Trade Creation and Diversion Revisited: Accounting for Model Uncertainty and Natural Trading Partner Effects*

Theo S. Eicher
University of Washington

Christian Henn
International Monetary Fund

Chris Papageorgiou†
International Monetary Fund

September 24, 2009

Abstract

The effect of Preferential Trade Agreements (PTAs) on trade flows is subject to model uncertainty stemming from the diverse and even contradictory effects suggested by the theoretical PTA literature. The existing empirical literature has produced remarkably disparate results and the wide variety of empirical approaches reflects the uncertainty about the "correct" set of explanatory variables that ought to be included in the analysis. To account for the model uncertainty that surrounds the validity of the competing PTA theories, we introduce Bayesian Model Averaging (BMA) to the PTA literature. Statistical theory shows that BMA successfully incorporates model uncertainty in linear regression analysis by minimizing the mean squared error, and by generating predictive distributions with optimal predictive performance. Once model uncertainty is addressed as part of the empirical strategy, we find strong evidence of trade creation, trade diversion, and open bloc effects. Our results are robust to a range of alternative empirical specifications proposed by the recent PTA literature.

JEL Classification: F10, F15, C11.

Keywords: Trade Creation, Trade Diversion, Preferential Trade Agreements, Bayesian Model Averaging.

*We thank the editor and four anonymous referees for many valuable comments and suggestions. We also thank Steven Yamarik for sharing his dataset and Serban Ranca for outstanding research assistance. Brian Donhauser and Alan van der Hilst provided helpful comments. Christian Henn acknowledges support from the Henry Buechel Memorial Fellowship. The views expressed in this study are the sole responsibility of the authors and should not be attributed to the International Monetary Fund, its Executive Board, or its management.

†Send correspondence to Chris Papageorgiou, Research Department, International Monetary Fund, 700 19th Street, NW Washington, DC 20431, email: cpapageorgiou@imf.org, tel: (202) 623-7503, fax: (202) 589-7503.

1 Introduction

Bhagwati and Panagariya (1996) call Preferential Trading Arrangements (PTAs) "two faced" because PTAs introduce trade liberalization at the cost of discrimination. The controversy regarding the costs and benefits of PTAs has raged since the 1950s, due to the potential for trade creation and trade diversion (Viner, 1950). Time has not provided a consensus; to the contrary, with the proliferation of PTAs in the 1990s, the number of theories that predict either increasing or decreasing trade flows among (non)members increased in tandem. And as the number of theories expanded, the set of candidate regressors suggested by empirical PTA approached the point where comprehensive robustness has become virtually unfeasible. Consequently, it has become common practice in this literature to juxtapose results that represent alternative PTA approaches. It is therefore not surprising that PTA coefficient estimates have been found to be highly sensitive to the specific set of regressors used in any given study (see Baxter and Kouparitsas, 2006).

Ghosh and Yamarik (2004) provide the most extensive PTA robustness analysis to date. Not only do they include a large set of PTAs, but also they employ Extreme Bound Analysis (Leamer, 1983) to examine a diverse set of PTA theories. Ghosh and Yamarik (2004) find little evidence for either trade creating or trade diverting PTAs. They conclude that "... the pervasive trade creation effect found in the literature reflects not the information content of the data but rather the unacknowledged beliefs of the researchers."

In this paper we apply Bayesian Model Averaging (BMA) to the PTA literature to reexamine PTA model uncertainty. BMA is specifically designed to incorporate model uncertainty into the estimation process, and it is firmly rooted in statistical theory. It is a methodology that explores the model space without restrictions, weighs each model according to quality, and provides a probability distribution for each coefficient estimate. Raftery and Zheng (2002) prove that BMA maximizes predictive performance while minimizing the total error rate when compared to any individual model. The rapidly growing list of economics applications using BMA include policy evaluations (e.g. Brock, Durlauf and West, 2003) monetary policy (e.g. Levin and Williams, 2003), macroeconomic forecasting (e.g. Garratt, Lee, Pesaran and Shin, 2003), economic growth (e.g., Fernandez, Ley and Steel, 2001), and international economics (e.g., Chen and Rogoff, 2006).

The issue of model uncertainty surrounding PTA effects is well known in the PTA literature. Seldom do papers present less than a dozen different PTA regression specifications. This is why Ghosh and Yamarik's (2004) findings are so troublesome. We show that BMA overturns the fundamental Ghosh and Yamarik result by identifying a number of PTAs that exert decisive effects on trade flows. Since Ghosh and Yamarik (2004), the PTA literature has evolved to introduce a number of innovations that address omitted variable

bias. We show that our main finding of measurable PTA effects on trade flows is robust to an update of the Ghosh and Yamarik (2004) dataset to include additional years, additional PTAs, and alternative fixed effect specifications.[1] Our methodological extensions include a full account of multilateral resistance (see e.g., Anderson and van Wincoop, 2003; Subramanian and Wei, 2007), bilateral unobserved heterogeneity (see, e.g., Glick and Rose, 2002; Egger and Pfaffenmayr, 2003), and accession dynamics (Freund and McLaren, 1999). Our approach follows a voluminous literature spanned by Frankel, Stein and Wei (1995, 1997), Rose and van Wincoop (2001), Frankel and Rose (2002), and Rose (2004).[2]

Our BMA benchmark specification, using Ghosh and Yamarik's (2004) own dataset, shows strong trade creation, trade diversion, and open bloc effects for 12 PTAs.[3] Our results are at odds with Ghosh and Yamarik (2004), even if we use their identical dataset, and the differences arise for the following two reasons:[4] First, BMA inference is based on an unrestricted search of the model space spanned by all candidate regressors, while Extreme Bound Analysis covers only a fraction of the model space due to the researcher's categorization of variables into "free" (variables that should always be included in the regression specification) and "doubtful" (variables that *may* be effective in the regression specification). Second, BMA theory requires that each model is weighed according to its posterior model probability (which is associated with the model's quality or performance), while Extreme Bound Analysis weighs all models equally and thus attributes the same power of inference to exceptionally weak and strong models.

Even after we extend the Ghosh and Yamarik data from 1970-1995 to 1960-2000 and include more recent bilateral trade agreements, our results are robust. Indeed a number of PTAs are estimated with increased precision, which allows us to identify additional trade creating PTAs. The updated dataset also modifies the counterintuitive trade diversion effects (for NAFTA) and unexpectedly large open bloc effects (for MERCOSUR) that wereimplied by the Ghosh and Yamarik data. Controlling for multilateral resistance, does not affect our result qualitatively and the vast majority of PTAs is shown to exert influence on trade flows, most in trade creating direction.

Our approach to addressing multilateral resistance follows directly from Anderson and van Wincoop

[1] It is important to note that most of the literature has ignored general equilibrium effects and estimates. The primary goal of this paper is to flag more robust estimates of the "partial" or direct effects of PTAs and other controls, in order to provide potentially better inputs for general equilibrium comparative statics.

[2] An appealing alternative is to examine the intensive and extensive margins of trade as proposed by Helpman, Melitz and Rubinsein (2008), and Felbermayr and Kohler (2006). We leave this to future research

[3] It is common in Extreme Bound Analysis to attach all the weight of the posterior to the prior distribution. While Extreme Bound Analysis provides no guidelines, Ghosh and Yamarik (2004) also examine the case where 95 percent of the weight of the posterior distribution is on the prior and 5 percent on the sampling distribution – in this case they find trade creation in four PTAs (CACM, CARICOM, MERCOSUR and APEC).

[4] Previous comparisons between Extreme Bound Analysis and BMA results have also found Extreme Bound Analysis to be excessively stringent (see Sala-i-Martin, 1997; and Fernandez, Ley and Steel, 2001a).

(2003) and Novy (2006, 2007), as implemented by Subramanian and Wei (2007) but in a different context that did not address PTA effects. As a corollary, we also show that estimates based on multilateral resistance are generally larger than estimates that account for unobserved country-pair heterogeneity (an approach advocated by Glick and Rose, 2002; Rose, 2004; and Rose, 2005). This may be due to the methodological difference, where country-pair fixed effects render estimates that measure only those PTA effects that are directly related to accession. This raises the question of accession dynamics. Our final result highlights that PTA trade effects generally appear *after* accession; although we also find PTAs with observable effects at or even pre-accession.

The remainder of the paper is organized as follows. Section 2 discusses the basic framework of the BMA methodology used in our estimation. In section 3 we take a look at the datasets employed, and in Section 4 we report and discuss our results. Section 5 concludes.

