

Research Article

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Exploring the Heterogeneous Impact of Trade Agreements on Trade: Depth Matters

<https://doi.org/10.1515/econ-2022-0064>

received September 16, 2023; accepted December 22, 2023

Abstract: One of the most relevant features in the context of international trade in recent decades is the increase in the depth of trade agreements. The aim of this article is to explore the heterogeneous effect of preferential trade agreements (PTAs) on bilateral trade flows including their depth in addition to other agreement characteristics such as the geographical scope of the member countries, their degree of development, or their nature. To measure depth, we follow the most recent works that propose indirect instead of direct measures. Once we control for depth, our results reveal that (i) the positive effect of regional PTAs is notably larger for deep agreements whereas the shallow interregional agreements do not seem to increase bilateral trade flows; (ii) North–North PTAs only boost trade when they exhibit a high depth level; and (iii) the depth is not a relevant factor for plurilateral agreements and those that consist of the adhesion of a country to an existent PTA.

Keywords: Intra- and international trade flows, deep trade agreements, gravity models

1 Introduction

Undoubtedly, one of the most relevant features in the context of international trade in recent decades is the increase in the number and depth of trade agreements, so that they extend beyond traditional trade areas and cover new aspects such as services, investment, and competition policy (Ruta, 2017). The expansion of agreement scope is clear attending to the number of policy areas covered: in the 1950s, the average preferential trade agreement (PTA) covered eight policy areas

whereas in recent years they have averaged 17 (Mattoo et al., 2020).¹ The existence of differences in the scope and the level of integration commitments between the agreement parties introduces a new source of heterogeneity in the impact of agreements on trade. This is a topic that has already been addressed in the literature. Seminal empirical studies explored the impact of the depth of trade agreements using their level of economic integration based on the traditional definition by Frankel et al. (1997) as a depth measure.²

However, this area of research has received a renovated interest after the development of databases on the depth of trade agreements. This literature points out that controlling for the depth of trade agreements is required for a proper quantification of the trade effects of trade agreements. The aim of this article is to study the heterogeneous effect of trade agreements on bilateral trade flows over the period 1980–2015 through the estimation of a gravity equation including the depth of trade agreements in addition to other characteristics that define the type of agreement (their geographical scope of the member countries, their degree of development, or their nature). To measure the depth, we follow the most recent works that propose indirect instead of direct measures.

To the best of our knowledge, we are the first to implement such an approach for exploring the existence of sizeable different effects of trade agreements on trade depending on both the depth of the agreement and other agreement

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¹ The expression PTA in this article refers to several types of trade agreements including, according to the WTO classification, Customs Unions, Free Trade Agreements, Partial Scope Agreements, Economic Integration Agreements, Free Trade Agreements & Economic Integration Agreements, and Customs Unions & Economic Integration Agreements.

² Magee (2008) and Roy (2010) found that customs unions had larger aggregate trade flow effects than free trade agreements. Baier et al. (2014, 2018) found that more comprehensive trade agreements such as customs unions, common markets, and economic unions have larger trade effects than free trade agreements, and the latter have larger effects than two-way and one-way preferential trade agreements. These last two works also provided evidence of the differential (partial) effects of those types of Economic Integration Agreements (EIAs) on both intensive and extensive margins of trade.

characteristics. This research goes a step further than Díaz-Mora *et al.* (2023) where only those other agreement characteristics are included as a source of heterogeneity, but not depth. Moreover, our empirical analysis implements 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 considering theory-motivated intra-national as well as international 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 Poisson Pseudo Maximum Likelihood (PPML) estimator to deal with econometric problems resulting from heteroskedastic residuals and the prevalence of zeros in bilateral trade flows.

To preview our results, using information from the World Bank Deep Trade Agreements database 2.0 and indirect measures of depth proposed by Breinlich *et al.* (2021) and Fontagné *et al.* (2021) to classify PTAs, we find that the depth of the agreements is also a source of heterogeneity when the impact of different types of agreements on trade flows is taken into account. In particular, we find that (i) the positive effect of regional PTAs is notably larger for the deepest agreements whereas the shallow inter-regional agreements do not seem to increase bilateral trade flows; (ii) North–North PTAs only boost trade when they exhibit a high depth level; (iii) the depth is not a relevant factor for plurilateral agreements and those that consist of the adhesion of a country to an existent PTA.

The remainder of the article is organized as follows. After this Introduction section, Section 2 briefly reviews the literature on the effect of deep trade agreements on bilateral trade flows. Section 3 outlines the empirical methodology and describes the data sources. Section 4 presents and discusses the main findings of the empirical model. Section 5 concludes.

2 Literature Review

As mentioned in the introduction section, advances in this topic have been hand in hand with the development of new databases that capture the agreements' depth. Considering that deep trade agreements cover heterogeneous areas and many provisions, the quantification of the effect of agreements' depth on trade flows is a challenge for researchers. The initial contributions rely on directly constructed indices that sum up the number of provisions and the individual or subjective assessment of the researchers of the key provisions in each policy area.

Among these initial contributions are Dür *et al.* (2014) and Hofmann *et al.* (2019). The former is based on one of the first databases named Design of Trade Agreements Database, which codifies trade agreements by including fine-grained data with information related to 17 cooperation areas.³ The authors used two depth indicators which are highly correlated: an additive index that combines the seven provisions that these authors consider key in deep trade agreements and a synthetic index using a type of factorial analysis (latent trait analysis) on a total of 48 variables that are theoretically related to the depth of an agreement but with different importance in establishing the extent of countries' commitments. When these variables of depth for 536 PTAs signed between 1945 and 2009 are included in a gravity model to explain bilateral merchandise trade for 179 countries, they found positive and statistically significant at the 1% level coefficients, confirming that the deeper an agreement is, the larger its effect on trade flows between member countries.

