreements, and again, the relative size of the estimated coefficients remains unaltered in all cases. The relatively high values indicate that the cumulative effects of PTAs are higher than the contemporaneous effects in all cases, with the exceptions of North–North and bilateral agreements. Moreover, we find a positive and statistically significant coefficient for the two-year lead for South–South PTAs and for the one-year lead of plurilateral PTAs. This may point towards an endogeneity problem if the agreement is signed to enhance trade flows between countries when such flows are previously established, or it may capture a possible anticipation effect if trade increases in anticipation of the agreement.

To consider a longer period of time for phase-in effects of trade agreements, we estimate the effect of additional lagged effects (up to eight years) of the PTAs' variables. Their cumulative effects are reported in Table 4. Interestingly, the results are similar to those obtained with our previous specifications. The only difference is that North–North agreements do not exhibit a significant coefficient.

As a robustness check, Table 5 replicates the estimations reported in Table 2 with data at five-year intervals spanning 8 years (1980, 1985, …, 2015). Considering data at intervals has been commonly used in the gravity equation literature of international trade to address the concern raised by Trefler (2004) and Cheng and Wall (2005) regarding the time required for the dependent and independent variables to adjust to trade policy fluctuations. As we can see, all the conclusions remain unaltered when we use data at five-year intervals.[16]

4. Conclusions

This paper re-examines the potential differential effect of different types of PTAs on trade. We estimate theory-grounded specifications of the gravity equation using domestic trade flows in addition to international trade flows. We estimate state-of-the-art gravity equations that follow all best practices and recommendations for estimating gravity equations as suggested by Yotov et al. (2016) and Yotov (2022). These best practices include, in addition to consider theory-motivated intra-national trade flows, the use panel data techniques (to account for unobserved bilateral heterogeneity and endogeneity), the inclusion of controls for multilateral resistance terms, and the use of the PPML estimator to deal with econometric problems resulting from heteroskedastic residuals and zero trade flows. Moreover, the inclusion of domestic trade flows allows us to control for general globalization trends and to more accurately estimate the actual impact of PTAs on bilateral trade once we control for any possible decline in unobservable bilateral trade costs that may have increased international relative to intranational trade. Last, but not least, our empirical strategy also pays attention to dynamic adjustment processes which are important to grasp the overall impact of trade agreements on trade.

Our results suggest that previous estimates of PTAs' partial effects are probably biased due to the non-inclusion of domestic trade in the analysis. Once we both include domestic trade flows and control for general globalization trends, some interesting results stand out. First, we find that both PTAs and GATT/WTO have a positive effect on bilateral trade. Second, according to the geographical scope of the agreements, we find that regional PTAs have a significantly larger effect on bilateral trade than interregional PTAs, even though both boost trade. Third, South–South PTAs show the largest impact, followed by North–South PTAs and then, but at a greater distance, North–North PTAs. Finally, once globalization trends are introduced, the initially reported positive effect of bilateral agreements vanishes. This result has clear and important policy implications given the remarkable proliferation of bilateral trade agreements over the last two-three decades, which have gained ground on plurilateral ones. Moreover, the results are robust to both considering the existence of a dynamic adjustment process by including different leads and lags of the PTAs' variables, which help capture anticipation and phasing-in effects and address endogeneity issues, and to using data at time-intervals, rather than pooled over consecutive years.

[15] Following the suggestion of one reviewer, as an alternative way to capture globalization trends through the inclusion of the set of time-varying border dummies, we have instead included a linear time trend interacted with the international border dummy. The results remain qualitatively and quantitatively unaltered and are available from the authors upon request.

[16] We have also estimated the gravity equations with data at three-year intervals and the results do not change in any significant way.

Table 3
The impact on trade of preferential trade agreements by type of agreement with globalization trends and dynamic adjustment process. PPML estimates.

