The effects of preferential trade agreements (PTAs) on international trade flows

by

Jianzhi Guo

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Major Professor
Peri da Silva

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Abstract

This report considers the effects of preferential trade agreements (PTAs) on bilateral trade flows. First, it describes the evolution of PTAs since the end of WWII, noting that PTA formation has trended upward since the late 1980s. As of April 2021, there are 349 active PTAs in force. However, international trade economists have only recently developed empirical strategies to consistently estimate the average effect of a PTA on bilateral trade. Baier and Bergstrand (2007) showed that - after accounting for endogeneity bias using panel techniques - PTAs had much greater effects on bilateral trade flows than was previously suggested in the literature.

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Chapter 1 - Introduction

Global society has long relied heavily on the exchange of goods and services. During the 1930s, the U.S. imposed tariffs under the Smooth-Hawley tariff act. This movement brought about numerous retaliatory tariffs by other countries on U.S. exports. This protectionism was an important ingredient contributing to the disintegration of the world economy before World War II. The post-WWII era witnessed a concerted effort, led by the U.S. and other countries, to foster cooperation in international matters. In this environment, we should interpret the role played by the principles of reciprocity and non-discrimination in promoting efficient outcomes in the multilateral trading system (Bagwell & Staiger, 1997, pp. 281–325).

Trade negotiations among 23 countries in 1947 led to the formation of the General Agreement on Tariffs and Trade (GATT). In 1995, the World Trade Organization (WTO) was formed. Unlike the GATT, it represents a permanent multilateral institution that elaborates and oversees international trade rules and provides an elaborated dispute settlement process. Bagwell, Bown, and Staiger (2016, p. 4) show that the main pillars of the GATT are multilateral rules that prohibit non-discrimination and promote reciprocity. As they explain, GATT members have to negotiate and respect the application of most-favored-nation (MFN) tariffs, which simply means that, if a GATT member exacts a tariff on a particular product, the same tariff must be extended to all exporters that are members of that agreement. Thus, the MFN rule prevents discrimination. Notably, member countries have successfully carried out eight rounds of multilateral negotiation under the principles of reciprocity and non-discrimination (De Gruyter, 2009, pp. 587–610).

Essentially, this principle argues that tariff modifications should lead to equal changes in the values of a country's export and import volumes, which neutralize terms-of-trade effects during tariff negotiations. According to World Bank (2019) data, the average tariff rate on manufactured products applied by Japan, the European Union, and the U.S. is 4.1%, 3.22%, and 4.15%, respectively. These tariffs represent a small fraction of their levels before multilateral negotiations were undertaken after WWII. The principle of reciprocity then creates an environment where members do not pursue the use of tariffs for terms of trade gains. Thus, multilateral liberalization efforts have been undertaken successfully through the negotiation rounds held between 1947 and 1994: Geneva (1947), Annecy (1949), Torquay (1950), Geneva (1956), Geneva (1960–61) (also known as the Dillon Round), the Kennedy Round (1962–67), the Tokyo Round (1973–79), and the Uruguay Round (1986–94). In general, these rounds had different goals. The first five rounds concentrated exclusively on tariff negotiations. The main aim of the Kennedy Round was the negotiation of non-tariff measure obligations. However, it could not completely achieve its goal. The Tokyo Round contributed more to the regulation and control of non-tariff measures than it did to tariffs (Jackson, 1997, p. 74). The negotiated multilateral agreements "reduced average tariffs on industrial goods from forty percent (1947) to less than five percent (1993)" (Wilkinson, 2006). Table 1 displays details of these rounds of multilateral negotiation.

Table 1：Scope and success of the tariff-reducing activity of GATT[1]

Round	Dates	Number of countries	Value of trade covered	Average tariff cut	Average tariffs afterward
Geneva	1947	23	$10 billion	35%	"Not available"
Annecy	1949	33	Unavailable	35%	"Not available"
Torquay	1950	34	Unavailable	35%	"Not available"
Geneva	1956	22	$2.5 billion	35%	"Not available"
Dillon	1960–61	45	$4.9 billion	35%	"Not available"
Kennedy	1962–67	48	$40 billion	35%	8.7%
Tokyo	1973–79	99	$155 billion	34%	6.3%
Uruguay	1986–94	120+	$3.7 trillion	38%	3.9%

Source: Jackson, 1997, pp. 74

De Gruyter (2009, pp. 587–610) states that multilateral negotiations carried out under the auspices of the GATT/WTO are designed to avoid opportunism and increase available information about any member's trade policy. WTO negotiations strive to reduce MFN tariff rates through the imposition of binding tariff rates. This strategy ensures that countries cannot legally raise them in the future, giving members greater certainty with regard to other members' trade policies. In addition, members of the GATT enforce the application of negotiated tariff bindings by requiring members to express barriers to trade in the form of tariffs. This process of "tariffication" demands that members essentially convert non-tariff barriers (e.g., quotas and export subsidies) into tariffs so that the costs of protectionism are more apparent and easier to negotiate.

[1] The tariff averages refer to tariffs on the non-primary products of industrial countries.

The GATT is an agreement focused on the liberalization of trade in goods. It aimed to liberalize trade by reducing tariffs and removing quotas among member countries. Examples of the application of non-tariff barriers include the U.S.'s voluntary export restraints on Japanese autos during the 1980s, which were equivalent to a tariff rate exceeding 60% (Branstetter, 2017). Additional examples include the Steel Trigger Price Mechanism of 1982–1984 and the Farm Bill of 1981–1984, which sought to protect the interests of the steel industry and landowners, respectively. By contrast, the General Agreement on Trade in Services (GATS) seeks to liberalize trade in services across nations. A somewhat novel program negotiated during the Uruguay Round, the GATS does not mandate the liberalization of all services. Still, it promotes voluntary liberalization and enforces that liberalized service items are not restricted again.

Despite the key role played by the MFN rule on the GATT/WTO, the possibility that countries exchange preferential tariffs is possible among WTO members. Article XXIV of the GATT regulates the formation of customs unions (CUs) and free trade areas (FTAs). The key distinction between these two PTAs is that the customs unions require the implementation of a common external tariff, while the latter allows countries to apply different external tariffs. Notice that this Article requires that member countries essentially apply duty-free trade on preferential imports and prohibits members from increasing their tariffs on non-members. It then represents an additional tool for promoting free trade under the auspices of the WTO. Instead, GATT's Enabling Clause allows developing countries to create even partial scope agreements (PSAs), wherein preferential trade can be more limited. Developing countries can exchange preferences by creating PTAs that do not adhere to Article XXIV (Mansfield & Reinhardt, 2003, pp. 829–862).

The formation of PTAs has been on an upward trend since the late 1980s. As of April 2021, there are 560 active regional trade agreements (RTAs)[2] in force, but agreements that include goods and services count as two agreements using under the WTO criterion. In this case, 314 notifications under the GATT Article XXIV, 184 under GATS Article V, and 62 enabling clauses for the contracting parties (WTO, 2021). The acceptance of PTAs gave rise to new recommendations and implementations for tariffs to be set at or close to zero among preferential partners. These can be in the form of free trade areas (FTAs), CUs, PSAs,[3] and economic integration areas (EIAs).[4] In this case, EIA refers to an agreement in goods (FTA/CU/PS) that also covers services beyond the commitments under the GATS. For example, the North America Free Trade Agreement (NAFTA) represents an FTA that also liberalizes trade in services, thereby also receiving the label of an EIA. On the other hand, the European Union represents a customs union, with deep integration in service activities, becoming an EIA as well.

A partial trade agreement frees up trade between two or more countries for a few industries. For example, the PSA between Brazil and Mexico that was established in May 2003 enhances bilateral trade between the two countries by eliminating barriers to trade in goods. However, current WTO documentation suggests that no PSA has been extended

[2] In this report, we use the terms PTA and RTA interchangeably.

[3] Partial scope agreements: partial scope which is not defined or referred to the WTO agreement, means that the agreement covers only certain products.

[4] Economic integration is the unification of economic policies between different states, through the partial or full abolition of tariff or non-tariff restrictions on trade.

to cover services. On the other hand, several FTAs and CUs have evolved to include trade in services, and these tend to promote conditions that allow cross-border investments, facilitate trade-related dispute resolution, and sometimes establish competition policies.

PTAs usually follow the No Double Counting Clause, whereby the parties intend that an agreement's provisions be applied in a manner that prevents any item of refund, credit, offset, abatement, taxes, or expenses from being charged or applied more than once. This clause ensures that the prices are equalized for the members of a PTA. However, the WTO has struggled somewhat to apply its regulations on PTAs. For instance, PTA members are required to declare new preferential groupings to GATT working parties (before 1995) and the WTO's Committee on Regional Trade Agreements (since 1995). These bodies, which assess the degree of PTAs' compliance with GATT/WTO rules, have failed to reach a judgment on all but one of the 118 PTAs submitted for review. This outcome is due mostly to differences among WTO members about what constitutes compliance (Mansfield & Reinhardt, 2003, pp. 829–862). Regardless, Limão (2016, pp. 358–360) states that these PTAs share one common feature: a policy that aims to increase market access for at least one member.

Despite its popularity, PTAs do not necessarily improve member countries' welfare, at least in theory. According to Viner (1951), trade diversion is associated with a welfare loss because the change does not create new trade. Instead, it represents switching imports away from more efficient producers to less efficient ones. Instead, trade creation refers to welfare gains since the preferential partner switches from costly domestic production to more efficient preferential partners. Below we provide a graphical illustration of trade creation and trade diversion and use this graph to explain Viner's (1951) original intuition about the effects of PTAs.

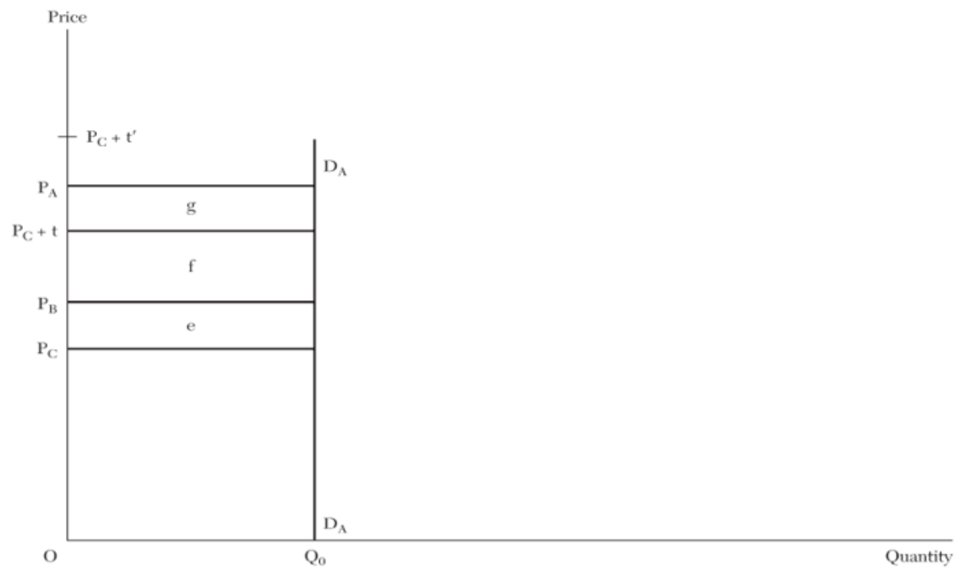

Figure 1: Trade creation and trade diversion

Panagariya (2000, pp. 290–293) uses Figure 1 to explain the concepts of trade creation and trade diversion outlined in the Theory of customs unions by Viner (1951). He explains, "These concepts are best introduced within a model exhibiting infinite supply elasticities and zero demand elasticities. The model avoids some of the ambiguities that arise in more general models." Let us then begin by representing country A's demand for a product by the vertical line $D_A D_A$ in Figure 1. Three countries (A, B, and C) supply this product, with prices of P_A, P_B, and P_C, respectively. Under perfect competition, these prices also represent the constant average and marginal costs of production. In the graph, we observe that Country A is the least efficient supplier, so Countries B and C will not import A's product. If the tariff rate is chosen such that $P_A > P_C + t > P_B$, then the entire quantity demanded, $0Q_0$, is imported from C. A's consumers need to pay $P_C + t$ to purchase C's product. A's government will receive e + f as a tariff revenue from this transaction. When

Country A forms a PTA with B, it retains only the tariff on C, and the movement creates no new trade. Supplier C is replaced by a less efficient supplier, B. Because of this change, Country A loses the tariff revenue. With area e used up to pay for higher production cost in Country B. The net loss to A and the world from the union is area e. In Viner's terminology, we call the union *trade diverting*.