Later, Hofmann *et al.* (2017) developed the World Bank Deep Trade Agreements Database 1.0 which was based on the methodology of Horn *et al.* (2010) and Kohl *et al.* (2016). This data set documented the scope of trade agreements by mapping the inclusion (and legal applicability) of 52 selected policy areas in 279 PTAs notified at WTO signed between 1958 and 2015. The changing coverage of PTAs is referred to as horizontal depth. The 52 policy areas covered comprise two groups of provisions: 14 WTO "plus" or WTO + which are those included in the current mandate of the WTO and are already subject to some type of commitment in the WTO agreements, such as tariffs, customs regulations, export taxes, anti-dumping measures, compensatory, technical barriers to trade, or sanitary and phytosanitary standards; and 38 WTO "extra" or WTO-X areas, which are those that are outside the current mandate of the WTO, such as investment policy, competition, environment or nuclear safety. Based on this data set, several research studies construct various measures of depth and their effect on trade using a gravity model (Ahcar & Siroën, 2017; Boffa *et al.*, 2019; Dhingra *et al.*, 2023; Falvey & Foster-McGregor, 2022; Kohl *et al.*, 2016; Laget *et al.*, 2020; Hofmann *et al.*, 2019; Rubínová, 2017). Their findings confirm that trade agreement heterogeneity matters for international trade and deeper, rather than shallow RTAs

³ Market access, services, global value chains, investments, temporary entry of business persons, intellectual property rights, competition, public procurement, technical barriers to trade, sanitary and phytosanitary measures, regulatory co-operation and transparency, trade defence instruments, e-commerce, data flows, capital movement and exchanges rates, non-trade issues, and dispute resolution.

promote trade. That is, the extensive margin of integration (defined as the number of policy areas that are covered by the agreement) has a positive effect on trade creation.

More recently, the development of a new database, the Deep Trade Agreements Database 2.0, has stimulated research to better quantify the impact of deep trade agreements on trade flows. This database provides detailed information on the content of a sub-sample of 18 policy areas most frequently covered in a set of 283 agreements currently notified to the WTO between 1958 and 2017 (Mattoo et al., 2020). Policy areas differ widely from each other in complexity and, consequently, in the number of provisions each comprises, the total number of provisions being 937. That is, trade agreements can include the same policy areas but different provisions within each policy area. Therefore, this database allows researchers to explore the impact on trade flows not on the number of policy areas that are covered by the agreement (extensive margin of integration), but on the specific commitments within a policy area (intensive margin of integration). This detailed coverage of policy areas is referred to as vertical depth. Based on the experts' knowledge, Mattoo et al. (2020) identify the set of provisions within each policy area that are essential to achieve the objectives of the agreement and the non-essential provisions that are referred to as "corollary."

Using Deep Trade Agreements Database 2.0, a few studies have employed indirectly estimated measures relying on new statistical methods such as machine learning to restrict the number of provisions and better identify those provisions more effectively to promote international trade. These works are those of Baier and Regmi (2023), Breinlich et al. (2021), and Fontagné et al. (2021). The first one employs an unsupervised learning method such as k-means clustering to identify the clusters of provisions that are typically grouped together and then classify trade agreements into different clusters. Detailed information on each treaty is taken from the NSF-Kellogg Institute EIA (economic integration agreement) database. Given the provision scores for each of the clusters, they can be classified into shallower agreements (those with lower provision scores) and deeper agreements (those with higher provision scores). Later, by running a gravity model with exporter-time, importer-time, and pair fixed effects (often called the three-way gravity model) using data from Comtrade for the period 1970–2014, these authors find that deeper agreements result in larger estimates of the impact of trade agreements. Moreover, by looking at the prominent provisions in the deepest cluster, 18 provisions are identified as those most successful in trade creation.

Breinlich et al. (2021) complement the approach adopted by Baier and Regmi (2023) by selecting the provisions using a

supervised method that also considers the impact of the provisions on trade. More precisely, these authors propose to adapt a specific matching learning technique – the least absolute shrinkage and selection operator (Lasso) – to the context of trade agreements. They first specify a three-way panel data gravity to be estimated in its original nonlinear form using PPML. Data come from Comtrade and comprise merchandise trade flows for the period 1964 to 2016. Including a large number of provisions as covariates implies a high dimensionality that, combined with the relatively small number of PTAs, leads to implausibly large and uninterpretable estimates due to multicollinearity. To reduce the number of provisions, these authors use the lasso technique to shrink the impacts of individual provisions toward zero and progressively remove those that do not have a significant effect on the fit of the model. More precisely, they adopt a penalized regression approach that involves appending a penalty term to the Poisson pseudo-likelihood one would use to estimate the unpenalized gravity model. The higher this penalty term, the higher the variables forced to have zero coefficients and the fewer the variables that are selected which should be those with the strongest effect. Using this technique, the authors select six essential provisions (among the total 303 essential provisions from the World Bank Deep Trade Agreements database 2.0) that are associated with strong increases in trade flows. They are related to anti-dumping, competition policy, technical barriers to trade, and trade-facilitation procedures. However, the authors argue that the selection of these provisions could be due to the fact that they are included in agreements together with other provisions that are the real responsible for the increase in trade flows. For that reason, in the second step, the authors identify those other provisions which are related to each of the selected provisions in the first step. They term this novel methodology "iceberg lasso." The additional set of provisions that may be associated with enhancing the trade-increasing effect of trade agreements comprises 43 provisions.

An additional article that explores the trade impacts of trade agreements focusing on the provisions they contain using the World Bank Deep Trade Agreements database 2.0 is Fontagné et al. (2021). Like Baier and Regmi (2023), these authors rely on a clustering approach (specifically the iterative kmean++ algorithm developed by Arthur & Vassilvitskii, 2007) to identify groups of trade agreements based on their provisions' content. Three clusters are proposed in such a way that each group of trade agreements has a similar content of provisions by policy subject and is different from that of the other groups. The first cluster comprises 28 trade agreements, the second one 87, and the third 167. Thus, the diverse provisions contained in the

agreements may explain the heterogeneous trade effects of those agreements. To test it, in a second stage, the authors estimate the mean impact on trade of belonging to a trade agreement positioned in each of the three clusters using a three-way fixed effect panel PPML procedure of a gravity model. The trade flows data include both domestic and international manufacturing trade for the period 1982–2017, based on CEPII BACI and TradeProd databases combined with UNIDO INDSTAT2 2019. One of the clusters exhibits a statistically largest impact on trade, revealing the agreements included in it as the deepest agreements. The other two clusters obtain parameter estimates that are considerably lower and close to each other.

3 Methodology and Data

To quantify the impact of trade agreements depending on their depth and the type of the agreements, we rely on the structural gravity model. The gravity model has been extensively used to assess the effects of PTAs on bilateral trade flows (e.g., Anderson & Yotov, 2016; Ahcar & Siroën, 2017; Baier & Bergstrand, 2007; Baier *et al.*, 2014; Bergstrand *et al.*, 2015; Baier & Regmi, 2023).⁴ The empirical analysis is carried out following the latest developments both in theoretical and in empirical gravity literature, whose main features are sketched out below.