2 The Empirical Framework

Econometric studies that seek to identify the impact of PTAs on trade flows are generally based on the gravity model.[5] The approach fits the application particularly well, due to the gravity model's proven efficiency in predicting trade flows (see Frankel and Romer, 1999). This allows PTA coefficients to pick up on deviations between predicted and actual trade.

Ghosh and Yamarik (2004) include dummies that capture PTA effects on bilateral trade and a matrix of other covarites, Z_{ijt},[6] obtaining

$$\log T_{ijt} = \alpha_t + \beta_1 \log Y_{it} Y_{jt} + \beta_2 \log D_{ij} + \beta_3 Z_{ijt} + \beta_4 PTA_{ijt} + \beta_5 PTA_{it} + \varepsilon_{ijt}, \tag{1}$$

where bilateral trade, T_{ijt}, between countries i and j at time t depends positively on national incomes, Y_{it} and Y_{jt}, and negatively on bilateral distance, D_{ij}. Typically a matrix of covariates, Z_{ijt}, is included to represent alternative trade theories and to proxy for unobservable trade costs. The inclusion of time fixed effects, α_t, is standard in the literature to eliminate bias resulting from aggregate shocks to world trade, such as global income shocks. Time fixed effects also mitigate any spurious correlation introduced, for example, by the use of a U.S. price index to deflate all trade flows. Two sets of zero-one dummy variables are included for each time interval, t. PTA_{ijt} indicates that both trading partners are members of the same PTA in a given time interval, and PTA_{it} indicates that only one member has joined. These dummies enable us to isolate the three distinct effects that PTAs may exert on trade flows. A positive coefficient on PTA_{ijt}

[5] The theoretical foundations of the gravity model are presented in Frankel (1997) and Deardorff (1998).
[6] The set of specific correlates used are discussed in Section 2.1.

captures trade creation among PTA members, while trade diversion registers a negative PTA_{it} coefficient. Finally, open bloc trade creation is simply the opposite of trade diversion, characterized by a positive PTA_{it} coefficient.

Due to a cross-section dependence that may be present because of unobserved (heterogeneous) time-specific factors in the gravity equation, Serlenga and Shin (2007) show that the gravity equation may be biased. Pesaran (2006) proposes an alternative estimator that explicitly addresses such dependencies, which was applied and developed further in the context of the gravity equation by Serlenga and Shin (2007). For our BMA application such estimator does not yet exist, and we limit ourselves to following previous approaches. While we are mindful of the bias, we do think it is important to compare results using a principled approach to model uncertainty that generates policy relevant estimates.

Equation (1) can be extended to control for multilateral resistance and country-pair fixed effects. In place of average trade, multilateral resistance requires the use of either bilateral imports (Subramanian and Wei, 2007) or bilateral exports (Novy 2006, 2007) as the dependent variable.[7] Here we largely follow Subramanian and Wei (2007) to generate results that are comparable to their benchmark.

$$\log\left(Imports_{ijt}\right) = \alpha_t + \alpha_{it} + \alpha_{jt} + \beta_2 \log D_{ij} + \beta_3 \tilde{Z}_{ijt} + \beta_4 PTA_{ijt} + \varepsilon_{ijt}. \tag{2}$$

The added advantage of using bilateral imports, $Imports_{ijt}$, as the dependent variable is that it avoids bias induced from averaging trade flows (see Baldwin and Taglioni, 2006).[8] Since any nation faces only one import/export price index at any point in time, multilateral resistance can be accounted for with time-varying country fixed effects (represented by α_{it} and α_{jt}).[9] The inclusion of these time-varying importer and exporter effects requires, however, the dependent variable to be bilateral imports instead of the commonly used average trade flow variable. Multilateral resistance controls in (2) absorb some of the covariates, which reduces Z_{ijt} to $\tilde{Z}_{ijt}$. Most notably the remoteness measure is now absorbed, which shows why multilateral resistance is preferred. Remoteness addressed only physical remoteness, which does not change over time; while multilateral resistance accounts not only for geographic remoteness but also for variations in prices of all trading partners.

In addition, multicollinearity no longer allows for the identification of separate trade creation and diversion effects.[10] Instead the PTA_{ijt} dummies represent net trade creation. For a given year, a typical PTA member

[7] Some argue that this is advantageous, since trade theories yield predictions on unidirectional trade (see Freund, 2000; Anderson and van Wincoop, 2003; Baldwin and Taglioni, 2006).

[8] Alternative estimation approaches can also address measurement error bias see Felbermayr and Kohler (2006), and Santos Silva and Tenreyro (2006).

[9] Time-varying country dummies are lucidly motivated by Baldwin and Taglioni (2006).

[10] Multicollinearity does not allow for separate trade creation and diversion effects in the presence of multilateral resistance

country's import observations are partitioned into a) imports originating from fellow PTA members and b) imports from non-members. The linear combination of two separate dummy variables for each type of imports would be perfectly collinear with time-varying importer dummy that controls for multilateral resistance. Hence the interpretation of the β_4 PTA coefficients in equations (2) and (3) below differ. In (2) the omitted categories are (i) no country is in the PTA and (ii) only country j is in the PTA (since there is an additional PTA$_i$dummy). In equation (3), however, there is no such PTA$_i$ dummy and thus the omitted benchmark changed.

Alternatively, unobserved country pair heterogeneity can be addressed by controlling for all time-invariant bilateral heterogeneity with country-pair fixed effects, α_{jt}, as follows:

$$\log\left(Imports_{ijt}\right) = \alpha_t + \alpha_{ij} + \beta_1 \log Y_{it}Y_{jt} + \beta_3 \bar{Z}_{ijt} + \beta_4 PTA_{ijt} + \varepsilon_{ijt}. \tag{3}$$

Note that all time-invariant regressors are now absorbed into the pair-specific fixed effects.[11] These fixed effects capture any similarities among trading partners that are constant over time. The country-pair fixed effects, together with Rose's remoteness variable to capture (albeit imperfectly) multilateral resistance, represents a general formulation of the gravity equation to address unobserved heterogeneity (e.g., Egger, 2000; Baldwin, 2005). If country-pair fixed effects are omitted, the PTA coefficients are biased upward picking up trade creation that is simply due to unobserved bilateral heterogeneity. Notice that the introduction of additional fixed effects that control for either multilateral resistance or unobserved country-pair heterogeneity actually absorb control variables that were introduced previously, which reduces the matrix of controls from $\bar{Z}_{ijt}$ (in equation 3) to $\tilde{Z}_{ijt}$ (in equation 2).

2.1 Model Uncertainty in PTA Theory

A voluminous theoretical literature discusses appropriate controls in gravity models, which includes references to geography, history, economic policy, and development and factor endowments. Each control is motivated by a particular theory. At times the same control is claimed for different theories (with opposite sign) to underline the rampant model uncertainty. Below we provide a brief description of the theoretical underpinnings of the various controls suggested by the previous literature. It is crucial to outline this diversity of approaches to justify the use of the model averaging methodology.

controls. For a given year, a typical PTA member country's import observations are partitioned into a) imports originating from fellow PTA members and b) imports from non-members. The linear combination of two separate dummy variables for each type of imports would be perfectly collinear with time-varying importer dummy that controls for multilateral resistance.

[11] We estimate equations (2-3) using the Andrews, Schank and Upward's (2006) "FEiLSDVj" estimator, which relies on partitioned regression techniques to reduce computational burden; it delivers identical results as LSDV regressions.

Table 1 summarizes the model uncertainty by tabulating the covariates suggested by earlier studies. It highlights the numerous attempts to identify determinants of trade flows and the associated diversity of results. The table underlines how important it is to address model uncertainty that is inherent in gravity/PTA regressions as part of the empirical strategy. When the uncertainty about the true specification is not accounted for in the econometric method, the precision of estimates is inflated, since they neglect the uncertainty surrounding the true theory.

It is important to outline the theoretical backbone of each covariate included in the analysis. Without theoretical support, the results are difficult to interpret. The first set of control variables capture historical ties, such as *Common Language*, *Common Colonizer*, or *Colony.* These covariates are commonly included to capture transaction costs due to communication and/or cultural differences.[12] Common historical ties lead to similar institutions and similar levels of development, implying reliable contractual and legal standards, as well as trust in shared values. Controlling for model uncertainty addresses not only which one of these regressors (or regressor combinations) is appropriate, but also whether their inclusion is indeed approximating the true model.