Instead, suppose the initial non-discriminatory tariff in A is t'. In the graph, we can find $P_A < P_C + t' < P_B + t'$. In this case, the full demand for steel, $0Q_0$ is satisfied by Country A itself. Again, removing t' on B but not C results in the supplier changing from A to B. Country A gains the consumer surplus represented by areas g + f. The union creates new trade between A to B, and it is associated with switching from higher cost supplier A to lower cost supplier B. In Viner's terminology, the union is *trade creating*. This trade creation creates welfare gains denoted by area g + f. Thus, Panagariya (2000) indicates that trade diversion is associated with welfare loss and trade creation with welfare gain.

Meade (1955, ch. 2) shows that the relative magnitudes of trade creation and trade diversion are insufficient to determine the welfare effect of the union. Losses are determined not only by the amount of trade diversion but also by the magnitude of the increase in costs by trade diversion. For instance, if we drop the zero-elasticity demand, then the welfare effect will become ambiguous even in the presence of trade diversion. This can be illustrated in Figure 2. D_AD_A remains A's demand curve. In the case of trade diversion, Country A removes the tariff on B but not on C. The cost of production will increase as Country A switches imports to Country B. Thus, Country A loses area e + f in tariff revenue from the original imports. However, Country A's consumers will purchase more than Q_0. Assume they purchase Q1, and now area f + h denotes extra benefits to A's consumers. Country A then gains the area h on new imports. If area h is bigger than area e, then trade diversion improves welfare in this case. Thus, trade creation and trade diversion remain a central part of policy debates on PTAs.

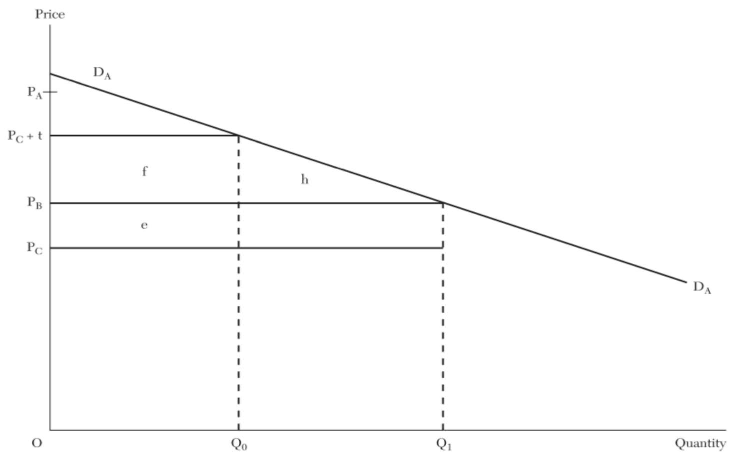

Figure 2: A Welfare gain under trade diversion

Chapter 2 - Do FTAs increase members' international trade?

As mentioned above, the number of PTAs have exponentially increased over the past decades. However, international trade economists have only recently claimed empirical support from reliable quantitative estimates of the average effect of a PTA on bilateral trade (Baier & Bergstrand, 2007, p. 73). The gravity model of international trade has been the key empirical framework for empirical analyses of the effects of PTAs on trade flows for over 50 years. At a cross-section level, the gravity equation explains country pairs' trade flows while controlling for the countries' gross domestic product (GDP), bilateral distances, dummy variables for common languages, the presence or absence of a PTA, and whether they share a common land border. Nobel laureate Jan Tinbergen (1962) was the first to publish an econometric study using the gravity equation for international trade flows. He found that membership in the British Commonwealth (Benelux FTA) accounted for only a 5% increase in trade flows. Subsequently, Aitken (1973), Abrams (1980), and Brada and Mendez (1985) found that membership in the European Community (EC) has an economically and statistically significant impact on trade flows among members, whereas Bergstrand (1985) and Frankel, Stein and Wei (1995) found insignificant effects. There is a potential endogeneity bias in estimating the effect of PTAs on trade volume, thus, international trade economists could not reach consistent conclusions on PTA effects until recently.

The endogeneity of the variable identifying a country-pair PTA membership is a critical concern in estimating the trade effects of PTAs. Endogeneity concerns about how trade barriers affect trade flows are common in economics. In a famous example, Trefler (1993) estimated the factors that simultaneously drive U.S. multilateral imports and nontariff barriers in a cross-industry analysis. He found that using instrumental variables to control for the endogeneity of trade policies increases the effects of these trade barriers on U.S. imports tenfold. The literature on the determinants of PTA formation provides evidence of the endogeneity of PTAs to trade flows (see, for example, Baier & Bergstrand, 2002, 2004b; Magee, 2003). Baier and Bergstrand (2007) were the first to measure consistently average PTA effects on trade flows by considering different sources of PTA formation endogeneity using a comprehensive sample of country-pairs with coverage for trade flows over five decades.

The most basic version of the gravity equation used in the literature is described by equation (1). It is commonly applied to cross-section gravity specifications in international trade, as shown in equation (1):

$$PX_{ij} = \beta_0 (GDP_i)^{\beta 1} (GDP_j)^{\beta 2} (DISTij)^{\beta 3} e^{\beta 4(LANGij)} e^{\beta 5(ADJij)} e^{\beta 6(FTAij)} \varepsilon ij \, . \qquad (1)$$

Where PX_{ij} is the value of country i's export goods to country *j*; $DIST_{ij}$ is the distance between countries i and *j*; and $LANG_{ij}$, ADJ_{ij}, and FTA_{ij} are binary variables. If i and j share a common language, then variable $LANG_{ij}$ equals 1 and 0 otherwise. ADJ_{ij} assumes the value 1 if i and j share a common land border and 0 otherwise. FTA_{ij} assumes the value 1 if i and j have free trade agreements[5] and 0 otherwise. e is the natural

[5] Baier and Bergstrand's sample includes FTAs and customs unions, both of which we refer to as PTA.

logarithm base, and εij is a lognormally distributed error term. PTA and the error term $(\epsilon - \beta_6 \varsigma)$ have a likely negative correlation. Assuming the trade policy variable is the bilateral tariff rate, if the countries share a PTA, then tariff rate = 0 and $\varsigma = 1$. Otherwise, PTA = 0 and tariff rate > 0. Thus, $\varsigma < 0$, and PTA and ς are positively correlated (Baier & Bergstrand, 2007, p. 80). The initial applications of the gravity equation to international trade flows had no formal theoretical foundation. Since 1979, the literature has provided different formal theoretical economic foundations for the gravity equation, such as in Equation (1).

We can log-linearize Equation (1) and estimate it using decadal information to obtain the estimates in Table 2 as follows:

Table 2: Typical Cross-Sectional Gravity Equation Coefficient Estimates

Variables	1960	1970	1980	1990	2000
$\ln GDP_i$	0.76 (45.79)	0.88 (57.55)	1.01 (69.37)	1.08 (85.13)	1.18 (104.13)
$\ln GDP_j$	0.76 (48.66)	0.92 (63.95)	1.00 (72.69)	0.97 (78.08)	0.98 (87.39)
$\ln DIST_{ij}$	-0.64 (-16.23)	-0.85 (-21.10)	-1.06 (-28.15)	-1.07 (-28.82)	-1.17 (-32.57)
ADJ_{ij}	0.16 (1.03)	0.14 (0.85)	0.35 (2.18)	0.59 (3.72)	0.74 (4.88)
$LANG_{ij}$	0.06 (0.65)	0.34 (3.48)	0.56 (5.48)	0.80 (8.16)	0.72 (7.71)
FTA_{ij}	0.63 (3.46)	1.37 (6.64)	-0.13 (-0.73)	-0.14 (-0.95)	0.29 (2.85)
Constant	-9.38 (-20.44)	-12.17 (-26.88)	-16.23 (-35.59)	-17.09 (-40.37)	-17.94 (-49.11)
RMSE	1.4163	1.7616	1.8900	1.9919	1.9645
R^2	0.6061	0.6334	0.6446	0.6649	0.7137
No. OBS	2633	4030	5421	6474	7302

t-statistics are in parentheses. The dependent variable is (natural log of the) nominal bilateral trade flow from i to j.
Source: Baier and Bergstrand (2007, p. 76)

The data come from Baier and Bergstrand (2007). The nominal bilateral trade flows are from the International Monetary Fund's Direction of Trade Statistics from 1960 to 2000, taken at 10-year intervals. For panel analysis, exporter's GDP deflators are used to generate real trade flows, and GDP deflators scale nominal GDPs to create real GDPs. The bilateral distances, language, and adjacency dummies are compiled using the CIA Facebook. Baier and Bergstrand (2007) considered a single dummy variable, which combined the full (impartial) PTAs, that is, the combination of FTAs and CUs. Table A1 in the Appendix lists the countries used.[6]

Table 2[7] provides cross-sectional coefficient estimates for the relevant years using a log-linear version of gravity equation (1). These estimates are generated using the (non-zero) nominal trade flows between 96 countries, as listed in Table A1 in the Appendix. Table 2 provides the coefficient estimates for the highly volatile dummy. For instance, the PTA significantly and positively affected trade between two PTA members in the 1970s, with a 294% increase ($e^{1.37} - 1 = 2.94$), but showed a negative effect in 1980 and 1990. Frankle (1997, p. 62) also showed that membership in the E.C. decreased trade in 1970, 1975, and 1980. It is then obvious that the country-pair effects of PTA formation show considerable unobserved heterogeneity.

However, equation (1) does not control for trader barriers applied to international trade flows. As we include trade barriers in the gravity equation, price indexes for the importer and exporter countries are added. Otherwise, the lack of these additional controls would generate trade biases in the specification because these barriers may be related to other variables in the model, including the controls for PTA formation. Thus,

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[6] The data set is available at Baier and Bergstrand's websites (http://www.nd.edu/~jbergstr and http://people.clemson.edu/~sbaier).