3.1 PPML Estimation of the Gravity Model

We estimate the gravity model in multiplicative form (instead of logarithmic form) using the PPML estimator proposed by Santos Silva and Tenreyro (2006). As pointed out by Larch and Yotov (2023), the introduction of the PPML estimator is one of the most influential empirical contributions to gravity literature. In particular, this estimator is the preferred option to deal with heteroskedasticity in trade data and to take advantage of the information that is contained in zero trade flows.⁵ Santos Silva and

Tenreyro (2022) explain that the PPML estimator outperforms other estimators for count data when the objective is to estimate a gravity equation since its consistency depends only on the gravity equation being correctly specified and not on incidental distributional assumptions, as happens when estimating gravity equations using, for example, the estimator for zero-inflated count data models. Another aspect pointed out by these authors is that in the context of count data models, most of the alternatives to Poisson regression lead to the so-called overdispersion, which implies that estimates obtained using these models are sensitive to the scale of the dependent variable and the units in which it is measured and therefore are arbitrary. This problem arises when using, for example, the negative binomial estimator or the zero-inflated models whose use has been recommended by some authors (e.g., Burger *et al.*, 2009; Kohl, 2015).

Moreover, Santos Silva and Tenreyro (2022) also note that, although some authors have claimed that PPML suffers from the incidental parameter problem when the model includes two sets of fixed effects (origin-time and destination-time fixed effects), the PPML is still consistent in this context, as shown by Fernández-Val and Weidner (2016). Furthermore, Weidner and Zylkin (2021) demonstrate that the consistency of the PPML estimator also holds when three sets of fixed effects (origin-time, destination-time, and pair-fixed effects) are included in the gravity model, as is usual since Baier and Bergstrand (2007). In fact, Weidner and Zylkin (2021) show that PPML is the only member of a family of pseudo maximum likelihood estimators that has this property.

However, it should be noted that the widespread use of the PPML estimator in studies that analyze large samples of countries and years has taken place only recently, as it has required the development of algorithms to solve the computational and convergence problems that exist in estimations with these types of samples.⁶ The existence of convergence problems was revealed from the beginning. In fact, Santos Silva and Tenreyro (2010) showed that PPML estimates could not exist if there is perfect collinearity for the subsample with positive observations of the dependent variable, which is common in trade data where some countries do not trade in certain years and/or sectors. Subsequently, Santos Silva and Tenreyro (2011) raised other

⁴ For a comprehensive review of the empirical literature on the effect of PTAs on trade, refer to the study by Limão (2016).

⁵ Santos Silva and Tenreyro (2006) challenged the long-established practice of estimating the gravity equation in their log-linearized form and proposed the use of the PPML estimator because it has two interesting properties when compared with the traditional log-linear gravity specifications. First, it avoids the statistical problems that arise from the existence of zero bilateral trade flows, since the gravity

equation in its log-linear specification is not defined for zero trade flows. Second, and most importantly, the PPML estimator solves econometric problems of both efficiency and consistency that emerge in the likely presence of heteroskedastic residuals.

⁶ The first article to use this estimator on a large sample of time and countries is Larch *et al.* (2019).

numerical issues that could lead to convergence problems and proposed a *ppml* Stata code, which implements the methods discussed by Santos Silva and Tenreyro (2010). More recently, Correia et al. (2019) revisited the problem and developed a refined version of the algorithm to detect the non-existence of the PPML estimates. This method and the corresponding solution to the problem of non-existence are implemented in their *ppmlhdfe* Stata command (Correia et al. 2020), whose algorithm greatly simplifies the estimation by PPML of models with multiple sets of high dimensional fixed effects (hdfe). Indeed, as noted by Santos Silva and Tenreyro (2022), the *ppmlhdfe* Stata command effectively deals with the non-existence problem, and therefore, nowadays, this is not a serious issue in empirical applications even with large panels.

Finally, as it is well known, the gravity equation provides a reliable way to evaluate not only the partial equilibrium effects but also the general equilibrium effects of trade policies by considering their effects through the multilateral resistance channels (Anderson & van Wincoop, 2003). The usual way to account for multilateral resistance terms in panel data sets is to include origin-time and destination-time fixed effects in the regressions. In this sense, it is worth noting that, as Fally (2015) demonstrates, when the gravity equation is estimated with PPML, the estimated exporter and importer fixed effects are exactly equal to the multilateral resistances that satisfy the structural gravity equation system of trade. Moreover, Fally (2015) also shows that the PPML is the only pseudo-maximum likelihood estimator with this property.

In a nutshell, as Santos Silva and Tenreyro (2022) conclude, the PPML estimator is extraordinarily well suited for the estimation of gravity equations. Specifically, the PPML estimator is the only pseudo-maximum likelihood estimator for gravity models that is valid under very mild assumptions, consistent in the presence of high-dimensional fixed effects, not negatively affected by the possible non-existence of the estimates, and whose results are compatible with structural gravity models.

In the empirical analysis, we estimate the following specification of the gravity equation using the PPML estimator with three types of (high-dimensional) fixed effects (exporter-time, importer-time, and country-pair):

$$X_{ij,t} = \exp \left(\beta_0 \text{PTA}_{ij,t} + \beta_1 \text{Deep_PTA}_{ij,t} + \beta_2 \text{GATT/WT0}_{ij,t} + \sum_t \beta_t \text{INTER}_{ij,t} + \eta_{ij} + \chi_{i,t} + \lambda_{j,t} \right) \times \epsilon_{ij,t}. \quad (1)$$

The dependent variable, $X_{ij,t}$, is the nominal value of bilateral trade flows (in levels) from country i (exporter) to country j (importer) at time t . The panel dimension of $X_{ij,t}$ improves estimation efficiency. Moreover, as suggested by Yotov (2022), the dependent variable includes both international and intra-national trade flows.