Geographic factors have been introduced as proxies for either transport costs (e.g., Aitken, 1973), trade-and-geography theories (e.g., Helpman and Krugman, 1985), or for New Trade Theories (e.g., Rivera-Batiz and Romer, 1991). *Remoteness* is widely used to capture the notion that relatively remote country pairs are expected to trade more, because they have fewer options in choosing trade partners.[13] It has also been motivated as a proxy for multilateral resistance, or the average trade costs facing a country (Brun, Guillamont and de Melo, 2005; Carrere, 2006). Land *Area* is intended to capture self-sufficiency and scale effects that are prominent in both the new trade and growth theories (e.g., Rose, 2000; Rose and Van Wincoop, 2001; Soloaga and Winters, 2001). Scale effects are also proxies for technology or knowledge spillovers (e.g., Grossman and Helpman, 1991).

Alternative proxies in the geography category, such as *Border*, *Landlocked*, and *Island* have previously been utilized by a variety of authors although it is not immediately clear why adjacency should matter after having controlled for distance.[14] Perhaps variables that measure distance center-to-center introduce errors that are mitigated by the additional controls because neighboring countries often engage in large volumes of border trade. BMA addresses the uncertainty among geography variables and resolves whether additional

[12] See Wei (1996), Frankel (1997), Rose (2000), Soloaga and Winters (2001), Rose and van Wincoop (2001), and Frankel and Rose (2002).

[13] See Wei (1996), Rose (2000), Soloaga and Winters (2001), and Baier and Bergstrand (2007).

[14] See Frankel and Romer (1999), Rose (2000), Feenstra, Markusen and Rose (2001), Rose and van Wincoop (2001), Soloaga and Winters (2001), and Frankel and Rose (2002).

variables for proximity ought to be included and which covariates are relevant to explaining how PTAs influence trade patterns.

Development and factor endowments covariates juxtapose the Heckscher-Ohlin factor endowments driven trade theory with Linder's (1961) hypothesis that similar countries trade more due to comparable tastes. Davis (1995) presents an augmented Heckscher-Ohlin-Ricardo model that provides support for either theory, depending on the technological distance between the countries and Spilimbergo and Stein (1998) examine the issue empirically. Common proxies for factor endowments differences are based on *Per Capita GDP, Schooling,* and *Population Density.*[15] The best theoretical rationale for *Per Capita GDP* is based on the strategic trade literature (e.g., Helpman and Krugman, 1985) that predicts intra-industry trade decreases as a result of differences in the countries' levels of development. Furthermore, countries with higher per capita GDP are likely to have better access to less distortionary revenue sources, hence they may experience more bilateral trade since they can afford lower tariffs.

Economic policy variables that are commonly included relate to trade/financial openness and exchange rate management. These are important controls as trade restrictions can explain deviations from trade pattern implied by the pure gravity equation. The *Sachs-Warner Trade Openness* variable is inserted into the gravity equation to account for trade policy effects. In addition, proxies that measure capital account openness, and financial transaction costs such as *Currency Union, Floating FX Rate,* and *FX Volatility* are usually included although it is not clear what coefficient estimates are to be expected. Clark et al. (2004) survey the literature and highlight that just this subset of regressors alone is so deeply affected by model uncertainty that the impact of exchange rate fluctuations depends on the specific assumptions of each model.[16]

Finally we address model uncertainty in the PTA theory itself.[17] Not only do we have opposing implications suggested by different theories, but at times opposing theories have been suggested by the same author (see e.g., Krugman, 1991a,b). The theory of PTAs is based on Viner's (1950) theory of trade creation and diversion. By the 1990s, a full scale discussion erupted regarding the drivers of trade creation and diversion. Krugman (1991a,b) examined the relative merits of PTAs in a static, monopolistically-competitive framework that emphasized economic geography. His first model implied PTAs should not be welfare creating in the absence of intercontinental transport costs. At the other extreme, Krugman's second model suggested

[15] They have been introduced by Frankel (1992), Frankel and Wei (1993), Frankel, Stein and Wei (1995), Frankel (1997), Freund (2000), Rose and van Wincoop (2001), and Frankel and Rose (2002).

[16] Authors who introduced such regressors into the gravity equation include Rose (2000), Frankel and Rose (2002), Rose and van Wincoop (2001), Glick and Rose (2002), and Tenreyro and Barro (2007).

[17] For a more detailed literature review see, Panagariya (1999, 2000).

regional PTAs increase trade flows and subsequently welfare in the presence of prohibitive inter-continental transport costs. Krugman's theories led Frankel, Stein, and Wei (1995), Frankel (1997), and Wei and Frankel (1998) to develop theories based on a continuum of transport costs. Their work characterizes trade partners as "natural" on the basis of relatively low intra-continental transport costs and their approach implies that trade creation among "natural" trading partners should dominate small trade diversion among remote country pairs from a welfare perspective. As trade costs fall, however, trade diversion may become larger since "natural" trading partners overly skew their trade toward PTA partners. Frankel, Stein and Wei (1995) suggest two hypotheses. First, the more remote trading partners are from the rest of the world, the more likely they are to form PTAs due to less potential trade diversion. This effect could be picked up by the *Remoteness* proxy, too. Second, the more "natural" trading partners are, the more likely PTAs are to lead to trade creation.

Krugman's and Frankel, Stein and Wei's theories are based on one factor – one industry models. Deardorff and Stern (1994) and Haveman (1996), note that these models preclude trade due to comparative advantage. Deardorff and Stern point out that this "stacks the cards" against bilateralism and argue that, given differences in factor endowments, trade with a few countries suffices in order to maximize gains from trade, so that trade diversion would be minimal. In response, Baier and Bergstrand (2004) construct a model that builds upon Frankel, Stein and Wei (1995) to allow for comparative advantage and scale effects. Freund (2000) argues strongly for PTA open bloc trade creation effects (even if trade creation among members is absent) since PTAs help outside exporters overcome fixed trade costs. Trade diverting effects, instead, are highlighted by Bond and Syropoulos (1996) and Syropoulos (1999), who indicate that the increased market power of PTAs, relative to the market power of each member taken individually, may lead to higher external tariffs.

2.2 Bayesian Model Averaging

Next we briefly comment on the BMA methodology used in our estimation. We limit ourselves to discussing the properties relevant to our application. The interested reader is referred to the comprehensive tutorial by Raftery, Madigan and Hoeting (1997) for further discussion.[18] BMA is a natural candidate to address model uncertainty surrounding the correct controls in equations (1)-(3), since it provides a probability distribution over the model space as well as over the parameter space. In our PTA estimation, the model space consists of

[18] For recent methodological contributions to BMA see e.g. Doppelhofer and Weeks (forthcoming), Ley and Steel (2007, forthcoming), and Eicher, Papageorgiou and Raftery (forthcoming). For recent applications see e.g. Crespo Cuaresma and Doppelhofer (2007) and Masanjala and Papageorgiou (2008).

all the possible subsets of candidate regressors that have been suggested by the distinct theories summarized above.

For linear regression models, the basic BMA setup can be concisely summarized as follows. Given a dependent variable, Y, a number of observations, n, and a set of candidate regressors, $X_1, X_2, ..., X_k$, the variable selection problem is to assess the quality of model

$$Y = \alpha + \sum_{j=1}^{p} \beta_j X_j + \varepsilon, \tag{4}$$

where $X_1, X_2, ..., X_p$ is a subset of $X_1, X_2, ..., X_k$, and β is a vector of regression coefficients to be estimated. Note that (4) is specified for linear models. At this point no BMA search algorithms exist that search not only the linear model space, but also all of the possible nonlinear dimensions. Given the data, d, BMA first estimates a posterior distribution $P(\beta_r|d,\, M_k)$ for every candidate regressor, r, in every model M_k that includes β_r. It then combines all posterior distributions into a weighted averaged posterior distribution, $P(\beta_r|d)$, using each model's posterior probability, $P(M_k|d)$, as model weight

$$P(\beta_r|d) = \sum_{r\,\in M_k} P(\beta_r|d,\, M_k)\, P(M_k|d). \tag{5}$$

The posterior model probability of M_k is simply the ratio of its marginal likelihood to the sum of the marginal likelihoods over all other models

$$P(M_k|d) = \frac{l(d|M_k)}{\sum\limits_{h=1}^{2^k} l(d|M_h)}, \tag{6}$$

which posterior model probabilities are also the weights used to establish the posterior means and variances

$$\mu \equiv E\left[\beta_k|d\right] = \sum_{k\in M}^{K} \hat{\beta}_k P\left(M_k|d\right), \tag{7}$$

$$\sigma \equiv Var\left[\beta_k|d\right] = \sum_{k\in M}^{K} \left(Var\left[\beta_k|d, M_k\right] + \hat{\beta}_k^2\right) P\left(M_k|d\right) - E\left[\beta_k|d\right]^2. \tag{8}$$