[7] R^2 denotes explanatory power ranging from 60% to 80%, indicating 20%–40% unobserved heterogeneity influences.

log-linearizing equation (1) and adding trade barriers to the model yields a more accurate specification as follows:

$$\boldsymbol{ln\left[PX_{ij}/(GDP_iGDP_j)\right] = \beta_0 + \beta_3\left(lnDIST_{ij}\right) + \beta_4\left(ADJ_{ij}\right) + \beta_5\left(LANG_{ij}\right) + \beta_6\left(FTA_{ij}\right) - lnP_i^{1-\sigma} - lnP_j^{1-\sigma} + \varepsilon_{ij}}. \quad (2)$$

Equation (2) shows the gravity model equation controlling for the price indexes $P_i^{1-\sigma}$ and $P_j^{1-\sigma}$ due to the inclusion of trade barriers. These indexes control for the degree of multilateral resistance of barriers to international trade. For instance, the trade flows between countries *i* and *j* are affected by their bilateral barriers as well as by the barriers imposed by country *j* on other trade partners. Thus, if country *j* raises its barriers to imports from country *w*, then these additional barriers may promote trade between countries *i* and *j*. However, estimating these price indexes is extremely computationally expensive. Alternatively, we can control for the price indexes using exporter- and importer-fixed effects.

Thus, we can write equation (2) replacing the multilateral resistance terms with importer- and exporter-fixed effects as follows:

$$\ln\left[\frac{PX_{ij}}{GDP_iGDP_j}\right] = \beta_0 + \beta_3\left(lnDIST_{ij}\right) + \beta_4\left(ADJ_{ij}\right) + \beta_5\left(LANG_{ij}\right) + \beta_6\left(FTA_{ij}\right) + \alpha_i + \alpha_j + \epsilon_{ij}. \quad (3)$$

Table 3: Theory-motivated Cross-sectional Gravity Equations with Country Fixed Effects

Variables	1960	1970	1980	1990	2000
ln$DIST_{ij}$	-0.68 (-16.77)	-0.89 (-21.58)	-1.28 (-31.36)	-1.30 (-31.65)	-1.46 (-35.79)
ADJ_{ij}	0.31 (2.26)	0.35 (2.38)	0.43 (2.95)	0.58 (3.93)	0.59 (4.09)
$LANG_{ij}$	0.38 (3.99)	0.84 (8.33)	0.82 (8.06)	0.98 (9.41)	0.97 (9.78)
FTA_{ij}	0.01 (0.09)	0.61 (3.27)	-1.44 (-8.65)	-1.08 (-7.30)	-0.14 (-1.36)
Constant	-14.06 (-8.25)	-12.49 (-18.66)	-14.98 (-19.37)	-16.64 (-31.88)	-12.76 (-27.18)

RMSE	1.1826	1.5025	1.6635	1.7806	1.7851
Within R^2	0.5020	0.4300	0.3857	0.3648	0.3845
No. OBS	2633	4030	5421	6474	7302

The dependent variable is the (natural log of the) nominal bilateral trade flow from country *i* to country *j* divided by the product of their nominal GDPs. Coefficient estimates of country fixed effects are not reported for brevity.

Source: Baier and Bergstrand (2007, p. 77)

Table 3 above reports the estimates for the same years as those in gravity Equation (2). Baier and Bergstrand (2007) used importer and exporter fixed effects to account for the variation of multilateral price terms $P_i^{1-\sigma}$ and $P_j^{1-\sigma}$. However, the PTA dummy coefficient estimates remain unstable year-over-year. Accordingly, the PTA coefficient's estimate is negative in certain years. For instance, although PTA in 1970 increased members' bilateral trade flows by 84%, it reduced these trade flows by 76% in 1980. Thus, the country fixed effects do not correct for the bias introduced if countries are members of the same PTA. The potential endogeneity of the right-hand-side (RHS) variables controlling for the presence of a PTA is the key concern in cross-sectional empirical work. When the RHS variables in Equations (1) or (2) are correlated with ϵij, the endogeneity of the estimates means that the econometric estimates can be biased. Consequently, ordinary least squares (OLS) may yield biased and inconsistent coefficient estimates (Baier & Bergstrand, 2007, p. 77). These endogeneity biases are caused by three reasons: omitted variables, simultaneity, and measurement error (Wooldridge, 2002, pp. 50–51). A potential omitted variable (and selection) bias is the most important reason, which we can discuss before other factors.

The gravity equation is the major empirical framework to investigate drivers of bilateral trade flows because of its strong explanatory power (R^2). However, Table 3 illustrates that significant unobserved heterogeneity among country pairs remains. PTA is not determined randomly. In terms of observable economic characteristics, Baier and Bergstrand (2004a) present strong cross-sectional empirical evidence stating that country pairs that are larger and more similar in GDPs, closer in distance, and more remote from other countries tend to have PTAs. Thus, their relative factor endowments tend to have a wider difference with respect to each other. This evidence includes the same factors that explain larger trade flows. Therefore, most country pairs with PTAs tend to have economic characteristics related to considerable trade flows and (in theory) welfare-enhancing net trade creation attributed to a PTA.

Assume the error term ε_{ij} represents domestic regulations that inhibit bilateral trade. If PTA can expand liberalization beyond tariff barriers into domestic regulations, then the two countries will prefer to join the PTA. The reason is that they expect a large welfare gain from potential bilateral trade. Whether or not policymakers participate in a PTA depends on the trade level (relative to its potential level), rather than on the recent change in trade levels. Thus, PTA determinants are likely to be cross-sectional in nature (Baier & Bergstrand, 2007, p. 79). These factors point to the presence of simultaneity bias in investigating the effect of PTA formation on bilateral trade. If two countries trade more than their "natural" level, then political pressure will be applied to avoid trade liberalization, holding typical gravity equations RHS variables constant. This situation would cause a negative simultaneity bias in the PTA coefficient estimate. When the country pairs' governments trade more than their gravity equation suggested "natural" level. The two countries may be induced to form an PTA because political pressure such as high tariffs may decline their trade level. Hence, positive simultaneity bias would occur.

Baier and Bergstrand (2007) concluded that PTA and the error term $(\epsilon - \beta_6 \varsigma)$ in Equation (1) have a negative correlation. As a result, the classical "attenuation bias" of PTA's coefficient estimate approaches zero. They considered this condition one of the reasons that the PTA coefficient estimates may be underestimated. Baier and Bergstrand aimed to obtain reliable estimates of the treatment effect of a PTA. Accordingly, they focused on estimating accurately the ex post effect of a PTA dummy on trade flows. In the presence of unobserved time-invariant heterogeneity, most standard econometric textbooks suggest the use of panel data as an alternative method for estimating the treatment effect in cross-sections. The reason is that a panel data with country-pair and year variation can be used to control for unobserved time-invariant heterogeneity with the inclusion of country-pair fixed effects.

In Equation (4), distance, language, and adjacency were eliminated since they vary at the country- pair *(ij)* level and country-pair fixed effects then control for their effects. X_{ijt} is the exports from country *i* to country *j* in year *t*. α_{it} and α_{jt} are exporter by year and importer by year fixed effects, respectively. The country-pair fixed effects that control for country-pair level omitted variables are represented by α_{ij}. The panel fixed effects approach provides consistent estimates regardless of the presence of any correlation between the time-invariant unobservable ε_{ij}. This panel data strategy can be represented by the following expression:

$$\ln\left[\frac{PX_{ijt}}{GDP_{it}GDP_{jt}}\right] = \beta_0 + \beta_1\left(FTA_{ijt}\right) + \beta_2\left(FTA_{ijt-1}\right) + \beta_3\left(FTA_{ijt-2}\right) + \alpha_{ij} + \alpha_{it} + \alpha_{jt} + \varepsilon_{ij}. \quad (4)$$

Baier and Bergstrand (2007) note that the formation of PTAs includes long phase in periods for preferential tariffs that can take over one decade. As such, they control for these long PTA implementation periods by including lagged values of this variable in expression (4). They are represented by variables $\mathrm{FTA_{ijt-1}}$ *and* $\mathrm{FTA_{ijt-2}}$. In this case, they use data for every five years, implying that these two lagged variables control for 5- and 10-years PTA implementation periods. Estimates for expression (4) can be found in Table 4. For instance, column (2) of Table 4 indicates that a PTA promotes trade by approximately 58%, the same as the coefficient estimate in column (1) ($e^{0.46} - 1 = 0.58$), albeit using trade flows divided by the GDPs as the LHS variable in the former case.

Table 4: Panel gravity equations with bilateral fixed and country-and-time effects[8]

Variables	(1)	(2)	(3)	(4)	(5)
$FTA_{ij,t}$	0.46** (9.07)	0.46** (9.06)	0.29** (4.95)	0.28** (4.66)	0.35** (4.20)
$FTA_{ij,t-1}$			0.38** (5.62)	0.27** (3.30)	0.16** (1.64)
$FTA_{ij,t-2}$				0.21** (2.60)	0.17** (1.87)
$FTA_{ij,t+1}$					-0.04 (-0.62)
Constant	8.85** (151.71)	-24.59** (429.81)	9.70** (147.93)	10.06** (124.57)	9.98** (93.20)
Total ATE	0.46	0.46	0.67	0.76	0.68
Within R^2	0.3102	0.1891	0.3044	0.2750	0.2516
No. OBS	47,081	47,081	36,563	34,105	27,575

The dependent variable for specification (1), (3), (4), and (5) is the (natural log of the) real bilateral trade flow; the dependent variable for specification (2) is the (natural log of the) real bilateral trade flow divided by the product of the real GDPs. *(**) denotes statistical significance at 5 (1) percent level in one-tailed t-test. Coefficient estimates for bilateral fixed and country-and-time effects are not reported for brevity.

[8] Total Average Treatment Effect (ATE) is the sum of the statistically significant FTA coefficient estimates.

Source: Baier and Bergstrand (2007, p. 89)

The estimates shown in columns 3 through 5 confirm that the role played by phase-in periods of PTAs have strong effects on member's trade flows. These results are in line with practical experience with PTA formation. Virtually, every PTA is "phased-in," often over 10 years, such as the NAFTA agreement and the original 1957 European Economic Community (EEC) agreement. Thus, the entire economic (treatment) effect cannot be captured completely using effects for the concurrent year only. Assume a PTA entered in force "legally" in 1990; its economic effect would be fully activated by 2000. Thus, having one or two lagged levels of the PTA dummy ($FTA_{ij,t-1}$ and/or $FTA_{ij,t-2}$) is reasonable. In addition, the economic effects of a PTA include varying terms of trade. We can assume that a PTA may be enforced in 1960 and entirely "phased-in" by 1965 and still impact trade flows until 1970. Columns (3) - (4) in Table 4 provide the results, indicating that PTA formation has statistically significant lagged effects on trade flows. The coefficient estimates have economically plausible values and balance across periods (Baier & Bergstrand, 2007, p. 90). In columns (3) and (4), the cumulative average effects with one and two lags are 0.65 and 0.76 percent, respectively. With three lags, the coefficient estimate of the third lag was statistically insignificant. The total ATE of 0.76 implies that the trade level will increase by 114% (($e^{0.76} - 1$) over 10 years due to PTA formation.

Notice that the specification in column (5) tests whether controlling for lagged values of PTA eliminates endogeneity concerns. Baier and Bergstrand use the fixed effects specification described in (4) to run an additional regression and confirmed that trade changes and PTA changes had no "feedback effects." Wooldridge (2002, p. 285) suggested that the “strict exogeneity” of PTA in the panel context can be test easily by including the future level of this variable. The conclusion that the lead variable $(FTA_{ij,t+1})$ is not significant indicates that this concern is not present in this empirical strategy.