The data on the dependent variable come from the Structural Gravity Manufacturing Database (Monteiro, 2020), which provides consistent data on the bilateral international and domestic trade of manufactured goods for 186 trading partners over the period 1980–2016. This data set uses export flows which are expressed as free on board and complemented by mirrored import data flows after adjusting for insurance and freight costs (CIF). Domestic trade flows are computed as the difference between gross output and exports of manufacturing goods. Of the aforementioned works that examine the impact of PTAs according to their depth on trade flows, only Dhingra et al. (2023) and Fontagné et al. (2021) include intra-national flows.

The set of explanatory variables includes our main variables of interest (PTAs and a measure of their depth), other control variables, and a set of three-way fixed effects following the state-of-the-art recommendations in the estimation of the gravity equation (Yotov et al., 2016). We discuss them in turn.

3.2 PTAs and their Depth

The assessment of the impact of the depth of PTAs on trade constitutes the main goal of the article. First, the variable $\text{PTA}_{ij,t}$ is a variable that takes the value of one when i and j are members of the same Preferential Trade Agreement in force at time t , and it is equal to zero otherwise. Second, the variable $\text{Deep_PTA}_{ij,t}$ is a dummy variable that takes the value of one for trade agreements categorized as deep and zero for shallow agreements. Hence, equation (1) estimates the elasticity of trade separately for deep and shallow agreements.

Previous studies relied on counts of the provisions included in these PTAs to examine the impact of the depth of trade agreements on trade. Unlike these studies, two recent works, Breinlich et al. (2021) and Fontagné et al. (2021), propose indirect indicators that use new statistical methods addressing the high heterogeneity and number of provisions covered by trade agreements. Using information from the World Bank's Deep Trade Agreements database and relying on the methods developed by these authors, we create our $\text{Deep_PTA}_{ij,t}$ dummy variable in the following three steps.

First, we use Fontagné et al.'s (2021) three clusters of trade agreements with different depths and, according to

their results, different impacts on trade flows. We split trade agreements into two groups. One group comprises the 28 trade agreements included in the cluster that exhibit the statistically largest impact on trade. The second group includes the remaining trade agreements. We consider the agreements in the first group as deep and the remaining agreements as shallow.

Second, Breinlich et al. (2021) identify 43 provisions as those with the strongest trade-enhancing effect. We classify agreements as deep or shallow depending on the number of these provisions that are included in each agreement. More specifically, and applying Fontagné et al. (2021) percentages of deep and shallow agreements, we consider that the deepest agreements are the 10% of the agreements that have the largest number of the 43 provisions. The maximum number of those provisions included in one agreement is 19, which corresponds to COMESA agreement.⁷ Besides, the successive EU enlargements would also be among the deepest agreements given that it includes 18 of those provisions.⁸ Moreover, those agreements that include more than eight of those provisions have also been classified as deep agreements. Therefore, agreements with less than eight of those selected provisions would be shallow agreements, which amount to 90% of total agreements in our sample.

Third, we build our dummy variable $\text{Deep_PTA}_{ij,t}$ by reconciling the two previous approaches to measure the depth of trade agreements. In particular, we classify as deep agreements those agreements that would be classified as such in each of these two approaches (i.e., $\text{Deep_PTA}_{ij,t} = 1$). For all other agreements (i.e., shallow agreements), the dummy variable would take the value of 0.

In the empirical analysis, we further explore the impact of the depth of trade agreements by different types of PTAs, namely: (i) by their regional scope (regional vs interregional agreements); (ii) by the degree of development of the member

countries (North vs South); and (iii) the nature of the agreements (bilateral, plurilateral, etc.). We explain them below.

First, we use the World Bank classification to categorize PTAs as regional (*Regional PTA*), when all its member countries belong to the same region, or as interregional (*Interregional PTA*) when countries from more than one region are part of the agreement. To construct this variable, we consider six regions: East Asia, South Asia, and the Pacific; Europe and Central Asia; Latin America and the Caribbean; Middle East and North Africa; North America; and Sub-Saharan Africa.

Second, we use the World Bank's Classification of Countries by Income to categorize PTAs by the income levels of their partners at the entry-into-force date of the agreement. Here, three types of PTAs are distinguished which are North–North (N_N), South–South (S_S), and North–South (N_S). When all their member countries are classified as high-income countries, a PTA is categorized as a North–North PTA whereas it is categorized as a South–South PTA when all member countries belong to groups of low, low-middle, or upper-middle income. When both high and non-high-income countries are part of an agreement, this is classified as a North–South PTA.

Third, concerning the classification of PTAs according to their nature, we split PTAs into four categories according to the number of participants and the characteristics of the agreements: bilateral agreements (*Bilateral*), plurilateral agreements (*Plurilateral*), agreements consisting in the adhesion of a country to an existing PTA (*PTA_cou_enlargement*), and agreements between an existing PTA and a country or between two existing PTAs (*PTA_cou_agreement*).

3.3 Other Explanatory Variables

Equation (1) also includes additional control variables. First, the variable $\text{GATT/WTO}_{ij,t}$ takes the value of one when i and j belong to the GATT (until 1994) or WTO (from 1995) in year t , and zero otherwise. Data on membership in GATT/WTO come from the World Trade Organization. Second, following the recommendations by Bergstrand et al. (2015), a set of time-varying border dummy variables ($\text{INTER}_{ij,t}$) to account for common globalization effects are included. To obtain these dummy variables, we interact a binary indicator for each year t (D_t) with 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 ($i = j$).

Finally, following the suggestions by Baltagi et al. (2003), Baier and Bergstrand (2007), and Baldwin and Taglioni (2007), equation (1) includes three types of fixed effects

⁷ The Common Market of Eastern and Southern Africa (COMESA) began in December 1994 with the aim of promoting regional integration through trade and the development of natural and human resources for the mutual benefit of all people in the region. Nowadays, COMESA is a Customs Union that includes 21 African States with a population of more than 600 million people and a geographical area of 12 million square kilometers.

⁸ Note that our sample period begins in 1980, so due to the inclusion of bilateral fixed effects in the regressions, the identification of the EU effect is based on countries that joined the EU in the data period. In particular, our sample includes the following EU enlargements: Greece in 1981, Portugal and Spain in 1986; Austria, Finland, and Sweden in 1995; Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia in 2004; Bulgaria and Romania in 2007; and Croatia in 2013.