Summing the posterior model probabilities over all models that include a candidate regressor, we obtain the posterior inclusion probability

$$P\left(\beta_k \neq 0|d\right) = \sum_{r\in M} P\left(M_k|d\right). \tag{9}$$

The posterior inclusion probability provides a probability statement regarding the importance of a regressor that directly addresses the researchers' prime concern: what is the probability that the regressor has a non-zero relationship with the dependent variable? The general rule developed by Jefferies (1961) and refined

by Kass and Raftery (1995) stipulates effect-thresholds for posterior probability. Posterior probabilities $<$ 50% are seen as *evidence against* an effect, and the evidence for an effect is either *weak*, *positive, strong*, or *decisive* for posterior probabilities ranging from 50-75%, 75-95%, 95-99%, and $>$ 99%, respectively. In our analysis, we refer to a regressor as "effective," if its posterior inclusion probability exceeds 50%.

BMA has a number of key advantages over estimating a single model, and over Extreme Bound Analysis. Raftery and Zheng (2003) show that BMA a) minimizes the total error rate (sum of Type I and Type II error probabilities), b) point estimates and predictions minimize mean squared error (MSE), and c) predictive distributions have optimal predictive performance relative to other approaches. Contrary to Extreme Bound Analysis, BMA examines the entire model space and imposes no restrictions on the model size. Ghosh and Yamarik (2004) only consider models that contain a specific number of fixed variables to which a specific number of regressors is rotated in and out across models, which limits the search for the exact model to a fraction of the model space. This has been shown to render Extreme Bound Analysis excessively stringent (see Sala-i-Martin, 1997).

3 Data

To start with, we use the Ghosh and Yamarik (2004) dataset to allow for a direct reexamination of their evidence using BMA as our alternative statistical methodology. The Ghosh and Yamarik dataset is based on Frankel and Rose (2002) that consists of 12 major PTAs,[19] 3,420 bilateral trade pairs at five year intervals from 1970 to 1995, and a total of 14,522 observations.[20] This dataset features average bilateral trade as the dependent variable, recorded in U.S. dollars and deflated by the U.S. GDP chained price index. In addition to the basic gravity and trade agreement variables, 16 controls variables have been suggested by various gravity approaches discussed in Section 2.1.

To address refinements in the theoretical and empirical trade flow specifications suggested by the recent literature, we expand the baseline dataset in several dimensions. We extend the time horizon from 1960 to 2000 and allow for 60 additional (bilateral) trade agreements that are included in Subramanian and Wei (2007). The total number of observations increase substantially to 37,983 observations. We follow Subramanian and Wei (2007) and choose bilateral imports as the dependent variable; nominal imports are

[19] The PTAs are the European Union (EU), European Free Trade Arrangement (EFTA), European Economic Area (EEA), Central American Common Market (CACM), Caribbean Community (CARICOM), North America Free Trade Arrangement (NAFTA), Latin America Integration Agreement (LAIA), Andean Pact (AP), Southern Cone Common Market (MERCOSUR), Association of South-East Asian Nations Free Trade Area (AFTA), Australia-New Zealand Trade Agreement (ANZCERTA), and Asian Pacific Economic Cooperation (APEC).

[20] See Ghosh and Yamarik (2004, Appendix C) for further details.

obtained from the IMF's *Direction of Trade Statistics*.[21] Overall our updated dataset extends the unbalanced panel of Subramanian and Wei (2007) in the following three dimensions: (a) disaggregates the Subramanian-Wei catch-all PTA variable, (b) allows for additional PTAs not considered in the Subramanian and Wei (2007),[22] (c) incorporates a comprehensive list of additional controls suggested by the previous literature. Detailed descriptions of PTAs and the controls in the extended dataset can be found in Tables 2a-c.

The Subramanian and Wei (2007) data is in turn based on Rose's (2002, 2004) work on the determinants of trade flows and we maintain their convention to include only observations of the about 280,000 observations whose trade values exceed $500,000. There exists, however, an important literature that seeks to understand the true nature of the data when zero trade flows are observed. If a zero trade values is an accurate representation of two countries goods trade, the information should not be excluded, since it holds information. However, in the log linear gravity equation, the log of zero is problematic. Frankel (1997) surveys the various approaches that have been introduced to address the issue. However the observed zero trade value may also be due to a rounding error or missing observations. Depending on the nature of these errors the estimates may be biased and inconsistent. Santos Silva and Tenreyro (2007) suggest the Poisson pseudo-maximum-likelihood (PPML) estimator to appropriately address the issue zero trade values. This method has been shown to reduce estimates by as much as 40 percent. Here we follow Rose's and Subramanian and Wei's OLS approach to maintain a comparison to their results, but also because the PPML theory for BMA has not been developed to date.

4 Results

4.1 PTA Trade Creation: Differences due to Methodologies

Ghosh and Yamarik (2004) embarked on the most comprehensive robustness test of PTAs to date. They considered not just a subset, but all major PTAs and employed Extreme Bound Analysis to explore the model space far beyond what ordinary robustness exercises can hope to represent. Our first objective is to replicate Ghosh and Yamarik's (2004) results using BMA methodology. Table 3 reports results for two specifications. Specification 1 employs BMA on the exact same data and regression equation in Ghosh and Yamarik (2004, equation 1). Specification 2 differs from Specification 1 only in that it uses our new updated dataset based on Subramanian and Wei (2007).

[21] Note that Subramanian and Wei (2007) deflate bilateral imports by the U.S. CPI. Here we use nominal import values as they yield the same results once time fixed effects are included (see Baldwin and Taglioni, 2006).

[22] This extension adds the European Free Trade Agreement (EFTA), the European Economic Area (EEA), the Andean Pact (AP), the Latin America Integration Agreement and the Asia Pacific Economic Community (APEC) to the analysis.

Table 3 highlights that our key result is independent of the choice of datasets. Once model uncertainty is addressed in a principled fashion using BMA, Ghosh and Yamarik's (2004) own econometric specification produces a host of PTA effects that range from trade creating to open bloc and even trade diverting. We obtain effective coefficients (indicated with asterisks) whose signs and magnitudes are similar to those commonly reported in the previous literature. BMA thus provides evidence that the model space spanned by "free and doubtful variables" through Extreme Bound Analysis was too restrictive. The models flagged out by Extreme Bound Analysis did not contain those that feature the highest posterior probabilities and the heuristic model weighting assigned by Extreme Bound Analysis's generated excessively conservative results that indicated no PTAs effects. The expanded model space together with a principled weighting of effective models, are the reasons why BMA provides superior predictive performance.

Of the 13 major trade agreements, 8 are found to be either trade creating and/or exhibiting open bloc effects in Specification 1. All western hemisphere PTAs are identified as trade diverting in the original Ghosh and Yamarik dataset (Specification 1). The additional years and controls for bilateral agreements in our updated dataset (Specification 2) increase the precision of the estimates, but render our key insights unchanged. Specification 2 produces four additional trade creation effects (for key PTAs such as the EFTA, AFTA and the EU), and erases the odd implication of NAFTA trade diversion that was reported by Specification 1. These changes are most certainly due to the extension of the time horizon from the mid 1990s to 2000. In summary, the BMA results robustly link PTAs to changes in trade flows, although the effect varies across PTAs.

A substantial literature addresses the possibility of PTA coefficient bias due to omitted variables or inaccurate model specification. We extend our analysis to incorporate the insights of this recent literature to examine the robustness of our results. The scale of some PTA coefficients in Table 3 is certainly suspicious if not implausible. Coefficients that exceed unity imply that a PTA increased trade more than twofold (since the regression is in logs); such aberrant magnitudes have previously been noted and questioned in the literature (e.g., Frankel, 1992; Frankel and Wei, 1993; Frankel, Stein and Wei, 1995; Frankel, 1997). We take up the issue of omitted variable bias in the following section.