Chapter 3 - The heterogeneous effect of PTAs

Baier and Bergstrand (2007) showed that the panel fixed effect approach can provide consistent and precise estimates of PTA effects regardless of the correlation between time-invariant unobservable variables and the error term ε_{ij}. These estimates for the PTA dummy variable and its lagged values illustrate that, on average, PTAs increase their members’ trade volumes. However, Chapter 1 indicates that PTAs can take different forms. In fact, most PTAs take the form of FTAs, followed by PSAs and CUs. It is clear then that PTAs may have heterogeneous effect in promoting trade as they may differ in the depth of economic integration. Therefore, the average PTA effect investigated by Bureau and Jean (2013) and Baier and Bergstrand (2007) needs to be extended so that the heterogeneous effects of PTAs conditional on their type can be examined. Therefore, in this chapter, we focus on the heterogeneity of PTA effects on bilateral trade flows.

We describe in detail two important papers that focus on the heterogeneous effects of PTAs on bilateral trade.

Chapter 3.A - Baier, Bergstrand, and Feng (2014)

First, we focus on Baier, Bergstrand, and Feng (2014), which identify six main types of PTAs: one-way PTAs (OWPTAs), two-way PTAs (TWPTAs), which coincides with PSAs, FTAs, CUs, common markets, and monetary unions[9]. Due to few observations on common markets and monetary unions, Baier, Bergstrand, and Feng (2014) (henceforth BBF) combined the two types of "deeper" PTAs with CUs and identified these three agreements by the binary variable CUCMECU, representing "deep" PTAs. Then, they studied the heterogeneous effects of PTAs on trade flows by controlling for their type using binary variables (OWPTA, TWPTA, FTAs, and CUs (deep PTAs)).

BBF (2014) also consider how PTA type affects trade flows. Essentially, they follow the approach outlined in Hummels and Klenow (henceforth HK) (2005) and rely on their trade margin-decomposition methodology to show that bilateral imports can be disentangled in terms of an intensive margin, an extensive margin, and the importer's total imports. Importantly, HK (2005) described the extensive margin as the fraction of goods exported by a country to a trade partner, whereas the intensive margin captures the intensity at which an exporter sells products to a specific country relative to its exports to all other partners. Thus, BBF (2014) also explore the heterogeneous effects of different types of PTA on these margins of trade. In sum, they considered two sources of heterogeneity (PTA types, and trade margins).

The literature points out that considering the different margins of trade is crucial to understanding bilateral trade flows. HK (2005) conducted a cross-sectional analysis of the importance of trade margins in explaining trade flows between the U.S. and its trading partners. They revealed that 60% of these economies' exports were attributable to

[9] In this chapter, PTA denotes an agreement with only partial liberalization (not free trade).

the extensive trade margin (a wider set of goods) rather than the intensive goods margin (larger quantities of a given good). Furthermore, they claimed that the faster the exporter country's economy grows, the wider are the set of goods exported. Thus, BBF (2014) explored the impact of PTAs on aggregate[10] trade flows and intensive (goods) and extensive (goods) margin, country pairs, and years.

Below, we describe the results found by BBF (2014) where we link PTA types to their effects across margins of trade and bilateral aggregate trade. In doing so, we also highlight that the effects of PTA on margins of trade may vary across time. These results are important for different reasons. First, the relative impact of trade liberalization on the intensive and extensive margins influences the estimations of welfare gains. Second, although Arkolakis et al. (2012) argued that welfare gains are isomorphic across many modern quantitative trade models, but they found that the source of gains can vary across models that allow for firm heterogeneity. Thus, the intensive and extensive margin effects must be differentiated to identify the precise source of "gains from trade." Lastly, the quantitative path of welfare gains is time-sensitive because the two margins have different trade elasticities (BBF.,2014, p. 340).

The literature highlights the importance of studying the evolution of trade margins. Hillberry and McDaniel (2002) used the HK (2005) decomposition to investigate the effects of NAFTA on the intensive and extensive trade margins. They provided a decomposition of post-NAFTA trade among the three partners into intensive and extensive margins using trade flows originally organized at the 4-digit Standard

[10] Aggregate refers to all goods (or industries or product categories).

International Trade Classification (SITC). Subsequently, Kehoe and Ruhl (2009) applied a modified HK's (2005) decomposition methodology to a series of cross-sectional analyses of NAFTA and the Canada–U.S. FTA. They decomposed extensive and intensive margin changes post-agreement using original data at the SITC from Feenstra et al. (2005). Both studies showed that the formation of NAFTA expands bilateral trade flows across members by increasing the intensive and extensive margins of trade. As a result, BBF (2014) conclude that their analysis should be conducted based on HK's original definition of trade margins

BBF (2014) used the Melitz model to generate a standard gravity equation as follows:

$$X_{ijt}^{m} = N_{it}^{m} Y_{jt}^{m} \left(\frac{(a_{Lit}^{m})^{-y^m} w_{it}^{-y^m} \tau_{ijt}^{-y^m} f_{ijt}^{-[y^m/(\sigma^m-1)-1]}}{\sum_{k=1}^{k} N_{kt}^{m} (a_{Lkt}^{m})^{-y^m} w_{kt}^{-y^m} \tau_{kjt}^{-y^m} f_{kjt}^{-[y^m/(\sigma^m-1)-1]}} \right), \tag{5}$$

where X_{ijt}^{m} denotes trade flow of good *m* from *i* to *j* in year *t*; N_{it}^{m} is the number of firms in *i* and includes exporting and non-exporting firms that produce outputs of good *m*; Y_{jt}^{m} represents good *m* expenditure; a_{Lit}^{m} represents unit input requirement of labor, which is the lower bound of the Pareto distribution of productivities in good *m* in *i*; y^m is an index of productivity heterogeneity of good *m* among firms; w_{it} denotes wage rate in *i*; τ_{ijt} is the variable trade costs of *i*'s exports to *j*; f_{ijt} is the fixed export costs from *i* to *j*; and σ^m is the elasticity of substitution in consumption. The relative price term in the large parentheses is a standard representation of the relative prices in the gravity equation. It also reflects productivity heterogeneity (from a_{Lit}^{m} to y^m) and fixed export cost (f_{ijt}), c.f., Melitz (2003), Chaney (2008), Redding (2011), and Arkolakis et al. (2012). This model shows that τ_{ijt} will affect X_{ijt}^{m} in terms of intensive and extensive margins.

Baier and Bergstrand (2007) argued that the panel fixed effects approach is a better method for eliminating the endogeneity bias of PTAs. Based on the endogenous self-selection of country pairs into PTAs, they argued that the fixed effects estimation can obtain consistent estimates of the partial effect[11] of PTAs as follows:

$$lnX_{ijt} = \beta_0 + \beta_1(PTA_{ijt}) + \eta_{ij} + \delta_{it} + \psi_{jt} + \epsilon_{ijt}, \tag{6}$$

where η_{ij} is country-pair fixed effects (CPFEs), which capture all time-invariant unobservable bilateral factors that may affect the likelihood of a PTA; δ_{it} and ψ_{jt} are exporter by year and importer by year fixed effects, respectively, which capture time-varying country heterogeneity, such as multilateral price/ resistance" terms (cf., Anderson and van Wincoop, 2003). Equation (6) is commonly referred to as a "fixed effects" specification. However, Baier and Bergstrand (2007) also employed an alternative specification as a robustness test, namely, the first difference (FD) specification:

$$\Delta_5 lnX_{ijt} = \beta_0 + \beta_1(\Delta_5 PTA_{ijt}) + \delta_{5,it} + \psi_{5,jt} + \nu_{5,ijt}, \tag{7}$$

where Δ_5 refers to first differencing over 5 years. Although bilateral CPFEs are removed as we take the first difference of the data, importer and exporter fixed effects that vary by time remain. They capture changes in time-varying exporter and importer GDPs and

[11] Partial effects refer to the absence of general-equilibrium; see Anderson and Wincoop (2003) and Baier and Bergstrand (2009) on partial versus general equilibrium trade effects of trade cost change.

multilateral price terms over the same 5-year period. Changes over time in exporter- and importer-specific unobservable variables are captured with δ_5 and ψ_5, whereas changes over time in pair-specific unobservable variables, such as falling variable and fixed bilateral export costs unrelated to PTAs, are not accounted for. Thus, BBF (2014) add a CPFE to Equation (7) to control for unobservable country-pair specific changes over time as follows:

$$\Delta_5 lnX_{ijt} = \beta_0 + \beta_1(\Delta_5 PTA_{ijt}) + \delta_{5,it} + \psi_{5,jt} + \eta_{ij} + \nu_{5,ijt}. \quad (8)$$

BBF (2014) expected intensive and extensive margins to be influenced by the formation of PTAs in the short and long term, respectively. The reason is that changes in volumes of intensive margin do not require startup costs entirely. On the contrary, startup costs are critical for extensive margin; thus, new firms need considerable time to begin exporting to new market. They evaluated this hypothesis, as will be discussed later. Baier and Bergstrand (2007) did not estimate heterogeneous effects on trade flows based on the type of PTAs[12]. Furthermore, no empirical study has examined the differential impact of deep PTAs on the extensive and intensive margins relative to PSAs and FTAs, particularly the differential timing of such effects. Thus, BBF (2014) address these shortcomings.

First, they described the HK's (2005) decomposition methodology using the two trade margins. Let x_{ijt} denote the value of country *i*'s export goods to country *j* in year *t*.

[12] Roy (2010) used the panel fixed effects approach and found that CUs promote more trade across members than other.

Following HK (2005), the extensive margin of goods exported from country *i* to *j* in any year *t* is defined as follows:

$$EM_{ijt} = \frac{\sum_{m \in M_{ijt}} X_{Wjt}^{m}}{\sum_{m \in M_{Wjt}} X_{Wjt}^{m}}, \tag{9}$$

where X_{Wjt}^{m} is the value of imports of product *m* by country *j* from the world in year *t*; M_{Wjt} is the set of all products exported by the world to *j* in year *t*; and M_{ijt} is the subset of all products exported from *i* to *j* in year *t*. Therefore, EM_{ijt} is a measure of the fraction of all products that are exported from *i* to *j* in year *t* with the weight of each product according to its importance in world exports to *j* in year *t*. It increases if country j imports a larger set of products from country i.