GATT/WTO	t	(1)	(2)	(3)	(4)
		0.270 (0.054)***	0.261 (0.055)***	0.271 (0.056)***	0.299 (0.049)***
	t + 2	−0.0154 (0.017)			
	t + 1	−0.005 (0.006)			
PTA	t	0.142 (0.025)***			
	t − 1	0.045 (0.015)***			
	t − 2	0.039 (0.025)			
	Cumulative	**0.226 (0.039)*** **			
	t + 2		−0.031 (0.019)		
	t + 1		0.008 (0.007)		
Regional PTA	t		0.213 (0.035)***		
	t − 1		0.029 (0.009)***		
	t − 2		0.064 (0.064)***		
	Cumulative		**0.305 (0.054)*** **		
	t + 2		−0.032 (0.010)***		
	t + 1		−0.017 (0.025)		
Interregional PTA	t		0.058 (0.032)***		
	t − 1		0.073 (0.036)**		
	t − 2		−0.018 (0.044)		
	Cumulative		**0.112 (0.045)** **		
	t + 2			−0.016 (0.008)*	
	t + 1			−0.040 (0.024)*	
N-N PTA	t			0.113 (0.027)***	
	t − 1			0.016 (0.022)	
	t − 2			−0.031 (0.031)	
	Cumulative			**0.098 (0.043)** **	
	t + 2			−0.013 (0.007)*	
	t + 1			0.002 (0.017)	
N-S PTA	t			0.155 (0.025)***	
	t − 1			0.051 (0.015)***	
	t − 2			0.046 (0.028)	
	Cumulative			**0.251 (0.044)*** **	
	t + 2			0.049 (0.015)***	
	t + 1			0.048 (0.029)	
S-S PTA	t			0.192 (0.034)***	
	t − 1			0.067 (0.022)**	
	t − 2			0.081 (0.032)**	
	Cumulative			**0.340 (0.046)*** **	
	t + 2				−0.023 (0.011)**
	t + 1				−0.034 (0.024)
Bilateral PTA	t				0.022 (0.027)
	t − 1				0.037 (0.018)*
	t − 2				−0.065 (0.044)
	Cumulative				**−0.007 (0.067)**
	t + 2				−0.002 (0.015)
	t + 1				0.069 (0.024)***
Plurilateral PTA	t				0.184 (0.030)***
	t − 1				0.035 (0.022)
	t − 2				−0.007 (0.039)
	Cumulative				**0.212 (0.062)*** **
	t + 2				−0.001 (0.011)
	t + 1				−0.088 (0.024)***
PTA-Country	t				0.369 (0.036)***
(enlargement)	t − 1				0.019 (0.010)*
	t − 2				0.104 (0.022)***
	Cumulative				**0.492 (0.050)*** **
	t + 2				−0.003 (0.009)
	t + 1				0.016 (0.019)
PTA/Country	t				0.113 (0.024)***
(new agreement)	t − 1				0.064 (0.029)**
	t − 2				0.006 (0.032)

(*continued on next page*)

Table 3 (*continued*).

GATT/WTO	t	(1)	(2)	(3)	(4)
		0.270 (0.054)***	0.261 (0.055)***	0.271 (0.056)***	0.299 (0.049)***
	Cumulative				**0.183 (0.033)*** **
No observations		895 255	895 255	895 255	895 255

Notes. The regressand is the value of bilateral exports plus domestic trade flows, measured by dyad-year. Robust standard errors, clustered by dyad are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. All regressions include country-pair fixed effects, as well as exporter-time and importer-time fixed effects. The fixed effects, time-varying international border dummy variables and constant term are not reported for brevity. The international border dummy for 2015 (INTL_BRDR_2015) is omitted (reference group) to avoid perfect collinearity. The sample includes annual data for consecutive years over the period 1980–2015.

Table 4
Cumulative effects of preferential trade agreements on trade by type of agreement with globalization trends (8-year leads and lags). PPML estimates.

	(1)	(2)	(3)	(4)
PTA	0.217 (0.045)***			
Regional PTA		0.306 (0.060)***		
Interregional PTA		0.096 (0.048)**		
N-N PTA			−0.027 (0.053)	
N-S PTA			0.292 (0.055)***	
S-S PTA			0.481 (0.066)***	
Bilateral PTA				−0.205 (0.126)
Plurilateral PTA				0.258 (0.054)***
PTA-Country (enlargement)				0.469 (0.054)***
PTA-PTA/Country (new agreement)				0.252 (0.044)***
No observations	895 255	895 255	895 255	895 255

Notes. The regressand is the value of bilateral exports plus domestic trade flows, measured by dyad-year. Robust standard errors, clustered by dyad are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. All regressions include country-pair fixed effects, as well as exporter-time and importer-time fixed effects. The fixed effects, time-varying international border dummy variables and constant term are not reported for brevity. The border dummy for 2015 (INTL_BRDR_2015) is omitted (reference group) to avoid perfect collinearity. The sample includes annual data for consecutive years over the period 1980–2015.