(country-pair fixed effects (η_{ij}), exporter-time fixed effects (χ_{it}) and importer-time fixed effects (λ_{jt})) to deal with two sources of omitted variables bias. First, country-pair fixed effects control for the impact of both observed variables such as distance, common language, contiguity, colonial ties, etc., and unobserved time-invariant determining factors of bilateral trade that may be correlated with the other regressors. Furthermore, these country-pair fixed effects alleviate endogeneity concerns regarding our main policy variable of interest (PTA_{ijt}). Second, country-year fixed effects (both for exporting and for importing countries) capture the unobservable multilateral resistance (price) terms described by Anderson and van Wincoop (2003). This set of exporter-time and importer-time fixed effects controls for trade barriers of each country with their remaining trading partners and for any other country-specific time-varying variables that may affect bilateral trade on the exporter or importer side.

4 Results

Drawing on the most recent developments in gravity modeling of trade flows, which recommend the inclusion of both intra and international trade flows, we employ the PPML estimator with the dependent variable defined in levels and including exporter- and importer-time fixed effects as well as a country-pair time-invariant fixed effect in all the specifications. This constitutes the best estimator and specification to obtain unbiased and theory-consistent estimates.

The estimation results for the PTA effect on trade depending on the depth level of the agreement appear in Table 1. As explained in the previous section, we classify the agreements in deep and shallow using jointly Breinlich et al.'s (2021) and Fontagné et al.'s (2021) approaches. Our estimates, which are displayed in column (1), show a positive and statistically significant coefficient for shallow PTAs with a coefficient value of 0.090, which involves a positive effect on bilateral trade of 9.3% ($[\exp(0.090) - 1] \times 100 = 9.3\%$). Moreover, we find that deep trade agreements boost trade flows by 49% ($[\exp(0.309 + 0.090) - 1] \times 100 = 49\%$). This estimated increase in trade is much lower than that obtained by Fontagné et al. (2021) which is around 70% but slightly higher than that obtained by Dhingra et al. (2023) which is around 40%.

In these estimates, the coefficient for belonging to GATT/WTO is also positive and statistically significant, suggesting an increase in trade flows by around 38%. The estimated coefficients of all international border dummies that are included in the model to capture the globalization

effects are negative, and almost all of them are statistically significant. As the international border dummy for 2015 is dropped from the specification, this is the reference group, and the estimated coefficients of the remaining border dummy variables should be interpreted as deviations from that international effect in 2015. Our results suggest that the effects of borders on trade have fallen significantly over the sample period. These results are consistent with those of Bergstrand et al. (2015) and Yotov et al. (2016), confirming the existence of a clear effect of globalization on trade over time.

Next, we present the results when, in addition to depth, we classify the agreements according to the following criteria: (i) by their geographical scope, distinguishing between regional and interregional agreements (columns 2 and 3 of Table 1); (ii) by the income level of the trading partners, grouping them as North–North, North–South and South–South (Table 2); and (iii) by their “nature,” splitting them into bilateral, plurilateral, whether they consist of the adhesion of a country to an existent PTA, and agreements between an existent PTA and a country or between two existing PTAs (Table 3).

When we split PTAs according to their regional scope, the point estimate of the depth variable is still statistically significant (column 2 of Table 1). The coefficient is very similar (0.290) to that obtained in column 1 of Table 1, and consequently, the impact of deep PTAs on trade is similar in magnitude: an increase of 33.6%. Regarding the regional scope, when the depth of the agreements is controlled for, our results find that regional PTAs do have a statistically significant effect on trade flows whereas interregional PTAs do not. Our estimates show that bilateral trade between partners with a regional agreement in force increases by 19.2%.

These results contrast with those reported by Díaz-Mora et al. (2023), who conclude that both continental and intercontinental trade agreements boost trade when the depth of the agreement is not controlled for, although the increase is clearly higher for regional agreements (32%) than of interregional agreements (9.3%). That is, when the depth of the agreement is included in the specification, the positive effect of interregional agreements disappears and that of the regional agreements shrinks, pointing out the importance of measuring the depth of PTAs.

To try to infer how the elasticity of trade changes depending on whether the regional and interregional agreements are deep or shallow, we interact the dummy variables capturing the regional scope with the dummy variable capturing deep agreements. We find that for both regional and interregional agreements, deep agreements have a positive and significant impact on trade flows (column 3 of Table 1).

Table 1: The impact on trade of preferential trade agreements by depth level and type of agreement (regional vs interregional; PPML estimates)