HK (2005) defined the intensive margin of goods exported from *i* to *j* as follows:

$$IM_{ijt} = \frac{\sum_{m \in M_{ijt}} X_{ijt}^{m}}{\sum_{m \in M_{ijt}} X_{Wjt}^{m}}, \tag{10}$$

where X_{ijt}^{m} is the value of country *i*'s export of product *m* to country *j* in year *t*. IM_{ijt} represents the market share of country *i* in country *j*'s imports from the world among the set of products that *i* exports to *j* in year *t*. Accordingly, the intensive margin increases as country *i*'s exports levels grow as a percent of the country j's trade in that product category. The product of the two margins equals the ratio of exports from *i* to *j* to country *j*'s total imports as follows:

$$EM_{ijt} IM_{ijt} = \frac{\sum_{m \in M_{ijt}} X_{ijmt}}{\sum_{m \in M_{Wjt}} X_{Wjmt}} = X_{ijt}/X_{jt} \tag{11}$$

Where X_{jt} is country *j*'s total imports in year *t*. We can take the natural logs of Equation (11) and obtain the following:

$$lnX_{ijt} = lnEM_{ijt} + lnIM_{ijt} + lnX_{jt}. \tag{12}$$

Therefore, the HK (2005) decomposition methodology illustrates that the log of country *i*'s export value to country *j* in any year *t* can be decomposed linearly into the (logs of the) extensive margin, intensive margin, and country *j*'s total import value. HK (2005) applied their methodology only to a cross-sectional analysis centered around U.S. trade partners. However, BBF (2014) applied the HK (2005) decomposition to time-series data involving bilateral trade flows for 183 countries from 1965 to 2000, these countries are listed in Appendix A2. Thus, the trade weights used in constructing EM_{ijt} and IM_{ijt} will change from year to year. To control for the heterogeneous effects of PTAs, BBF (2014) adapts specification (8) by employing multiple dummies to control for PTA type. In this strategy, specifications (13-15) (see below) include separate dummies for OWPTA, TWPTA (PSAs), FTAs, and CUCMEUCU. TWPTAs correspond to the PSAs discussed in the introduction section. They distinguished various types of PTAs and accounted for their lagged effects as well. Thus, the random growth first-difference (RGFD) model with no lags can be described as follows:

$$\begin{aligned} \Delta_5 lnX_{ijt} = \beta_0 + \beta_1(\Delta_5 CUCMEUCU_{ijt}) + \beta_2(\Delta_5 FTA_{ijt}) + \beta_3(\Delta_5 TWPTA_{ijt}) \\ + \beta_4(\Delta_5 OWPTA_{ijt}) + \delta_{5,it} + \psi_{5,jt} + \eta_{ij} + \nu_{5,ijt}, \end{aligned} \tag{13}$$

$$\Delta_5 lnEM_{ijt} = \theta_0 + \theta_1(\Delta_5 CUCMEUCU_{ijt}) + \theta_2(\Delta_5 FTA_{ijt}) + \theta_3(\Delta_5 TWPTA_{ijt}) + \theta_4(\Delta_5 OWPTA_{ijt}) + \delta_{5,it} + \psi_{5,jt} + \eta_{ij} + \nu_{5,ijt}, \quad (14)$$

$$\Delta_5 lnIM_{ijt} = \lambda_0 + \lambda_1(\Delta_5 CUCMEUCU_{ijt}) + \lambda_2(\Delta_5 FTA_{ijt}) + \lambda_3(\Delta_5 TWPTA_{ijt}) + \lambda_4(\Delta_5 OWPTA_{ijt}) + \delta_{5,it} + \psi_{5,jt} + \eta_{ij} + \nu_{5,ijt}. \quad (15)$$

As discussed above, BBF (2014) add lags to the different PTA identification variables used in specifications (13) – (15). We denote the lag of the change in the binary variable identifying the formation of FTAs by the notation $lag\,\Delta_5 FTA_{ijt}$. To control for endogeneity concerns, they also use the future change in the FTA identifier ($lead\Delta_5 FTA_{ijt}$). Similar notation applies to CUs and PSAs.

The two critical variables of BBF's (2014) empirical analysis are the bilateral trade flows and the binary variables identifying the various PTA types between numerous country pairs for several years. They used Scott Baier and Jeffrey Bergstrand's data set[13] and defined the index based on Frankel (1997): no PTA (0), OWPTA (1), TWPTA (2), FTA (3), CU (4), common market (5), and monetary union (6). As explained above, BBF (2014) combined CU (4), common market (5), and monetary union (6) into CUCMEUCU. Their baseline estimates of specifications (13)-(15) can be found in Table 5 below.

[13] The data set is available at Jeffrey Bergstrand's website, www.nd.edu/ jbergstr/.

Table 5: 5-year differenced data

Variable	Set 1 (RGFD)			Set 2 (RGFD)		
	(a)	(b)	(c)	(a)	(b)	(c)
	$\Delta_5 \ln Trade_{ijt}$	$\Delta_5 \ln EM_{ijt}$	$\Delta_5 \ln IM_{ijt}$	$\Delta_5 \ln Trade_{ijt}$	$\Delta_5 \ln EM_{ijt}$	$\Delta_5 \ln IM_{ijt}$
$\Delta_5 CUCMECU_{ijt}$	0.329***	0.100*	0.229***	0.387***	0.106*	0.281***
	(0.072)	(0.062)	(0.065)	(0.077)	(0.067)	(0.069)
$lag\ \Delta_5 CUCMECU_{ijt}$				0.309***	0.131**	0.179***
				(0.076)	(0.065)	(0.072)
$\Delta_5 FTA_{ijt}$	0.192***	0.074*	0.118***	0.242***	0.085**	0.157***
	(0.053)	(0.043)	(0.046)	(0.056)	(0.10046)	(0.049)
$lag\ \Delta \mathrm{FTA}_{ijt}$				0.228***	0.084**	0.145***
				(0.055)	(0.047)	(0.049)
$\Delta_5 TWPTA_{ijt}$	−0.001	0.012	–0.013	0.069	0.023	0.046
	(0.072)	(0.055)	(0.063)	(0.079)	(0.063)	(0.068)
$lag\ \Delta_5 TWPTA_{ijt}$				0.111*	0.071	0.041
				(0.071)	(0.063)	(0.068)
$\Delta_5 OWPTA_{ijt}$	0.072	–0.064	0.135**	0.116**	–0.043	0.159***
	(0.065)	(0.053)	(0.062)	(0.067)	(0.055)	(0.063)
$lag\ \Delta_5 OWPTA_{ijt}$				0.285***	0.171***	0.114**
				(0.069)	(0.055)	(0.067)
Constant	0.413***	0.167*	0.247*	0.608***	–0.089	0.697**
	(0.120)	(0.130)	(0.182)	(0.247)	(0.274)	(0.342)
Fixed effects						
Exporter-year $(i, t-(t-5))$	Yes	Yes	Yes	Yes	Yes	Yes

Importer-year $(j, t-(t-5))$	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair (ij)	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.294	0.365	0.357	0.330	0.402	0.403
No. OBS	48,619	48,619	48,619	41,767	41,767	41,767

Notes: Robust standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, in two-tailed t-tests.
Source: BBF (2014, p. 345)

Table 5 provides the estimation results of Equations (13)–(15) using the RGFD. The results are presented in the form of panels Set 1 and Set 2. The former does not control for lagged values of explanatory variables while the latter does. Each panel reports the results for three alternative LHS variables: bilateral trade, extensive margin, and intensive margin. Moreover, BBF (2014) have vertically ordered the list of existing PTAs from deeper to shallower economic integration. The results in column (1a) suggest that, deeper PTAs (CUs, common markets, and monetary unions) have larger effects on aggregate trade flows than FTAs, whereas FTAs have larger effects on trade than partial scope or unilateral agreements (OWPTA and TWPTA). The coefficient estimates on $\Delta_5 CUCMECU_{ijt}$ and $\Delta_5 FTA_{ijt}$ are economically and statistically significant. The extensive margin effects in column 1(b) are statistically significant for deep PTAs and FTAs; the effect is largest for deeper agreements ($\Delta_5 CUCMECU_{ijt}$), followed by FTAs ($\Delta_5 FTA_{ijt}$). The intensive margin effects in column 1(c) are economically and statistically significant for deep PTAs, FTAs, and OWPTA. Similarly, the effect is largest for deep PTAs, followed by OWPTA, and slightly smaller for FTAs. In the absence of lagged effects, a comparison between sets 1(b) and 1(c) for deep PTAs, FTAs, and

OWPTAs shows that the intensive margin effect is always larger than the extensive margin effect.

Results are not qualitatively affected by including the lag of explanatory variables. However, it is important to capture the effects of 10-year FTA changes in trade and margins. As discussed in chapter 2, PTA formation of includes long phase in period for preferential tariffs that can take more than 10 years. Baier and Bergstrand (2007) found that most of the impact of PTAs on aggregate trade flows was captured using two lagged variables of the PTA identificatory, which is equivalent to controlling for the PTA effects over 10 years. Considering deep PTAs in the specifications displayed in set 2, the results for aggregate trade are consistent with those shown in set 1. According to column 2a, the common membership in deep PTAs increases two members' bilateral trade flow by approximately 101% after 10 years ($e^{0.387+0.309} - 1 = 1.01$). We also find that the effect on trade flows is primarily driven by the intensive margin of trade in the short run. This finding is consistent with BBF's (2014) hypothesis. Comparing the results in columns 2b and 2c, we conclude that the intensive margin effect (0.281) dominates the extensive margin effect (0.106) for deep PTAs, with both effects being statistically significant. However, the lagged effect of the extensive margin (0.131) is statistically significant and larger than the current-period effect of the extensive margin effect. In contrast, the lagged intensive margin effect (0.179) is smaller than the current-period intensive margin effect (0.281).

Regarding FTAs, common membership in an FTA increases two members' bilateral trade flows by approximately 60% after 10 years ($e^{0.242+0.228} - 1 = 0.6$). Again, the intensive margin effects (0.118, 0.145) dominate the extensive margin effects (0.074, 0.084). For TWPTA, only the lagged effect (lag $\Delta_5 TWPTA$) change on Δ_5 in $TRADE_{ijt}$ is statistically significant. For aggregate trade, the results in column 2a indicate that common membership in TWPTA increases two members' bilateral trade flow by approximately 20% after 10 years ($e^{0.069+0.111} - 1 = 0.2$). Furthermore, the results suggest that the formation of a TWPTA does not have a statistically significant effect on both margins. In the short run, the intensive margin shows a larger effect (0.046) compared with the (0.023) effect for the extensive margin. However, the lagged effect of a TWPTA seems to yield the opposite result: the intensive margin shows a smaller effect (0.041) compared with (0.071) for the extensive margin. In general, the relative effects for $\Delta_5 TWPTA_{ijt}$ conformed to earlier result. For OWPTA, the current-period intensive margin effect (0.159) was economically and statistically significant and dominated the statistically insignificant extensive margin effect (−0.043). In conclusion, BBF (2014) conclude that deeper PTAs tend to have a greater effect on bilateral trade flows (BBF., 2014, p. 346).

Based on BBF's (2014) analysis using time-series cross-sectional data, the trade weights used in constructing EM_{ijt} and IM_{ijt} will change over time. Consequently, they considered using a "chain-weighted" approach for their RGFD specification to holding the trade weights. They used the same chain-weighting technique as that used in national income accounts because the LHS variables have a 5-year interval. For the $X_{Wjmt}s$, they used for t the geometric average of trade flows for corresponding years (beginning in 1965 and ending in 2000, i.e., the first 5-year period is 1960-1965).