4.2 Accounting for Multilateral Resistance

Ghosh and Yamarik (2004) and our Specifications 1 and 2 (Table 3) include time fixed effect, but the recent PTA literature suggests the inclusion of additional fixed effects that account for multilateral trade costs. Wei (1996), Deardorff (1998), Anderson and van Wincoop (2003), and Subramanian and Wei (2007) emphasized

that the standard gravity model is subject to misspecification bias if multilateral trade costs are ignored. The crucial insight is that even bilateral trade is influenced by the average multilateral trade cost faced by a country in any given period. Anderson and van Wincoop (2003) suggest that, empirically, the inclusion of country fixed effects captures such "multilateral resistance." Since bilateral trade between any two countries depends on the multilateral resistance of *both* importers and exporters, the Anderson and van Wincoop (2003) model requires fixed effects for both countries involved in any bilateral trading relationship.[23] In a panel, these importer and exporter fixed effects must be time varying, which allows the PTA dummies in equation (1) to identify net trade creation. This fixed effect approach has been popularized by Subramanian and Wei (2007) in their analysis of WTO trade effects (although these authors do not break out the effects of individual PTAs).

Table 4 reports results that control for multilateral resistance. First, we confirm in Specification 3 that our new set of results is not driven by changing in the PTA dummy specification, to represent net trade creation. In short, Specification 3 replicates Specification 2, without separate trade diversion/open bloc effects. As expected, the results for most trade agreements are very similar to the sum of trade creation and diversion in Specification 2.[24] More importantly, however, Table 4 shows that even after controlling for multilateral resistance, the fundamental result of our analysis remains unchanged: PTAs have a strong impact on bilateral trade. Of the 13 major PTAs covered, 8 PTAs exhibit an effect on bilateral trade, only one of which is trade diverting. This implies that controlling for multilateral resistance identifies four additional PTAs with significant impacts on bilateral trade flows.

The one surprise is in Specification 4, which uses the multilateral resistance specification preferred by Subramanian and Wei (2007). It indicates negative net trade creation for the EU. The attractiveness of the EU market with its large size and strong harmonization likely exerts a significant pull on non-EU exporters, resulting in large open bloc effects (of about 0.6) in Specifications 1 and 2. The drag of open bloc effects on net trade creation by itself thus explains roughly half of the negative coefficient estimate. It is, moreover, well known that the gravity equation, overpredicts EU trade, when estimated on a global sample. Given their close proximity and other bilateral characteristics, EU countries undertrade relative to the global-based prediction, resulting in a (negative) EU coefficient. This may be related to the gravity equation's inability to proxy firms' fixed costs in establishing trade relations (e.g. Freund, 2000). Empirically, Aitken (1973),

[23] Helpman, Melitz and Rubinstein (2008) suggest an alternative rationale for importer and exporter fixed effects based on firm heterogeneity.

[24] For example, the Central American Common Market (CACM) featured a coefficient for trade creation of 2.3 in Specification 2, and a trade diversion effect with the rest of the world of 0.17. The combined net trade creation for PTA members is then an implied 2.47, which is closely matched by the estimate of 2.45 in Specification 3.

Soloaga and Winters (2001) and Rose (2004), among many others, find similarly negative results regarding the EU. Inclusion of country pair fixed effects is commonly suggested to control for such time-invariant bilateral heterogeneity. It thus represents the main alternative to time-varying country fixed effects for our robustness analysis. By examining EEA, EFTA and EU effects across alternative fixed effects specifications, Baier, Bergstrand, Egger, and McLaughlin (2008) also find a similar instability where country pair fixed effects are required to obtain solidly positive effects.

4.3 Accounting for Unobserved Heterogeneity

To capture unobserved time-invariant heterogeneity among trade partners, we reestimate Specification 4, accounting for country-pair fixed effects. This specification does not address multilateral trade costs as comprehensively as suggested by Anderson and van Wincoop (2003), especially if they exhibit large fluctuations over time. However, Rose (2004) makes the point that country-pair fixed effects constitute a valid proxy for average multilateral resistance exhibited in country pairs. Hummels and Levinsohn (1995) first introduced country-pair fixed effects to better distinguish between factor endowments and market structure as trade flow drivers. Egger and Pfaffermayr (2003) advocate country-pair fixed effects to account for heterogeneity induced by time-invariant factors (e.g., geography, history, policy, and culture) that are only partially accounted for by the explanatory variables or completely unobserved. Glick and Rose (2002) use the same specification as Egger and Pfaffermayr (2003), but motivate country-pair fixed effects as proxies for trade resistance. Here we employ it as a robustness test of the estimated parameter magnitudes for specific PTAs, such as the EU.

Note that the introduction of country-pair fixed effects removes the cross-sectional information so that Specification 5 relies *only* on the time-series information content of the data. Specification 5, therefore, expresses only PTA effects directly caused by PTA accession or exit. Nevertheless, our central result remains robust: PTAs exert a significant effect on trade flows. The rewarding aspect of the country-pair analysis is that BMA confirms the hypothesis that the gravity model overpredicts trade flows only when pair specific heterogeneity is ignored. Once these effects are accounted for, EU trade creation is indeed positive. On the other hand, other previously quite (maybe unreasonably) large effects are muted. In fact, ANZCERTA, AP, EEA and MERCOSUR lose their influence on net trade flows pointing at considerable unobserved bilateral heterogeneity among PTA members. With the exception of the Latin American Integration Agreement (LAIA), magnitudes of significant PTA impacts are uniformly smaller when we explore only the specific effect of entering and exiting a trade agreement. These results raise the general question of integration

dynamics. Are average estimates over the life of PTA membership appropriate or can we observe accession dynamics where static effects (before or at accession) differ fundamentally from subsequent dynamic changes in trade flows?

4.4 Accession Dynamics

Further investigation of accession dynamics may also yield benefits beyond the reconciliation of remaining differences between Specifications 4 and 5. Namely, accession dynamics provide insights whether gains from trade tend to be static, as advocated by neoclassical trade theory, or dynamic (e.g., Young 1991). Indeed the gain might even commence *before* the PTA accession. Hence we recode the PTA dummy into three separate effects. If accession occurs at time *t,* the *pre-accession* will be defined as the 5 years prior to joining a PTA (*t-1* in our notation). This effect captures the change in trade flows in the period prior to accession. Finally, we define the *post accession* period as the 5 year period following accession to the end of the sample (*t+1, n*), where *n* indicates either the year 2000, or the year a country exited the PTA.

The results that characterize the accession dynamics are presented in Table 5, where we present again specifications that control for multilateral resistance (Specification 4a) and unobserved bilateral heterogeneity (Specification 5a). For expositional purposes, Table 5 excludes the host of additional controls that were included in the analysis, because the posterior estimates and their inclusion probabilities were identical to the original Specifications 4 and 5, respectively. Table 5 also includes the average PTA effects (*t, n*) established in Specifications 4 and 5 to allow for a quick comparison between average effects and accession dynamics for each PTA.

The accession dynamics differ across PTAs, but in general the trend clearly indicates that for all PTAs with a trade effect in their original specifications, it only materializes in the post accession phase. Only in the case of bilateral PTAs do accession dynamics reveal an additional effect (Specification 4a). For the case of multilateral resistance, bilateral trade agreements show a strong post accession effect that is washed out when accession and post accession are averaged. Interestingly, the effects are mostly show up in the post accession period, so that the static effects either before or during accession usually show no effect. The two exceptions in the case of multilateral resistance are the EU and APEC, which have similar effects pre to post accession. This result is negated with pair fixed effects, which only show the EU as trade creating in the post accession period and the EEA posting a significant pre-accession effect.

4.5 Additional Effects on Trade Flows

So far we have solely considered the impact of PTAs on trade flows. However, the BMA exercise holds important additional information regarding other determinants of trade flows. The geography and history controls are highly significant in Specifications 1 and 2 (in agreement with the previous literature). Despite the fact that some of their effects are absorbed into the fixed effects once we control for multilateral resistance and bilateral heterogeneity, those remaining generally stay significant.

BMA identifies trade openness as a key variable in all specifications, which is not surprising since we are attempting to explain trade flows. More interesting is that a host of variables related to exchange rate policy are not significant unless we control for bilateral unobservables. The currency union variable on the other hand shows a strong effect independent of dataset or empirical specification. Additional variables that might influence trade flows are factor endowments. Here BMA allows us to examine the competing hypotheses that trade flows are either driven by differences in endowments (Heckscher-Ohlin) or by similarities (Lindner). In Specifications 1 and 2, the Heckscher-Ohlin factor endowment theory finds strong support as differences in per capita GDPs and population densities are strongly associated with greater trade flows. The endowment effect vanishes however, when we consider multilateral resistance while the density effect disappears when we consider bilateral heterogeneity. Finally, the BMA methodology shows that differences in schooling increase bilateral trade flows once we control for unobserved heterogeneity or multilateral resistance.