	(1)		(2)		(3)	
PTA	0.0896**	(0.0434)				
Deep_PTA	0.309***	(0.0642)	0.290***	(0.0526)		
PTA by geographical scope						
Regional PTA			0.176***	(0.0428)	0.159***	(0.0449)
Interregional PTA			−0.0310	(0.0589)	−0.006	(0.0768)
Regional PTA#Deep_PTA					0.322***	(0.0622)
Interregional PTA#Deep_PTA					0.238***	(0.0917)
GATTboth	0.326***	(0.0467)	0.321***	(0.0467)	0.322***	(0.0466)
INTL_BRDR_1980	−1.101***	(0.0522)	−1.107***	(0.0524)	−1.107***	(0.0524)
INTL_BRDR_1981	−1.074***	(0.0506)	−1.082***	(0.0512)	−1.083***	(0.0513)
INTL_BRDR_1982	−1.094***	(0.0496)	−1.101***	(0.0502)	−1.101***	(0.0502)
INTL_BRDR_1983	−1.050***	(0.0489)	−1.059***	(0.0495)	−1.059***	(0.0496)
INTL_BRDR_1984	−0.961***	(0.0504)	−0.973***	(0.0512)	−0.974***	(0.0513)
INTL_BRDR_1985	−0.923***	(0.0521)	−0.935***	(0.0528)	−0.936***	(0.0530)
INTL_BRDR_1986	−0.980***	(0.0499)	−0.991***	(0.0505)	−0.992***	(0.0506)
INTL_BRDR_1987	−0.956***	(0.0504)	−0.966***	(0.0509)	−0.967***	(0.0510)
INTL_BRDR_1988	−0.876***	(0.0503)	−0.886***	(0.0505)	−0.887***	(0.0505)
INTL_BRDR_1989	−0.812***	(0.0527)	−0.823***	(0.0532)	−0.824***	(0.0532)
INTL_BRDR_1990	−0.683***	(0.0468)	−0.692***	(0.0469)	−0.694***	(0.0469)
INTL_BRDR_1991	−0.672***	(0.0468)	−0.681***	(0.0465)	−0.683***	(0.0465)
INTL_BRDR_1992	−0.663***	(0.0463)	−0.673***	(0.0457)	−0.674***	(0.0456)
INTL_BRDR_1993	−0.618***	(0.0480)	−0.628***	(0.0470)	−0.630***	(0.0468)
INTL_BRDR_1994	−0.572***	(0.0436)	−0.570***	(0.0437)	−0.569***	(0.0437)
INTL_BRDR_1995	−0.543***	(0.0456)	−0.542***	(0.0457)	−0.541***	(0.0457)
INTL_BRDR_1996	−0.533***	(0.0445)	−0.531***	(0.0447)	−0.530***	(0.0447)
INTL_BRDR_1997	−0.414***	(0.0410)	−0.412***	(0.0412)	−0.411***	(0.0412)
INTL_BRDR_1998	−0.339***	(0.0385)	−0.337***	(0.0386)	−0.336***	(0.0387)
INTL_BRDR_1999	−0.342***	(0.0394)	−0.340***	(0.0396)	−0.339***	(0.0397)
INTL_BRDR_2000	−0.187***	(0.0404)	−0.183***	(0.0404)	−0.182***	(0.0405)
INTL_BRDR_2001	−0.204***	(0.0332)	−0.200***	(0.0333)	−0.199***	(0.0333)
INTL_BRDR_2002	−0.193***	(0.0359)	−0.189***	(0.0361)	−0.188***	(0.0362)
INTL_BRDR_2003	−0.219***	(0.0384)	−0.215***	(0.0386)	−0.214***	(0.0387)
INTL_BRDR_2004	−0.175***	(0.0366)	−0.173***	(0.0367)	−0.173***	(0.0367)
INTL_BRDR_2005	−0.139***	(0.0342)	−0.138***	(0.0342)	−0.138***	(0.0343)
INTL_BRDR_2006	−0.071**	(0.0321)	−0.069**	(0.0321)	−0.069**	(0.0321)
INTL_BRDR_2007	−0.082**	(0.0337)	−0.082**	(0.0337)	−0.082**	(0.0337)
INTL_BRDR_2008	−0.052*	(0.0279)	−0.053*	(0.0280)	−0.052*	(0.0280)
INTL_BRDR_2009	−0.142***	(0.0229)	−0.142***	(0.0229)	−0.142***	(0.0229)
INTL_BRDR_2010	−0.065***	(0.0219)	−0.066***	(0.0219)	−0.065***	(0.0219)
INTL_BRDR_2011	−0.015	(0.0199)	−0.016	(0.0199)	−0.015	(0.0199)
INTL_BRDR_2012	−0.009	(0.0157)	−0.011	(0.0156)	−0.011	(0.0157)
INTL_BRDR_2013	−0.025**	(0.0118)	−0.025**	(0.0118)	−0.025**	(0.0118)
INTL_BRDR_2014	−0.016*	(0.0088)	−0.016*	(0.0088)	−0.016*	(0.0088)
Observations	876,556		876,556		876,556	

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. To control for global trends in international trade, INTERij,t dummies are also included. The sample includes annual data for consecutive years and covers manufacturing trade for 186 countries over the period 1980–2015.

In the case of regional PTAs, even for shallow agreements, their effect is positive and statistically significant rising trade flows by 17%. That is, regional PTAs have a positive and significant impact although the effect is notably larger

for deep regional agreements boosting trade flows by an additional 38%, leading to an overall effect of 61.8% increase in bilateral trade flows. In the case of interregional PTAs, a positive and statistically significant effect only takes place

Table 2: The impact on trade of preferential trade agreements by depth level and type of agreement (North–North, North–South, South–South; PPML estimates)

	(1)		(2)	
Deep_PTA	0.321***	(0.0670)		
PTA by income level				
N_N	−0.063	(0.0521)	−0.079	(0.109)
N_S	0.095**	(0.0448)	0.092**	(0.0421)
S_S	0.309***	(0.0470)	0.323***	(0.0474)
N_N#Deep_PTA			0.344***	(0.122)
N_S#Deep_PTA			0.329***	(0.0680)
S_S#Deep_PTA			0.006	(0.108)
GATTboth	0.329***	(0.0473)	0.328***	(0.0472)
INTL_BRDR_1980	−1.059***	(0.0498)	−1.060***	(0.0499)
INTL_BRDR_1981	−1.078***	(0.0508)	−1.078***	(0.0508)
INTL_BRDR_1982	−1.096***	(0.0498)	−1.097***	(0.0498)
INTL_BRDR_1983	−1.053***	(0.0490)	−1.053***	(0.0491)
INTL_BRDR_1984	−0.960***	(0.0505)	−0.960***	(0.0505)
INTL_BRDR_1985	−0.922***	(0.0522)	−0.922***	(0.0522)
INTL_BRDR_1986	−0.982***	(0.0500)	−0.982***	(0.0500)
INTL_BRDR_1987	−0.958***	(0.0506)	−0.959***	(0.0505)
INTL_BRDR_1988	−0.878***	(0.0505)	−0.878***	(0.0505)
INTL_BRDR_1989	−0.813***	(0.0529)	−0.813***	(0.0529)
INTL_BRDR_1990	−0.683***	(0.0470)	−0.684***	(0.0471)
INTL_BRDR_1991	−0.673***	(0.0469)	−0.673***	(0.0469)
INTL_BRDR_1992	−0.665***	(0.0464)	−0.665***	(0.0465)
INTL_BRDR_1993	−0.618***	(0.0481)	−0.618***	(0.0482)
INTL_BRDR_1994	−0.572***	(0.0437)	−0.573***	(0.0437)
INTL_BRDR_1995	−0.499***	(0.0425)	−0.501***	(0.0426)
INTL_BRDR_1996	−0.489***	(0.0411)	−0.490***	(0.0411)
INTL_BRDR_1997	−0.371***	(0.0375)	−0.373***	(0.0376)
INTL_BRDR_1998	−0.295***	(0.0352)	−0.297***	(0.0353)
INTL_BRDR_1999	−0.299***	(0.0353)	−0.301***	(0.0355)
INTL_BRDR_2000	−0.146***	(0.0362)	−0.148***	(0.0364)
INTL_BRDR_2001	−0.164***	(0.0296)	−0.166***	(0.0297)
INTL_BRDR_2002	−0.152***	(0.0320)	−0.154***	(0.0321)
INTL_BRDR_2003	−0.177***	(0.0347)	−0.178***	(0.0348)
INTL_BRDR_2004	−0.176***	(0.0369)	−0.176***	(0.0369)
INTL_BRDR_2005	−0.141***	(0.0344)	−0.141***	(0.0344)
INTL_BRDR_2006	−0.072**	(0.0323)	−0.073**	(0.0323)
INTL_BRDR_2007	−0.085**	(0.0339)	−0.086**	(0.0339)
INTL_BRDR_2008	−0.054*	(0.0281)	−0.055*	(0.0281)
INTL_BRDR_2009	−0.143***	(0.0230)	−0.144***	(0.0230)
INTL_BRDR_2010	−0.065***	(0.0220)	−0.066***	(0.0220)
INTL_BRDR_2011	−0.016	(0.0200)	−0.016	(0.0200)
INTL_BRDR_2012	−0.011	(0.0158)	−0.011	(0.0157)
INTL_BRDR_2013	−0.026**	(0.0119)	−0.027**	(0.0119)
INTL_BRDR_2014	−0.016*	(0.00891)	−0.017**	(0.00878)
Observations	876,556		876,556	