Table 6: 5-Year Differenced Data (Chained)

Variable	Set 3 (RGFD-chained)		
	(a)	(b)	(c)
	$\Delta_5 \ln Trade_{ijt}$	$\Delta_5 \ln EM_{ijt}$	$\Delta_5 \ln IM_{ijt}$
$\Delta_5 CUCMECU_{ijt}$	0.387*** (0.072)	0.113** (0.068)	0.274*** (0.070)
$lag\ \Delta_5 CUCMECU_{ijt}$	0.309*** (0.076)	0.124** (0.067)	0.185*** (0.073)
$\Delta_5 FTA_{ijt}$	0.242*** (0.056)	0.090** (0.047)	0.152*** (0.050)
$lag\ \Delta \text{FTA}_{ijt}$	0.228*** (0.055)	0.076* (0.048)	0.153*** (0.050)
$\Delta_5 TWPTA_{ijt}$	0.069 (0.079)	0.025 (0.064)	0.044 (0.069)
$lag\ \Delta_5 TWPTA_{ijt}$	0.111* (0.071)	0.053 (0.064)	0.058 (0.069)
$\Delta_5 OWPTA_{ijt}$	0.116** (0.067)	−0.051 (0.055)	0.168** (0.064)
$lag\ \Delta_5 OWPTA_{ijt}$	0.285*** (0.069)	0.168*** (0.060)	0.117** (0.068)
Constant	0.608*** (0.247)	−0.066 (0.278)	0.679** (0.348)
Fixed effects			
Exporter-year $(i, t-(t-5))$	Yes	Yes	Yes
Importer-year $(j, t-(t-5))$	Yes	Yes	Yes
Country-pair (ij)	Yes	Yes	Yes
R^2	0.330	0.407	0.407
No. OBS	41,767	41,767	41,767

Notes: Robust standard errors are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively, in two-tailed t-tests.
Source: BBF. (2014, p. 346)

Table 6 presents the estimation results of equations (13)–(15) using trade margins based on chain-weighted trade weights. Comparing the results between Table 6 and set 2 of table 5, the alternative weighting approach does not seem to change the main conclusion regarding the effects of PTA formation on bilateral trade flow regressions. Likewise, the results in sets 3 and 2 do not significantly differ in terms of the effects of PTAs in determining the extensive and intensive margins of trade. For deep PTAs, the lagged extensive margin effect (0.124) is also statistically significant and larger than the current-period extensive margin effect (0.113). The lagged intensive margin effect (0.185) is smaller than the current-period intensive margin effect (0.274), as expected. Hence supporting similar results found in Table 5. Again, the results shown in Table 6 suggest that deeper integration agreements tend to have larger impacts on trade, and the effects of PTAs on the intensive margin effects tend to occur faster than extensive margin effects. However, selection bias (often referred to as "selection into exporting") can arise from existing fixed exporting costs and may be associated with firm heterogeneity in productivity (BBF, 2014, p. 346). Therefore, the results in tables 5 and 6 in BBF (2014) are sensitive to the absence of controls for sample selection and firm heterogeneity biases. For robustness, they used a panel adaption of Helpman et al.'s (2008) cross-sectional approach to controlling for selection bias and firm heterogeneity. The sensitivity analysis shows that the results do not significantly differ after correcting for sample selection and firm heterogeneity biases using the new approach.

Section 3.B - Baier, Yotov, and Zylkin (2019)

The small current levels of tariffs and the large PTA estimates from the existing literature demonstrate that the effect of PTAs on bilateral trade exceeds the simple elimination of tariffs. Besides, BBF (2014) shows that the effects of PTAs on trade flows and its margins can widely vary depending on the type (depth) of agreement. Thus far, only a few theoretically grounded arguments have been proposed as to why these partial effects might differ systematically across various agreements. In their work, Baier, Yotov, and Zylkin (henceforth BYZ) (2019) aimed to identify meaningful and theoretically motivated sources of variation in predicting the effects of trade deals ex ante using data on trade and production for 70 countries over the period 1986–2006. These countries are listed in Appendix A3. In this section, we focus on the individual effects of the most prominent of these PTAs.

For computational purposes, BYZ (2019) combined 17 countries excluded from any PTAs during the period into a single "rest-of-the-world" aggregate region. Then, they expanded on the method proposed by Baier and Bergstrand (2007) and BBF (2014) to obtain the agreement-specific effects for each PTA signed during the period and the "direction-of-trade" specific estimates for each member pairing within a given agreement.

Given that PTAs have shifted their focus away from tariffs, an increasing number of applied studies in the computable general equilibrium (CGE) literature have attempted to identify the impacts of the non-tariff barriers of FTAs on trade flows and welfare levels. However, due to the complexity of this issue, even model results based on the best-possible estimates of non-tariff barriers may be extremely vulnerable to minor variations in methodology (Fugazza & Maur, 2008). Thus, we should interpret these estimates cautiously. Although BYZ's (2019) method lacks the specificity of a fully specified CGE framework clearly, they are able to identify several broad sources of variation in PTA effects on trade flows, which have been previously overlooked in the literature.

Importantly, BYZ (2019) examined the effects of individual agreements. By and large, most studies have failed to report that most PTAs have increased trade. For example, Kohl (2014) found that only 27% of PTAs had positive and significant effects on trade. In comparison, BYZ (2019) discovered that the majority (57%) of PTAs had a positive effect on trade. They identified three reasons for such a result. First, they followed the econometric recommendations of Santos and Tenreyro (2006) by using Poisson Pseudo-Maximum-Likelihood (PPML), as opposed to OLS, to account for the heteroskedasticity of trade data. Then, they also used the information contained in zero trade. Second, BYZ (2019) captured the possibility that reducing internal trade would increase trading activities between liberalizing countries. Third, as mentioned previously, the formation of PTAs includes several adjustments, along with the phasing of different provisions that may accompany PTAs. Thus, we should allow agreements to have lagged effects that accumulate over time.

$$X_{ij} = \frac{A_i w_i^{-\theta} \tau_{ij}^{-\theta}}{\sum_i A_i w_i^{-\theta} \tau_{ij}^{-\theta}} E_j. \tag{16}$$

Equation (16) is a “structure gravity” equation originally derived by Anderson (1979). In turn, Baier and Bergstrand (2007) extended this to the panel dimension. In the equation, X_{ij} is the value of country i’s export goods to country j, E_j is the total expenditure by purchasers in j on goods across all different origins (including goods produced domestically in j), A_i denotes the overall quality of the production technologies available in country i, w_i is the wage in i, and τ_{ij} is the "iceberg" trade cost[14] required to send goods from i to j. Thus, the share of j's expenditure that is specifically allocated to products from country i is directly dependent on three factors, namely, A_i, w_i, and τ_{ij}. The summation term in the denominator of Equation (16) represents the overall degree of competition in j's import market. Thus, the effects of production cost and trade cost on trade are subject to a constant trade elasticity $\theta > 1$, given that goods from different origins are assumed to be imperfectly substitutable. BYZ (2019) used a more compact way to write Equation (16) as follows:

$$X_{ij} = \frac{A_i w_i^{-\theta} \tau_{ij}^{-\theta}}{P_j^{-\theta}} E_j, \tag{17}$$

where $P_j^{-\theta} = \sum_i A_i w_i^{-\theta} \tau_{ij}^{-\theta}$. As noted by Anderson and van Wincoop (2003), $P_j^{-\theta}$ is a useful aggregate of all bilateral trade costs faced by country j's consumers. Meanwhile, Equation (17) has distinct i, j, and i by j components, thus lending itself naturally to deriving a "fixed effects" estimation equation for trade flows. As the general determinants of trade frictions have been widely explored in the broader gravity literature, such as geographical distance and historical affinities, BYZ (2019) focused instead on how changes in $\tau_{ij}^{-\theta}$ may vary widely even within the same agreement. Thus, they derived a panel implementation of Equation (17) that allowed the identification of an average PTA effect across all the agreements in their sample by adding a time subscript t and error terms ε_{ij}, t. Then, they re-wrote Equation (17) in exponential form, as follows:

[14] For each good, a certain fraction melts away during the trading process, as if an iceberg is "shipped" across the ocean. This can be regarded as a tariff equivalent on imported goods.

$$X_{ij,t} = \exp\left(lnA_{i,t}w_{i,t}^{-\theta} + ln\frac{E_{j,t}}{P_{j,t}^{-\theta}} + ln\tau_{ij,t}^{-\theta}\right) + \varepsilon_{ij,t}. \tag{18}$$

BYZ (2019) then used a generic functional form for the trade costs terms $ln\tau_{ij,t}^{-\theta}$ shown below.

$$ln\tau_{ij,t}^{-\theta} = Z_{ij}\delta + \beta_1 FTA_{ijt} + \beta_2 FTA_{ij,t-5} + u_{ij,t}, \tag{19}$$

where FTA_{ijt} is an indicator variable reflecting whether *i* and *j* have an PTA at time *t*, and Z_{ij} denotes a set of time-invariant controls for the general level of trade costs between country pairs with coefficient vector δ. In addition, $FTA_{ij,t-5}$ is a 5-year lag of $FTA_{ij,t}$ (BYZ, 2019, p. 209). As mentioned in Chapter 2, the time-invariant unobserved variable may cause endogeneity bias. A key insight from Baier and Bergstrand (2007) is that specific knowledge of δ is neither necessary nor sufficient in obtaining consistent estimates of the PTA effects. Instead, drawing on the standard panel estimation technique described in Wooldridge (2002), Baier and Bergstrand (2007) recommended using pair-specific fixed effects in place of $Z_{ij}\delta$; in this way, the time dimension of the panel identifies the (average) causal effect of PTAs on trade. BYZ (2019) accounted for the same strategy, with their baseline specification for estimating the average effect of PTAs on trade barriers shown below.

$$X_{ij,t} = \exp\left(\eta_{i,t} + \psi_{j,t} + \gamma_{\overline{ij}} + \beta_1 FTA_{ij,t} + \beta_2 FTA_{ij,t-5}\right) + \varepsilon_{ij,t}. \tag{20}$$

In the equation, $\eta_{i,t}$ and $\psi_{j,t}$ are the exporter-time and importer-time fixed effects controlling for all country-level factors on the exporter and on the importer side, respectively. In addition, $\eta_{i,t}$ and $\psi_{j,t}$ absorb the $lnA_{i,t}w_{i,t}^{-\theta}$ and $ln\,E_{j,t}/P_{j,t}^{-\theta}$ terms in

Equation (18), which are endogenous and cannot be observed directly. Meanwhile, $\gamma_{\overline{ij}}$ is a (symmetric) pair-wise fixed effect that strips out all the time-invariant determinants of trade barriers between i and j; the additive residual term $\varepsilon_{ij,t}$ is used to reflect the measurement error in trade values and the absorption of the error term in $ln\tau_{ij,t}^{-\theta}$ in Equation (18) (BYZ, 2019, p. 209).

In accordance with the recommendations of Silva and Tenreyro (2006, 2011) for minimizing bias in the gravity equation, BYZ (2019) used the PPML estimator to perform the estimation of specification (20). In doing so, they obtained their final baseline specification for estimating the PTA effects by incorporating the methods of Bergstrand et al. (2015), who argued that PTA estimates based on specification (20) may be biased upward, because the effects of globalization may be captured. In this process, international trade increases may actually occur at the expense of internal trade. Some goods are not traded at all, and a proportion of tradeable goods is sold domestically. Thus, we need to control for the shrinking amount of production sold domestically over time. Adapting a related idea from Yotov (2012), the simple adjustment proposed by Bergstrand et al. (2015) aims to control explicitly for the effects of globalization dummies. Thus, applied to their setting, this adjustment results in the econometric model expressed as

$$X_{ij,t} = \exp\left(\eta_{i,t} + \psi_{j,t} + \gamma_{\overline{ij}} + \beta_1 FTA_{ij,t} + \beta_2 FTA_{ij,t-5} + \textstyle\sum_t b_t\right) + \varepsilon_{ij.t}, \tag{21}$$

where $\sum_t b_t$ is a set of indicator variables taking a value of 1 for international trade observation at each time t and zero for internal trade observation at each time t. If there are trends in globalization over time, the coefficients of these time-varying border dummies (the b_t's) may increase over time as international trade increase slows down and activities with their own internal markets are reduced.