5 Conclusion

The literature on preferential trade agreements (PTAs) features an unusual diversity of theoretical and empirical approaches. In this paper we incorporate model uncertainty into our empirical strategy by applying Bayesian Model Averaging (BMA). To date the most extensive robustness analysis by Ghosh and Yamarik (2004) used Extreme Bound Analysis and found evidence *against any* effects of PTAs at the extreme bounds. In contrast, by using BMA on the Ghosh and Yamark's dataset we find that PTA trade creation is strong and produces coefficient estimates that resolve a number of empirical puzzles.

We confirm strong PTA effects with Ghosh and Yamarik's original dataset, and with an updated dataset that includes additional years and PTAs. Our results are robust to the inclusion of multilateral resistance, accession dynamics, and unobserved bilateral heterogeneity. Overall the PTA effects reflect the diversity of PTAs and the degree of tariff reductions they encompass. BMA allows to also account for model uncertainty in the set of additional control variables usually featured in PTA regressions. Our approach highlights the

importance of including all controls for policy, development, factor endowments, geography, and history that have been suggested by the previous literature. Among these regressors, the only ones that receive mixed evidence are related to exchange rate fluctuations.

References

Aitken, N.D., 1973. "The Effect of the EEC and EFTA on European Trade: A Temporal Cross-Section Analysis," *American Economic Review*, 63, pp. 881-892.

Aitken, N.D., Lowry, W., 1973. "A Cross-Sectional Study of the Effects of LASEAN and CACM on Latin American Trade," *Journal of Common Market Studies*, 11, pp. 326-336.

Anderson, J., van Wincoop, E., 2003. "Gravity with Gravitas: A Solution to the Border Puzzle", *American Economic Review*, 93, pp. 170-192.

Andrews, M., Schank, T., Upward, R., 2006. "Practical Fixed Effects Estimation Methods for the Three-Way Error Components Model," *The Stata Journal*, 6, pp. 461-481.

Baier, S.L., Bergstrand, J.H., 2004. "Economic Determinants of Free Trade Agreements," *Journal of International Economics*, 64, pp. 29-63.

Baier, S.L., Bergstrand, J.H., 2007. "Do Free Trade Agreements Actually Increase Members' International Trade?," *Journal of International Economics*, 71, pp. 72-95.

Baier, S.L., Bergstrand, J.H., Egger, P. and McLaughlin, P.A., 2008. "Do Economic Integration Agreements Actually Work? Issues in Understanding the Causes and Consequences of the Growth of Regionalism," *The World Economy, Blackwell Publishing*, 31, pp. 461-497.

Baldwin, R., 2005. "The Euro's Trade Effects," Working Paper prepared for ECB Workshop "What Effects is EMU Having on the Euro Area and Its Member Countries?," Frankfurt, June 16, 2005.

Baldwin, R., Taglioni, D., 2006. "Gravity for Dummies and Dummies for Gravity Equations," NBER Working Paper No. 12516.

Barro, R., Lee, J.W., 2001. "International Data on Educational Attainment: Updates and Implications," *Oxford Economic Papers*, 53, 541-563.

Baxter, M., Kouparitsas, M.A., 2006. "What Determines Bilateral Trade Flows?," NBER Working Paper No. 12188.

Bhagwati, J., Panagariya, A., 1996. "Preferential Trading Areas and Multilateralism: Strangers, Friends or Foes?," in: Bhagwati, J., Panagariya, A., eds., *The Economics of Preferential Trade Agreements*, AEI Press, Washington, D.C.

Bergstrand, J., 1985. "The Gravity Equation in International Trade: Some Microeconomic Foundation and Empirical Evidence," *The Review of Economics and Statistics*, 67, pp. 474-481.

Bond, E.W., Syropoulos, C., 1996. "The Size of Trading Blocs, Market Power and World Welfare Effects," *Journal of International Economics*, 40, pp. 411-437.

Brada, J., Mendez, J., 1988. "Exchange Rate Risk, Exchange Rate Regime and the Volume of International Trade," *Kyklos*, 41, pp. 263-280.

Brock, W., Durlauf, S.N., West, K, 2003. "Policy Evaluation in Uncertain Economic Environments," *Brookings Papers on Economic Activity*, 1, pp. 235-322.

Brun, J., Carrere, C., Guillaumont, P., de Melo, J., 2005. "Has Distance Died? Evidence from a Panel Gravity Model," *World Bank Economic Review*, 19, pp. 99-120.

Carrere, C., 2006. "Revisiting the Effects of Regional Trade Agreements on Trade Flows with Proper Specification of the Gravity Model," *European Economic Review*, 50, pp. 223-247.

Chen, Y.C., Rogoff, K., 2006. "Commodity Currencies and Exchange Rate Predictability: A Bayesian Model Averaging Approach," Working Paper, University of Washington.

Cheng, I., Wall, H.J., 2005. "Controlling for Heterogeneity in Gravity Models of Trade and Integration," *Federal Reserve Bank of St. Louis Review*, 87, pp. 49-63.

Clark, P., Tamirisa, N., Wei, S.J., Sadikov, A., Zeng, L., 2004. "Exchange Rate Volatility and Trade Flows - Some New Evidence," Working Paper, International Monetary Fund.

Coe, D., Hoffmaister, A., 1999. "North-South Trade: is Africa Unusual," *Journal of African Economies*, 8, pp. 228-256.

Crespo Cuaresma, J., Gernot, D., 2007. "Nonlinearities in Cross-Country Growth Regressions: A Bayesian Averaging of Thresholds (BAT) approach," *Journal of Macroeconomics*, 29, pp. 541-554.

Davis, D.R., 1995. "Intra-Industry Trade: A Heckscher-Ohlin-Ricardo Approach," *Journal of International Economics*, 39, pp. 201-226.

Deardorff, A.V., 1998. "Determinants of Bilateral Trade: Does Gravity Work in a Classical World," in: Frankel, J. (Ed.), *The Preferentialization of the World Economy.* University of Chicago Press, Chicago, pp. 7-22.

Deardorff, A.V., Stern, R., 1994. "Multilateral Trade Negotiations and Preferential Trade Agreements," in: Deardorff, A.V., Stern, R., eds., *Analytical and Negotiating Issues in the Global Trading System*, University of Michigan Press, Ann Arbor, MI.

Doppelhofer, G., Weeks, M., forthcoming. "Jointness of Growth Determinants," *Journal of Applied Econometrics.*

Eichengreen, B., Irwin, D., 1996. "The Role of History in Bilateral Trade Flows," NBER Working Paper No. 5565.

Eicher, T.S., Papageorgiou, C., Raftery, A.E., forthcoming. "Determining Growth Determinants: Default Priors and Predictive Performance in Bayesian Model Averaging," *Journal of Applied Econometrics.*

Egger, P., 2000. "A Note on the Proper Econometric Specification of the Gravity Equation," *Economics Letters*, 66, pp. 25-31.

Egger, P., Pfaffermayr, M., 2003. "The Proper Panel Econometric Specification of the Gravity Equation: A Three-Way Model with Bilateral Interaction Effects," *Empirical Economics*, 28, pp. 571-580.

Fernandez, C., Ley, E., Steel, M., 2001. "Model Uncertainty in Cross-Country Growth Regressions," *Journal of Applied Econometrics*, 16, pp. 563-576.

Feenstra, R.C., Markusen, J.R., Rose, A.K., 2001. "Using the Gravity Equation to Differentiate among Alternative Theories of Trade," *Canadian Journal of Economics*, 34, pp. 430-477.

Felbermayr G., Kohler, W., 2006. "Exploring the Intensive and Extensive Margins of World Trade," *Review of World Economics*, 142, pp. 642-674

Frankel, J., 1992. "Is Japan Creating a Yen Bloc in East Asia and the Pacific?," NBER Working Paper No. 4050.

Frankel, J., 1997. *Preferential Trading Blocs in the World Trading System*, Institute for International Economics, Washington, D.C.

Frankel, J., Romer, D., 1999. "Does Trade Cause Growth?" *American Economic Review*, 89, pp. 379-399.

Frankel, J., Rose, A.K., 1998. "The Endogeneity of the Optimum Currency Area Criteria", *Economic Journal*, 108, pp. 1009-1025.