Table 5
The impact on trade of preferential trade agreements by type of agreement with globalization trends. PPML estimates at 5-year intervals.

	(1)	(2)	(3)	(4)
PTA	0.230 (0.037)***			
GATT/WTO	0.199 (0.052)***	0.194 (0.053)***	0.209 (0.055)***	0.224 (0.047)***
Regional PTA		0.302 (0.051)***		
Interregional PTA		0.131 (0.048)***		
N-N PTA			0.100 (0.042)**	
N-S PTA			0.272 (0.042)***	
S-S PTA			0.440 (0.047)***	
Bilateral PTA				−0.012 (0.064)
Plurilateral PTA				0.317 (0.053)***
PTA-Country (enlargement)				0.466 (0.049)***
PTA-PTA/Country (new agreement)				0.191 (0.035)***
INTL_BRDR_1980	−1.165 (0.052)***	−1.167 (0.052)***	−1.115 (0.050)***	−1.130 (0.050)***
INTL_BRDR_1985	−1.001 (0.053)***	−1.009 (0.053)***	−0.993 (0.053)***	−0.964 (0.050)***
INTL_BRDR_1990	−0.741 (0.046)***	−0.748 (0.046)***	−0.736 (0.047)***	−0.714 (0.045)***
INTL_BRDR_1995	−0.573 (0.046)***	−0.574 (0.046)***	−0.528 (0.043)***	−0.577 (0.045)***
INTL_BRDR_2000	−0.216 (0.041)***	−0.216 (0.041)***	−0.175 (0.037)***	−0.218 (0.040)***
INTL_BRDR_2005	−0.154 (0.033)***	−0.156 (0.034)***	−0.158 (0.034)***	−0.162 (0.034)***
INTL_BRDR_2010	−0.075 (0.021)***	−0.079 (0.021)***	−0.079 (0.021)***	−0.082 (0.021)***
Constant	26.307 (0.021)***	26.304 (0.022)***	26.299 (0.021)***	26.281 (0.019)***
No observations	190 986	190 986	190 986	190 986

Notes. The regressand is the value of bilateral exports plus domestic trade flows, measured by dyad-year. Robust standard errors, clustered by dyad are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. All regressions include country-pair fixed effects, as well as exporter-time and importer-time fixed effects. The fixed effects are not reported for brevity. INTL_BRDR_i stands for international border dummy variables for years i = 1980, 1985, 1990, 1995, 2000, 2005, 2010. The international border dummy for 2015 (INTL_BRDR_2015) is omitted (reference group) to avoid perfect collinearity. The sample includes data at five year-intervals over the period 1980–2015.

Table A.1
Summary statistics.

	Mean	Overall Std. Dev.	Between Std. Dev.	Within Std. Dev.	Number of 1's in the sample		
					1980	2000	2015
GATT/WTO	0.5045	0.5000	0.4410	0.2436	4166	17 286	19 040
PTA	0.0777	0.2677	0.1919	0.1721	198	1844	5182
Regional PTA	0.0408	0.1978	0.1607	0.1017	182	1384	1594
Interreg. PTA	0.0369	0.1886	0.1055	0.1492	16	462	3590
N-N PTA	0.0113	0.1055	0.0702	0.0642	146	372	500
N-S PTA	0.0400	1.1958	0.1129	0.1503	18	460	3624
S-S PTA	0.0265	0.1606	0.1413	0.0739	34	1014	1060
Bilateral PTA	0.0030	0.0542	0.0356	0.0382	2	64	244
Plurilat. PTA	0.0300	0.1705	0.1440	0.0853	64	1214	1118
PTA Country (enlargement)	0.0154	0.1233	0.0788	0.0766	68	270	892
PTA-PTA/Country (new agreement)	0.0294	0.1688	0.0975	01321	64	298	2930

Note: All the variables are dummy variables. Number of observations: 895 255 over the period 1980–2015.

Appendix

See Table A.1.

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