The average "total" effect of PTAs on trade is constructed as $\beta \equiv \beta_1 + \beta_2$ because of lagged effects. The specific interpretation of β can be described in two ways. First, from a strictly econometric perspective, β is the total average partial effect of a PTA on bilateral trade flows. In this case, exporter-time and importer-time fixed effects will influence the effect of PTA. Second, β gives the average treatment effect of an PTA, specifically on "trade cost." International trade increases do not directly imply reductions in the trade cost term ($ln\tau_{ij,t}^{-\theta}$). Owing to the presence of the time-varying exporter and importer fixed effects, only when trade increase between *i* and *j*—relative to each country's trade with all other partners—can the PTAs effect (β) be identified. Given that the average PTA effect is unable to provide predictions about the effects of specific PTAs, BYZ (2019) expanded three successive steps on the initial specification shown in (21), with the goal of capturing and analyzing the heterogeneous effect in the PTAs.

At this point, it should be noted that PTA effects vary based on the level of economic integration. First, BYZ (2019) used a distinct average partial effect $\beta_A \equiv \beta_{1,A} + \beta_{2,A}$ for each individual agreement, using superscript *A* to index by agreement and using subscripts 1 and 2 to refer to the concurrent- and lagged agreement-specific effects, respectively. Thus, this first refinement facilitates the acquisition of predictions about which PTAs in their sample promote more trade. Accordingly, specification (21) is modified to obtain the following:

$$X_{ij,t} = \exp\left(\eta_{i,t} + \psi_{j,t} + \gamma_{\overline{ij}} + \sum_A \beta_{1,A} FTA_{ij,t} + \sum_A \beta_{2,A} FTA_{ij,t-5} + \sum_t bt\right) + \varepsilon_{ij,t}. \quad (22)$$

However, the same agreement may not affect all countries involved in a similar manner. Thus, BYZ (2019) allowed for further heterogeneity at the level of each trading pair within an agreement.

$$X_{ij,t} = \exp\left(\eta_{i,t} + \psi_{j,t} + \gamma_{\overline{ij}} + \sum_A \sum_{p\in A} \beta_{1,A:p}\, FTA_{ij,t} + \sum_A \sum_{p\in A} \beta_{2,A:d}\, FTA_{ij,t-5} + \sum_t bt\right) + \varepsilon_{ij,t}. \tag{23}$$

Let $p \in A$ denote a pair of countries (i, j) belonging to agreement A, where the notation (i, j) and (j, i) represent the same pair: $\beta_{A:p} \equiv \beta_{1,A:p} + \beta_{2,A:p}$

However, even within a given pair, a PTA may not symmetrically affect trade in both directions. Thus, for this last refinement, BYZ (2019) used $d \in A$ to denote a unique "direction pair" of countries ($\overrightarrow{ij}$) belonging to agreement A, considering that (i, j) and (j, i) are different pairs. Hence, they estimated two effects for each agreement-pair, one for each direction of trade. The resulting equation is presented below.

$$X_{ij,t} = \exp(\eta_{i,t} + \psi_{j,t} + \gamma_{\overrightarrow{ij}} + \sum_A \sum_{d\in A} \beta_{1,A:d}\, FTA_{ij,t} + \sum_A \sum_{d\in A} \beta_{2,A:d}\, FTA_{ij,t-5} + \sum_t bt) + \varepsilon_{ij,t}. \tag{24}$$

Table 7: Estimates of Agreement-specific Effects

Agreement	β_A	s. e.	Agreement	β_A	s. e.
Positive effects:			(cont'd)		
Bulgaria-Turkey†	1.485	0.342	Israel-Mexico	0.553	0.136
EU-Romania†	1.463	0.142	EU-Turkey†	0.535	0.083
Romania-Turkey†	1.403	0.165	Canada-Costa Rica	0.492	0.189
Andean Community†	1.331	0.170	Canada-Israel†	0.481	0.091
Israel-Turkey†	1.269	0.434	Egypt-Turkey	0.463	0.232

EU-Bulgaria†	1.248	0.225	Chile-China	0.462	0.167
CEFTA†	1.240	0.242	Tunisia-Turkey	0.389	0.109
EU-Poland†	1.162	0.195	EU-Mexico	0.313	0.095
Costa Rica-Mexico	1.087	0.461	Chile-US	0.283	0.128
Mercosur†	1.024	0.205	EU-Tunisia	0.283	0.086
EU-Hungary†	0.996	0.170	Chile-South Korea	0.275	0.103
Poland-Turkey†	0.976	0.152			
Bulgaria-Israel†	0.948	0.212	Insignificant effects ($p > 0.05$):		
EFTA-Hungary†	0.939	0.244	Jordan-US	0.954	0.684
Hungary-Turkey†	0.932	0.132	Canada-Chile	0.851	0.447
EFTA-Poland†	0.921	0.193	Hungary-Israel	0.757	0.400
EFTA-Romania†	0.890	0.230	Mexico-Uruguay	0.463	0.377
Colombia-Mexico†	0.762	0.226	Chile-Costa Rica	0.419	0.313
EFTA-Bulgaria	0.740	0.353	EFTA-Morocco	0.384	0.234
Japan-Mexico†	0.701	0.115	Mercosur-Chile	0.353	0.244
NAFTA†	0.662	0.152	EFTA-Turkey	0.299	0.154
Australia-Thailand†	0.623	0.093	EU-EFTA	0.294	0.184
Mercosur-Andean†	0.622	0.125	Chile-Mexico	0.266	0.486
Israel-Poland	0.566	0.202	Agadir Agreement	0.188	0.123
Summary statistics					
Simple					
Median β^A estimate:			0.0.463		
Mean β^A estimate:			0.491		
Variance of estimate:			0.261		

Note: This table reports estimates of the partial PTA effects for all agreements in BYZ's (2019) sample. Standard errors are "three-way" clustered by exporter, importer, and year. † denotes estimates that are statistically different from the overall average estimate of $\beta = 0.293$. There are 33 such estimates, comprising 50.8% of the total.
Source: BYZ (2019, p. 214)

Table7: Estimates of Agreement-specific Effects (continued)

Agreement	β_A	s. e.
Insignificant effects ($p > .05$):		
Cont'd		
Israel-Romania	0.174	0.195
Pan Arab FTA	0.171	0.192
EU-Egypt	0.149	0.125
Australia-Singapore	0.139	0.282
EU-Morocco	0.117	0.090
Morocco-US	0.096	0.106
EU-Chile†	0.045	0.111
EU†	−0.016	0.066
Mercosur-Bolivia	0.007	0.260
EFTA-Singapore	−0.018	0.248
ASEAN†	−0.107	0.145
EFTA-Mexico†	−0.140	0.142
EFTA-Israel†	−0.213	0.129
Singapore-US	−0.279	0.312
Negative effects:		
Australia-US†	−0.170	0.064
EU-Cyprus†	−0.194	0.096
EU-Israel†	−0.256	0.080
Canada-US†	−0.375	0.126
Chile-Singapore†	−1.099	0.174
Summary statistics		
Weight averages		

By inverse variance	0.293
By number of country-pairs	0.382
By (#pair×inv. var):	0.200

Note: This table reports estimates of the partial PTA effects for all agreements in BYZ's (2019) sample. Standard errors are "three-way" clustered by exporter, importer, and year. † denotes estimates that are statistically different from the overall average estimate of $\beta = 0.293$. There are 33 such estimates, comprising 50.8% of the total.
Source: BYZ (2019, p. 214)

Tables 7 and Table 7 (continued) present BYZ's (2019) estimates of agreement-specific effects that are grouped by sign and significance and listed in descending order. As can be seen, 7.6% (5/65) of the coefficient estimates are negative and significant at the 5% level ($p - value\ less\ than\ 0.05$), while 38.5% (25/65) of the coefficient estimates are statistically insignificant. Hence, the majority of agreements in BYZ's (2019) sample have positive and statistically significant partial effects (1-7.6%–38.5%=53.9%). As shown in Dai et al. (2014), internal trade is a crucial factor in the overall reference group for estimating the theoretically consistent effects of trade policies. Thus, estimations that include internal trade generally yield larger, more precisely estimated PTA effects (BYZ, 2019, p. 213). In the first column of Table 7, we can clearly see that some country pairs, such as the Bulgaria–Turkey (1.485), EU–Romania (1.463), and EU–Poland (1.162) pairs, have consistently larger (partial equilibrium) impacts from PTAs compared with others.

Moreover, the agreements signed by the Israel–Turkey (1.269) and Costa Rica–Mexico (1.087) pairs as well as Mercosur (1.024) and the Andean Community (1.331) generally have strong effects. Aside from Israel and Turkey, other Mediterranean nations have generally experienced more modest impacts. However, Tarlea (2018) considered A negative coefficient estimated for export growth rate might not thus imply less trade. It can suggest a deceleration of trade, such as Canada–US pair. These results are not indicative of an actual slowdown in trade during negotiations in absolute terms. Overall, the estimates from Tables 7 and Table 7 (continued) confirm that PTAs have had very heterogeneous effects on trade. For robustness, BYZ (2019) deepened the analysis in three important ways: (1) they examined how the same agreement can affect different pairs of member countries, (2) they used direction-specific PTA effects to determine how the agreement can affect the country specifically, and (3) they placed greater emphasis on agreement-pair level and direction-specific PTA estimates to obtain more precise results.

Table 8 and Table 8 (continued) present summaries of the heterogeneities observed by BYZ (2019) after performing the agreement-pair level and direction-specific estimates, respectively. Both tables offer snapshots of the substantial variation in partial effects, which can be observed within a single agreement. BYZ (2019) used the EU as their example, because it is the largest agreement in the sample so far. In fact, there are 98 distinct pair-specific effects and 196 direction-specific effects in their analysis (BYZ, 2019). However, rather than show all these estimates, Table 8 roughly presents the upper and lower quartiles from the pair-specific effects, while Table 8 (continued) presents some examples of asymmetries within pairs. Similar to Table 7 and Table 7 (continued), the estimates of agreement-specific effects in Table 8 are also grouped by sign and significance and then listed in descending order. As discussed in BYZ (2019), 27.6% (27/98) of pairwise estimates are positive and statistically significant, while 13.3% (13/98) of pairwise estimates are negative and significant, as shown in Table 8.