Frankel, J., Rose, A.K., 2002. "An Estimate of the Effect of Common Currencies on Trade and Income," *Quarterly Journal of Economics*, 117, pp. 437–466.

Frankel, J., Stein, E., Wei, S.J., 1995. "Trading Blocs and the Americas: the Natural, the Unnatural and the Supernatural?," *Journal of Development Economics*, 47, pp. 61-95.

Frankel, J., Stein, E., Wei, S.J., 1997. *Regional Trading Blocs in the World Economic System,* Washington: Institute for International Economics.

Frankel, J., Wei, S.J., 1993. "Trading Blocs and Currency Blocs," NBER Working Paper No. 4335.

Frankel, J., Wei, S.J., 1996. "ASEAN in a Regional Perspective," Pacific Basin Working Paper No. PB96-02.

Freund, C., 2000. "Different Paths From Free Trade: The Gains from Regionalism," *Quarterly Journal of Economics*, 115, pp. 1317-1341.

Freund, C., McLaren, J., 1999. "On the Dynamics of Trade Diversion: Evidence from Four Trade Blocks," International Finance Discussion Paper 637, Board of Governors of the Federal Reserve System, Washington, D.C.

Garratt, A., Lee, K., Pesaran, M.H., Shin, Y., 2003. "A Long Run Structural Macroeconometric Model of the UK," *Economic Journal* 113, pp. 412-455.

Ghosh, S., Yamarik, S., 2004. "Are Preferential Trade Agreements Trade Creating? An Application of Extreme Bounds Analysis," *Journal of International Economics*, 63, pp. 369-395.

Glick, R., Rose, A.K., 2002. "Does A Currency Union Affect Trade? The Time-Series Evidence," *European Economic Review*, 46, pp. 1125-1151.

Grossman, G.M., Helpman, E., 1991. *Innovation and Growth in the Global Economy,* Cambridge, MIT Press.

Haveman, J.D., 1996. "Some Welfare Effects of Sequential Customs Union Formation," *Canadian Journal of Economics*, 29, pp. 941-958.

Helpman, E., Krugman, P.R., 1985. *Market Structure and Foreign Trade*, MIT Press, Cambridge, MA.

Helpman, E., Melitz, M. J., Rubinstein, Y., 2008. "Estimating Trade Flows: Trading Partners and Trading Volumes," *Quarterly Journal of Economics* 123, pp. 441-487.

Heston, A., Summers, R., Aten, B., Penn World Table Version 6.2, Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

Hummels, D., Levinsohn, J., 1995. "Monopolistic Competition and International Trade: Reconsidering the Evidence," *Quarterly Journal of Economics*, 110, pp. 799-836.

Jeffries, H., 1961. *Theory of Probability*, 3rd Edition, Clarendon Press, Oxford.

Kass, R.E., Raftery, A.E., 1995. "Bayes Factors," *Journal of the American Statistical Association*, 90, pp. 773-795.

Krugman, P., 1991a. "Is Bilateralism Bad?," in: Helpman, E., Razin, A., eds, *International trade and trade policy*, MIT Press, Cambridge, MA.

Krugman, P., 1991b. "The Move Toward Free Trade Zones," in: *Policy Implications of Trade and Currency Zones*, A Symposium Sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, WY, Aug., pp. 7-42.

Leamer, E.E., 1983. "Let's Take the Con Out of Econometrics," *American Economic Review*, 73, pp. 31-43.

Levin, A., Williams, J., 2003. "Robust Monetary Policy with Competing Reference Models," *Journal of Monetary Economics*, 50, pp. 945-975.

Ley, E., Steel, M.F.J., 2007. "Jointness in Bayesian Variable Selection with Applications to Growth Regression," *Journal of Macroeconomics,* 29, pp. 476-493.

Ley, E., Steel, M.F.J., forthcoming. "On the Effect of Prior Assumptions in BMA with Applications to Growth Regression," *Journal of Applied Econometrics.*

Linder, S.B., 1961. *An Essay on Trade and Transformation*, John Wiley, New York.

Masanjala, W.H., Papageorgiou, C., 2008. "A Rough and Lonely Road to Prosperity: A Re-examination of Sources of Growth in Africa using Bayesian Model Averaging," *Journal of Applied Econometric*s, 23, pp. 671-682.

Montenegro, C., Soto, R., 1996. "How Distorted is Cuba's Trade? Evidence and Predictions from a Gravity Model," *Journal of International Trade and Economic Development*, 5, pp. 45-70.

Novy, D., 2006. "Is the Iceberg Melting Less Quickly? International Trade Costs after World War II," Working Paper, University of Warwick.

Novy, D., 2007. "Gravity Redux: Measuring International Trade Costs with Panel Data," Working Paper, University of Warwick.

Panagariya, A., 1999. "The Regionalism Debate: An Overview," *World Economy*, 22, pp. 280-301.

Panagariya, A., 2000. "Preferential Trade Liberalization: The Traditional Theory and New Developments," *Journal of Economic Literature*, 38, pp. 287-331.

Pesaran, M.H., 2006. "Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error structure," *Econometrica*, 74, pp. 967-1012.

Raftery, A.E., D. Madigan and J.A. Hoeting, 1997, "Bayesian Model Averaging for Linear Regression Models," *Journal of the American Statistical Association*, 92, pp. 179-191.

Raftery, A.E., Zheng, Y., 2002. "Long-Run Performance of Bayesian Model Averaging," *Journal of the American Statistical Association*, 98, pp. 931-937.

Raftery, A.E., Zheng, Y., 2003. "Discussion: Performance of Bayesian Model Averaging," *Journal of the American Statistical Association*, 98, *Theory and Methods*, pp. 931-938.

Rivera-Batiz, L.A., Romer, P.M., 1991. "Economic Integration and Endogenous Growth," *Quarterly Journal of Economics*, 106, pp. 531-555.

Rose, A.K., 2000. "One Money, One Market? The Effects of Common Currencies on International Trade," *Economic Policy*, 15, pp. 7-46.

Rose, A.K., Glick, R., 2002. "Does a Currency Union Affect Trade? Time-Series Evidence," *European Economic Review*, 46, pp. 1125-1151.

Rose, A.K., 2004. "Do We Really Know That the WTO Increases Trade?," *American Economic Review*, 94, pp. 98-114.

Rose, A.K., 2005. "Which International Institutions Promote International Trade?," *Review of International Economics*, 13, pp. 682-698.

Rose, A.K., van Wincoop, E., 2001. "National Money as a Barrier to International Trade: The Real Case for a Currency Union," *American Economic Review*, 91, pp. 386-390.

Sachs, J., Warner, A., 1995. "Economic Reform and the Process of Global Integration," *Brookings Papers on Economic Activity*, 1, 1-118.

Sala-i-Martin, X.G., 1997. "I Just Ran Two Million Regressions," *American Economic Review, Papers and Proceedings*, 87, pp. 178-183.

Santos Silva J.M., Tenreyro, S., 2006. "The Log of Gravity," *The Review of Economics and Statistics*, 88, pp. 641-658.

Serlenga L., Shin Y. 2007. "Gravity Models of Intra-EU Trade: Application of the CCEP-HT Estimation in Heterogeneous Panels with Unobserved Common Time-Specific Factors," *Journal of Applied Econometrics*, 22, pp. 361-381.

Spilimbergo, A., Stein, E., 1998. "The Welfare Implications of Trading Blocs among Countries with Different Endowments," NBER Conference Volume, Frankel J., Stein E., eds, University of Chicago Press, Chicago.

Soloaga, I., Winters, L.A., 2001. "Preferentialism in the Nineties: What Effect on Trade?," *North American Journal of Economics and Finance*, 12, pp. 1-29.

Subramanian, A., Wei, S.J., 2007. "The WTO Promotes Trade, Strongly But Unevenly," *Journal of International Economics*, 72, pp. 151-175.

Syropoulos, C., 1999. "Customs Unions and Comparative Advantage," *Oxford Economic Papers*, 51, pp. 239-266.

Tenreyro, S., Barro, R.J., 2007. "Economic Effects of Currency Unions," Economic Inquiry, 45, 1-23.

Thursby, J., Thursby, M., 1987. "Bilateral Trade Flows, the Linder Hypothesis, and Exchange Risk," *The Review of Economics and Statistics*, 69, pp. 488-495.

Viner, J., 1950. *The Customs Union Issue*, Carnegie Endowment for International Peace, New York.