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. To control for global trends in international trade, INTERijt dummies are also included. The sample includes annual data for consecutive years and covers manufacturing trade for 186 countries over the period 1980–2015.

for deep agreements, which boosts trade flows by 27%. That is, shallow interregional agreements do not seem to increase bilateral trade flows.

Next, we examine the effects of PTAs on partners' income levels and the depth of the agreement (Table 2). We find positive and statistical coefficients for deep agreements, which increase trade flows by around 38%. *Ceteris paribus*, North–North PTAs do not show a significant impact on trade flows, and North–South and South–South ones have a positive and significant effect (column 1). The magnitude of the impact is notably higher for South–South agreements (36%) than for North–South agreements (10%).

When we also take into account the depth of each type of agreement by income levels using interactions (column 2 of Table 3), we find a positive and statistically significant effect when those agreements are deep for North–North PTAs. Deep North–North PTAs are associated with an increase of 41% in trade flows. However, the effect of shallow North–North agreements is not statistically significant. In the case of North–South agreements, both shallow and deep PTAs boost trade flows, although the magnitude of the effect is lower for the former (9.6%) than for the latter (52.4%). Regarding the South–South PTAs, our results show that their impact on trade flows is positive and statistically significant when they are shallow agreements (with an increase of around 38%) whereas the impact is not statistically significantly different for deep agreements. That is, the elasticity of trade to the entry into force of South–South agreements is not higher for deep agreements.

These results contrast with those of Díaz-Mora et al. (2023) who find that the elasticity of trade to PTAs is positive and significant for the three different PTAs according to the income levels of the member states. That is, our results suggest that the depth of the agreements also matters for increasing trade flows and not merely the type of agreement by income level.

Lastly, we explore how the influence of depth of PTAs on bilateral trade flows changes when, in addition, we classify the agreements between bilateral PTAs, plurilateral PTAs, enlargements of existent PTAs, and new agreements in which participating PTAs already in force (with another PTA or with another country). These results which are displayed in Table 3 are notably different from those previously obtained for other types of agreements. The main difference is that here deep agreements do not exhibit a statistically significant coefficient (column 1). The impact of bilateral agreements is also not significant whereas is positive and significant for the other three types of agreements. The larger effect (increase of trade flows of 54.5%) is found for agreements that consist of the adhesion

Table 3: The impact on trade of preferential trade agreements by depth level and type of agreement (bilateral, plurilateral, ACP enlargement, or ACP non-enlargement; PPML estimates)

	(1)		(2)	
Deep_PTA	0.053	(0.0749)		
PTA by nature				
Bilateral	0.015	(0.0934)	0.015	(0.0934)
Plurilateral	0.182***	(0.0572)	0.182***	(0.0573)
PTA_cou_enlargement	0.435***	(0.0871)	0.537*	(0.326)
PTA_cou_agreement	0.104**	(0.0419)	0.104**	(0.0419)
Plurilateral#Deep_PTA			0.053	(0.0751)
ACP_cou_enlargement#Deep_PTA			−0.049	(0.329)
GATTboth	0.326***	(0.0464)	0.326***	(0.0464)
INTL_BRDR_1980	−1.105***	(0.0522)	−1.105***	(0.0522)
INTL_BRDR_1981	−1.082***	(0.0511)	−1.082***	(0.0511)
INTL_BRDR_1982	−1.100***	(0.0500)	−1.100***	(0.0500)
INTL_BRDR_1983	−1.058***	(0.0493)	−1.058***	(0.0493)
INTL_BRDR_1984	−0.973***	(0.0511)	−0.973***	(0.0511)
INTL_BRDR_1985	−0.935***	(0.0527)	−0.935***	(0.0528)
INTL_BRDR_1986	−0.991***	(0.0504)	−0.991***	(0.0504)
INTL_BRDR_1987	−0.966***	(0.0508)	−0.966***	(0.0508)
INTL_BRDR_1988	−0.886***	(0.0503)	−0.886***	(0.0503)
INTL_BRDR_1989	−0.823***	(0.0530)	−0.823***	(0.0530)
INTL_BRDR_1990	−0.693***	(0.0467)	−0.693***	(0.0467)
INTL_BRDR_1991	−0.682***	(0.0463)	−0.682***	(0.0463)
INTL_BRDR_1992	−0.673***	(0.0455)	−0.673***	(0.0455)
INTL_BRDR_1993	−0.629***	(0.0467)	−0.629***	(0.0467)
INTL_BRDR_1994	−0.569***	(0.0437)	−0.569***	(0.0437)
INTL_BRDR_1995	−0.541***	(0.0457)	−0.541***	(0.0457)
INTL_BRDR_1996	−0.531***	(0.0447)	−0.531***	(0.0447)
INTL_BRDR_1997	−0.412***	(0.0412)	−0.412***	(0.0412)
INTL_BRDR_1998	−0.336***	(0.0387)	−0.336***	(0.0387)
INTL_BRDR_1999	−0.340***	(0.0397)	−0.340***	(0.0397)
INTL_BRDR_2000	−0.184***	(0.0405)	−0.184***	(0.0405)
INTL_BRDR_2001	−0.202***	(0.0333)	−0.202***	(0.0333)
INTL_BRDR_2002	−0.191***	(0.0362)	−0.191***	(0.0362)
INTL_BRDR_2003	−0.217***	(0.0387)	−0.217***	(0.0387)
INTL_BRDR_2004	−0.176***	(0.0367)	−0.176***	(0.0367)
INTL_BRDR_2005	−0.140***	(0.0343)	−0.140***	(0.0343)
INTL_BRDR_2006	−0.071**	(0.0321)	−0.071**	(0.0321)
INTL_BRDR_2007	−0.084**	(0.0337)	−0.084**	(0.0337)
INTL_BRDR_2008	−0.054*	(0.0280)	−0.054*	(0.0280)
INTL_BRDR_2009	−0.144***	(0.0229)	−0.144***	(0.0229)
INTL_BRDR_2010	−0.067***	(0.0220)	−0.067***	(0.0220)
INTL_BRDR_2011	−0.016	(0.0199)	−0.016	(0.0199)
INTL_BRDR_2012	−0.011	(0.0156)	−0.011	(0.0156)
INTL_BRDR_2013	−0.027**	(0.0118)	−0.027**	(0.0118)
INTL_BRDR_2014	−0.017**	(0.0087)	−0.017**	(0.0087)
Observations	876,556		876,556	