Table 8: Heterogeneities in EU Accession Effects

Pair	$\beta_{EU:p}$	s. e.	Pair	$\beta_{EU:p}$	s. e.
Largest EU accession effects (by pair):					
Hungary-Poland*†	2.186	0.487	Germany-Sweden*†	−0.220	0.107
Cyprus-Finland*†	1.711	0.399	Finland-Italy†	−0.256	0.136
Hungary-Malta*†	1.600	0.571	Hungary-Ireland†	−0.269	0.264
Austria-Malta*	1.101	0.514	Ireland-Sweden*†	−0.291	0.144
Cyprus-Netherlands*†	0.716	0.135	Cyprus-Malta	−0.307	0.371
Cyprus-UK	0.703	0.370	Finland-Sweden*†	−0.312	0.102
Cyprus-Italy*	0.555	0.139	Denmark-Malta†	−0.327	0.193
France-Poland*	0.517	0.147	Finland-UK*†	−0.331	0.133
Cyprus-Hungary*	0.503	0.251	Cyprus-Ireland*†	−0.334	0.159
BLX-Cyprus*	0.493	0.176	Finland-Ireland*†	−0.356	0.125
Finland-Hungary	0.470	0.418	Italy-Sweden*†	−0.360	0.087
UK-Poland*	0.469	0.225	BLX-Hungary†	−0.399	0.210
Cyprus-Greece*	0.457	0.196	Denmark-Finland*†	−0.443	0.150
Cyprus-Germany*	0.456	0.153	Cyprus-Denmark*†	−0.455	0.213
Denmark-Hungary*	0.437	0.149	Italy-Malta†	−0.584	0.403
BLX-Sweden*	0.431	0.129	Finland-Portugal†	−0.630	0.441
Spain-Poland	0.412	0.228	Portugal-Sweden*†	−0.694	0.353
UK-Hungary	0.400	0.218	Ireland-Malta*†	−1.069	0.232
Austria-BLX*	0.394	0.086	Cyprus-Poland*†	−1.220	0.247
Austria-Spain*	0.375	0.191	Greece-Malta*†	−1.819	0.308
Italy-Poland*	0.370	0.168			

BLX-Finland*	0.352	0.100
Austria-Poland*	0.352	0.105
Germany-Poland*	0.334	0.110
Small and negative EU accession effects (by pair):		
Austria-Sweden†	−0.202	0.107
Germany-Malta†	−0.205	0.112
Greece-Sweden†	−0.210	0.255
UK-Sweden†	−0.213	0.143

Note: This table reports examples of pair-specific and asymmetric estimated partial effects for the EU accessions. * denotes estimates that are statistically different from 0. † denotes estimates that are statistically different from the overall average estimate of $\beta =$ 0.293.
Source: BYZ (2019, p. 215)

Table 8: Heterogeneity in EU Accession Effects (continued)

Pair	$\beta_{EU:d}$	s. e.	Pair	$\beta_{EU:d}$	s. e.
Examples of asymmetric EU accession effects:					
Netherlands → Austria*	0.418	0.158	UK → Sweden	0.048	0.197
Austria → Netherlands*†	−0.486	0.162	Sweden → UK*†	−0.431	0.182
Poland → Spain*	0.795	0.258	Spain → Sweden	0.285	0.209
Spain → Poland	0.057	0.183	Sweden → Spain†	−0.152	0.207
Poland → UK*†	0.825	0.266	Poland → Austria*	0.575	0.186
UK → Poland	0.100	0.184	Austria → Poland	0.157	0.152
Netherlands →	0.317	0.199	Poland → Netherlands	0.364	0.193

Sweden					
Sweden → Netherlands†	−0.353	0.200	Netherlands →Poland	0.157	0.158
Spain →Austria*†	0.734	0.212	Sweden →Austria	−0.105	0.224
Austria →Spain	0.110	0.187	Austria →Sweden†	−0.293	0.239
Poland →Sweden*	0.549	0.223	UK →Austria	0.342	0.141
Sweden →Poland	0.040	0.156	Austria →UK	0.197	0.147
Summary of within-EU estimates pairwise estimates ($\beta_{EU:p}$):			Directional estimates ($\beta_{EU:d}$):		
Mean: 0.047	Median: 0.046	s.d.: 0.514	Mean: 0.085	Median: 0.048	s.d.:0.574
#positive and significant		27/98 (27.6%)	#positive and significant		37/196 (18.9%)
#negative and significant		13/98 (13.3%)	#negative and significant		26/196 (13.3%)
#statistically different from $\beta = 0.293$		41/98 (41.8%)	#statistically different from $\beta = 0.293$		82/196 (41.8%)

Note: The arrows indicate the direction of trade. This table reports examples of pair-specific and asymmetric estimated partial effects for the EU accessions. * denotes estimates that are statistically different from 0. † denotes estimates that are statistically different from the overall average estimate of β = 0.293.
Source: BYZ (2019, p. 215)

Compared to those in Tables 7 and Table 7 (continued), the rankings of the various estimates in Table 8 and Table 8 (continued) seem to display greater heterogeneity, suggesting that country-pair specific analysis is required to understand the effects of PTAs across members. In fact, BYZ (2019) expected that more detailed estimates would exhibit greater estimation noise. Importantly, Table 8 (continued) presents some representative examples of EU pairs in which country-pair asymmetries in the EU effect seem paramount. For instance, asymmetries in the Poland–Spain and Poland–UK pairs (as exporters) seem quite relevant. Poland's accession led to a greater increase in Polish exports to existing EU members than imports from them. On the contrary, the results in Table 8 (continued) show that Austrian imports tend to increase much more than their exports to other EU members. Simultaneously, one may find similar patterns for Sweden (as an acceding country in 1995) in terms of its EU effects with other members. Overall, these examples suggest that, even within certain agreements, there can be large, country-specific heterogeneous PTA effects that are worthy of further investigation.

Chapter 4 - Conclusion

In this report, we briefly describe the evolution and relative importance of various types of PTAs. We have also explained the rules allowing for trade to be preferentially liberalized between two countries or among a small group of countries. PTAs not only focus on phasing out tariffs; in many cases, also involve promoting conditions to increase cross-border investments, facilitate trade-related dispute resolution, and, sometimes to establish competition policies. Our focus is the discussion of the main papers that evaluate the impacts of PTAs on international trade flows.

First, Baier and Bergstrand (2007) provided a thorough empirical analysis of the average treatment effect of FTAs on trade. In accordance with their work, we can confirm that the trade creation effect of PTAs is really large and that it is important to account for the long tariff phase out periods that are characteristic of these agreements. However, BBF (2014) illustrated that the magnitude of the effect depends on the type of PTAs, where deeper integration agreements clearly have larger impacts on aggregate trade flows and in trade margins than shallower agreements. In addition, the intensive margin effects occur sooner than extensive margin effects for deep PTAs, FTAs, and OWPTA.

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Appendix

Table A.1 below lists the 96 countries that have been potentially used in the regressions, depending on the availability of non-zero and non-missing trade flows.

Table A.2 below lists the 183 countries that joined EIAs included in Baier and Bergstrand's data set for 2014.

Table A.3 below lists the 70 countries that have been used for quantifying and studying heterogeneity in the effects of PTAs.

Table A.1: Countries Used in the Regressions

Austria	Belgium–Luxembourg	Denmark
Finland	France	Germany
Greece	Ireland	Italy
Netherlands	Norway	Portugal
Spain	Sweden	Switzerland
United Kingdom	Canada	Costa Rica
Dominican Republic	El Salvador	Guatemala
Haiti	Honduras	Jamaica
Mexico	Nicaragua	Panama
Trinidad and Tobago	United States	Argentina
Bolivia	Brazil	Chile
Colombia	Ecuador	Guyana
Paraguay	Peru	Uruguay
Venezuela	Australia	New Zealand
Bulgaria	Hungary	Poland
Romania	Egypt	India
Japan	Philippines	Thailand
Turkey	Korea	Algeria
Angola	Ghana	Kenya
Morocco	Mozambique	Nigeria
Tunisia	Uganda	Zambia
Zimbabwe	China (Hong Kong)	Indonesia
Iran	Israel	Pakistan
Singapore	Sri Lanka	Syrian Arab Republic
China,P.R.: Mainland	Albania	Bangladesh
Burkina Faso	Cameroon	Cyprus
Côte d'Ivoire	Ethiopia	Gabon
Gambia, The	Guinea–Bissau	Madagascar
Malawi	Malaysia	Mali
Mauritania	Mauritius	Niger
Saudi Arabia	Senegal	Sierra Leone
Sudan	Congo, Dem. Rep. of	Congo, Republic of

Source: Baier and Bergstrand (2007, p. 93)

Table A.2: Countries Joined EIAs

Afghanistan	Djibouti	Kuwait	Qatar
Albania	Dominica	Kyrgyz Republic	Romania
Algeria	Dominican Republic	Laos	Russian Federation
Angola	Ecuador	Latvia	Rwanda
Antigua And Barbuda	Egypt, Arab Rep.	Lebanon	Samoa
Argentina	El Salvador	Lesotho	San Marino
Armenia	Equatorial Guinea	Liberia	Sao Tome and Principe
Australia	Eritrea	Libya	Saudi Arabia
Austria	Estonia	Lithuania	Senegal
Azerbaijan	Ethiopia	Luxembourg	Seychelles
Bahamas	Faeroe Islands	Macao	Singapore
Bahrain	Fiji	Macedonia, FYR	Slovak Republic
Bangladesh	Finland	Madagascar	Slovenia
Barbados	France	Malawi	Solomon Islands
Belarus	Gabon	Malaysia	Somalia
Belgium	Gambia	Maldives	South Africa
Belize	Georgia	Mali	Spain
Benin	Germany	Malta	Sri Lanka
Bermuda	Ghana	Marshall Islands	St. Kitts and Nevis
Bhutan	Greece	Mauritania	St. Lucia
Bolivia	Greenland	Mauritius	St. Vincent and the Grenadines
Bosnia and Herzegovina	Grenada	Mexico	Sudan
Botswana	Guatemala	Micronesia	Suriname
Brazil	Guinea	Moldova	Swaziland
Brunei Darussalam	Guinea-Bissau	Mongolia	Sweden
Bulgaria	Guyana	Morocco	Switzerland
Burkina Faso	Haiti	Mozambique	Syrian Arab Republic
Burundi	Honduras	Myanmar (Burma)	Tajikistan
Cambodia	Hong Kong	Namibia	Tanzania
Cameroon	Hungary	Nepal	Thailand
Canada	Iceland	Netherlands	Togo
Cape Verde	India	New Caledonia	Tonga
Cayman Islands	Indonesia	New Zealand	Trinidad And Tobago
Central African Republic	Iran, Islamic Rep.	Nicaragua	Tunisia
Chad	Iraq	Niger	Turkmenistan
Chile	Ireland	Nigeria	Uganda
China	Israel	Norway	Ukraine
Colombia	Italy	Oman	United Arab Emirates
Comoros	Ivory Coast	Pakistan	United Kingdom
Congo, Dem. Rep.	Jamaica	Panama	United States
Costa Rica	Japan	Papua New Guinea	Uruguay
Croatia	Jordan	Paraguay	Uzbekistan
Cuba	Kazakhstan	Peru	Venezuela
Cyprus	Kenya	Philippines	Vietnam
Czech Republic	Kiribati	Poland	Yemen
Denmark	Korea, Rep.	Portugal	

Source: Country list in Baier, Bergstrand, and Clance (2015)

Table A.3: Countries used for quantifying and studying heterogeneity in the effect of PTAs

Main sample *(52 countries/regions)*: Argentina, Australia, Austria, Bulgaria, Belgium-Luxembourg, Bolivia, Brazil, Canada, Switzerland, Chile, China, Colombia, Costa Rica, Cyprus, Germany, Denmark, Ecuador, Egypt, Spain, Finland, France, United Kingdom, Greece, Hungary, Indonesia, Ireland, Iceland, Israel, Italy, Jordan, Japan, South Korea, Kuwait, Morocco, Mexico, Malta, Myanmar, Malaysia, Netherlands, Norway, Philippines, Poland, Portugal, Qatar, Romania, Singapore, Sweden, Thailand, Tunisia, Turkey, Uruguay, United States.

"Rest of World" *(17 countries/regions)*: Cameroon, Hong Kong, India, Iran, Kenya, Sri Lanka, Macau, Mauritius, Malawi, Niger, Nigeria, Nepal, Panama, Senegal, Trinidad & Tobago, Tanzania, South Africa.

Source: BYZ (2019, p. 225)