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. To control for global trends in international trade, $INTER_{ijt}$ dummies are also included. The sample includes annual data for consecutive years and covers manufacturing trade for 186 countries over the period 1980–2015.

of a country to an existent PTA (for example, the accession of Armenia and the accession of Kyrgyz Republic to the Eurasian Economic Union). The magnitude of the increase in trade

flows is more moderate for plurilateral agreements (20%) and even more moderate for those agreements between an existent PTA and a country or between two existing PTAs (11%).

In summary, for this classification criterion, the depth of the agreements does not seem to affect the results.

When the estimates include interaction variables between the type of agreements and the dummy variable for deep agreements, the association between the depth and trade flows is clear-cut. More specifically, the results in column 2 of Table 3 suggest that there is not a significant impact on bilateral trade flows for both deep plurilateral and deep agreements that consist of the adhesion of a country to an existent PTA. Plurilateral PTAs stimulate bilateral trade flows when they are shallow agreements with an increase of 20%. For shallow agreements that consist of the adhesion of a country to an existent PTA, the statistical significance is weak but the magnitude of the increase in trade flows is high (71%). Since there are no deep agreements for the other two types of agreements, we cannot calculate their differentiated effects according to their depth. Hence, these results are quite similar to those of Díaz-Mora et al. (2023), suggesting that the depth of agreements that differ in their “nature” (bilateral, plurilateral, whether they consist of the adhesion of a country to an existent PTA, and agreements between an existent PTA and a country or between two existing PTAs) does not matter for increasing trade.

5 Conclusions

This article examines the impact of the depth of trade agreements on bilateral trade flows and the heterogeneous impact of depth across different types of trade agreements (classified by their geographical scope, their income level, and their nature). To measure depth, we follow the most recent works that propose indirect instead of direct measures relying on new statistical methods such as machine learning to restrict the number of provisions and better identify those provisions more effectively to promote international trade. By estimating theory-grounded specifications of the gravity equation using domestic and international trade flows and following all best practices and recommendations for these estimates, we find that depth is a source of heterogeneity in PTAs’ impact on bilateral trade flows. Consequently, previous estimates of PTAs’ partial effects are probably biased due to the omission of the level of depth of the agreements in the analysis.

Once we consider that trade agreements differ also in depth, some interesting results stand out. First, we find that deep PTAs have a higher positive effect on bilateral trade than that of shallow PTAs. Second, according to the geographical scope of the agreements, we find that when the depth of these agreements is controlled for, regional but not interregional agreements boost trade. Moreover, a

positive effect of regional PTAs is found for both deep and shallow agreements, although notably larger for the former than for the latter. However, interregional agreements only boost trade when they exhibit a high level of depth. Shallow interregional agreements do not seem to increase bilateral trade flows. Although the result that once the depth of these agreements is controlled for, regional but not interregional agreements boost trade may be thought as counter-intuitive, it may be consistent with the “natural trading hypothesis.” According to that hypothesis, the closer the two countries are the lower the transport costs and, consequently, the higher the trade creation effect of a trade agreement. Third, according to the type of agreement by income levels of their trade partners, our results show that in the case of North–North PTAs, their positive and statistically significant effects only take place when they are deep agreements. For North–South agreements, both deep and shallow PTAs boost trade flows, although again the magnitude of the effect is higher for the former than for the latter. The results are somewhat different for South–South PTAs since the elasticity of trade to the entry into force of these South–South agreements is not higher for deep agreements. Finally, depth is not a factor that positively affects trade flows when the impact of other types of agreements is analyzed. Specifically, a high level of depth for plurilateral and those agreements that consist of the adhesion of a country to an existent PTA does not seem to increase their positive effect on trade flows.

Our article uncovers significant heterogeneity in the impact of depth across different types of trade agreements. Our results have clear and important policy implications given the increasing depth and complexity of trade agreements in recent years. Our results indicate that the depth of trade agreements matters in boosting trade. Interestingly, the depth of trade agreements has a different impact on developed and developing economies, which might be related to their different institutional capacities and the heterogeneity in their initial tariff protection levels. Thus, for trade agreements of developed economies, only deep agreements effectively enhance trade, and in trade agreements including developed and developing economies deep trade agreements have a larger trade-enhancing effect than shallow agreements. These results could be related to the prior-to-agreement low trade protection levels of developed economies. In contrast, developing economies have initially higher barriers to trade in the absence of trade agreements. The latter may help explain the positive impact of lowering trade barriers for trade agreements between developing economies, while the depth of these agreements does not further promote trade probably due to the weak enforceability of provisions because of their weaker institutional capacities.

Funding information: This research was conducted as part of the Projects PID2021-122133NB-I00 financed by MCIN/AEI/10.13039/501100011033/FEDER, EU and CIPROM/2022/50 (Prometeo). It is also part of the project 2022-GRIN-34135, co-funded by Universidad de Castilla-La Mancha and the European Regional Development Fund EDRF.

Conflict of interest: Authors state no conflict of interest.

Data availability statement: All of the data used in our study comes from openly available databases.

Article note: As part of the open assessment, reviews and the original submission are available as supplementary files on our website.

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