Wei, S.J., 1996. "Intra-National Versus International Trade: How Stubborn are Nations in Global Integration?," NBER No. 5531.

Wei, S.J., Frankel, J., 1998. "Open Regionalism in World of Continental Trade Blocs," *IMF Staff Papers*, 45, pp. 440-453.

Wei, S.J., Zhang, Z., 2006. "Collateral Damage: Exchange Controls and International Trade," *Journal of International Money and Finance*, 26, pp. 841-863.

Wacziarg, R., Welch, K. H., 2003. "Trade Liberalization and Growth: New Evidence," NBER Working Paper No.10152.

Young, A., 1991. "Learning by Doing and the Dynamic Effects of International Trade," *Quarterly Journal of Economics*, 106, pp. 369-405.

Table 1: Relationship between Gravity Model Controls and Bilateral Trade in Past Studies

		Relationship in past studies		
		Positive	*None*	*Negative*
Trade Creation 0-1 dummies	$AFTA_{ij}$	3	2	
	$ANZCERTA_{ij}$	1		
	$APEC_{ij}$	3		
	AP_{ij}	3	2	
	$CACM_{ij}$	4	2	
	$CARICOM_{ij}$			
	EEA_{ij}			
	$EFTA_{ij}$	3	5	
	EU_{ij}	9	9	
	$LAIA_{ij}$	4	2	
	$MERCOSUR_{ij}$	2	3	
	$NAFTA_{ij}$	1	3	
Trade Diversion / Open Bloc 0-1 dummies	$AFTA_i$	2	1	1
	$ANZCERTA_i$			
	$APEC_i$			
	AP_i		1	2
	$CACM_i$		2	2
	$CARICOM_i$			
	EEA_i			
	$EFTA_i$	1	1	
	EU_i	2	1	
	$LAIA_i$		2	2
	$MERCOSUR_i$		2	2
	$NAFTA_i$	1	2	1
Core Gravity	log($DISTANCE_{ij}$)		1	23
	log($GDP_i\ GDP_j$)	23	2	1
	log($gdp_i\ gdp_j$)	9	1	2
Economic Policy Variables	$SACHS_i$+$SACHS_j$	1		
	CU_{ij}	3	1	
	$FLOAT_{ij}$	1		1
	$VOLATILITY_{ij}$	1	1	4
Dev't/Factor Endowment	abs(gdp_DIFF)	3	1	1
	abs($DENS\_DIFF$)	1	1	
	abs($SCHOOL\_DIFF$)		1	
Geography	$BORDER_{ij}$	19	5	
	$REMOTE_{ij}$	4	3	
	$LANDLOCK_{ij}$	3	2	2
	log($AREA_i\ AREA_j$)	4		
	$ISLAND_{ij}$	3	1	1
Historical Ties	$COMLANG_{ij}$	12	1	1
	$COMCOL_{ij}$	3		
	$COLONY_{ij}$	5		2

Notes: Following Ghosh and Yamarik (2004), from whom parts of this table are adapted, an estimated relationship is reported positive or negative when a paper reports the coefficient significant at the 1% level. One paper may have multiple entries for the same regressor, if different regressions in the paper yield different relationships. See Tables 2a-c for additional variable description.

Sources: Aitken (1973); Aitken and Lowry (1973); Baier and Bergstrand (2007); Baldwin and Taglioni (2006); Baxter and Kouparitsas (2006); Bergstrand (1985); Brada and Mendez (1988); Carrere (2006); Cheng and Wall (2005); Coe and Hoffmaister (1999); Eichengreen and Irwin (1996); Egger (2000); Egger and Pfaffermayr (2003); Feenstra, Markusen, and Rose (2001); Frankel (1992); Frankel and Rose (1998); Frankel, Stein, and Wei (1995); Frankel and Wei (1993), and (1996); Freund (2000); Montenegro and Soto (1996); Rose (2000); Soloaga and Winters (2001); Thursby and Thursby (1987); Wei (1996); Wei and Frankel (1998); and Wei and Zhang (2006).

Table 2a: Preferential Trading Arrangements

Abbreviation	Name of PTA	Start	Member countries
ANZCERTA	Australia – New Zealand Closer Economic Relations Trade Agreement	1983	Australia, New Zealand
APEC	Asia Pacific Economic Community	1989	Australia, Brunei, Canada, China (1991), Chile (1994), Taiwan (1991), Hong Kong (1991), Indonesia, Japan, South Korea, Malaysia, Mexico (1993), New Zealand, Papua New Guinea (1993), Peru (1998), Philippines, Singapore, Thailand, United States, Vietnam (1998).
AP	Andean Community / Andean Pact	1969	Bolivia, Colombia, Ecuador, Peru, Venezuela (1973), Former: Chile (1969-76)
AFTA	Association of South East Asian Nations (ASEAN) Free Trade Area	1967	Brunei (1984), Cambodia (1998), Indonesia, Laos (1997), Malaysia, Myanmar (1997), the Philippines, Singapore, Thailand, Vietnam (1995).
CACM	Central American Common Market	1960	Costa Rica (1963), El Salvador, Guatemala, Honduras, Nicaragua.
CARICOM	Caribbean Community/ Carifta	1968	Antigua and Barbuda, Bahamas (1983), Barbados, Belize (1995), Dominica (1974), Guyana (1995), Grenada (1974), Jamaica, Montserrat (1974), St. Kitts and Nevis, St. Lucia (1974), St. Vincent and the Grenadines, Suriname (1995), Trinidad and Tobago.
EEA	European Economic Area	1994	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Luxembourg, Iceland, Italy, Ireland, Liechtenstein, Netherlands, Norway, Portugal, Spain, Sweden, United Kingdom.
EFTA	European Free Trade Association	1960	Iceland, Liechtenstein (1991), Norway (1986), Switzerland Former: Denmark (1960-72), United Kingdom (1960-72), Portugal (1960-85), Austria (1960-94), Sweden (1960-94), Finland (1986-94).
EU	European Union	1958	Austria (1995), Belgium, Denmark (1973), Finland (1995), France, Germany, Greece (1981), Luxembourg, Ireland (1973), Italy, Netherlands, Portugal (1986), Spain (1986), Sweden (1995), United Kingdom (1973).
LAIA/LAFTA	Latin America Integration Agreement	1960	Argentina, Bolivia (1967), Brazil, Chile, Colombia (1961) Ecuador (1961), Mexico, Paraguay, Peru, Uruguay, Venezuela (1966).
MERCOSUR	Southern Cone Common Market	1991	Argentina, Brazil, Paraguay, Uruguay
NAFTA	Canada-US Free Trade Arrangement / North America Free Trade Agreement	1988	Canada, United States, Mexico (1994).
BilateralPTA	Bilateral Preferential Trade Agreements		All bilateral agreements considered are listed in Table 2b.

Notes: This table is based on Ghosh and Yamarik (2004) and includes corrections to some of the original PTA coding as follows. ASEAN, which is no free trade area was changed to AFTA with AFTA membership starting in 1992 instead of 1980. For the Andean Pact, Chile had to be excluded post-1976, when it left the AP. Finally, CARICOM membership for Guyana is corrected to start in 1973 (instead of 1995). The corrections do not alter the qualitative results.

Table 2b: Bilateral Preferential Trade Agreements considered in *BilateralPTA*

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

Source: Subramanian and Wei (2007).

Table 2c: Description of non-PTA related variables

Variable	Description	Source
log(*$IMPORTS_{ijt}$*)	Natural log of bilateral imports (current US Dollars)	IMF Direction of Trade Statistics
log(*$DISTANCE_{ij}$*)	Natural log of the bilateral distance	Subramanian and Wei (2007)
log(*GDP_{it} GDP_{jt}*)	Natural log of the product of nominal GDP	Penn World Tables
log(*gdp_{it} gdp_{jt}*)	Natural log of the product of real GDP per capita	Penn World Tables
$SACHS_{it}$+$SACHS_{jt}$	The sum of the Sachs-Warner index of an open trade policy	Sachs and Warner (1995), Wacziarg and Welch (2003)
CU_{ijt}	Dummy (1 if the two share a common currency)	Subramanian and Wei (2007)
$FLOAT_{ijt}$	Number of countries with a floating exchange rate (0,1,2)	IMF Annual Report on Exchange Rate Arrangements and Restrictions
$VOLATILITY_{ijt}$	The standard deviation of the first difference in the bilateral exchange rate during the previous three years	IMF International Financial Statistics
abs(*gdp_DIFF*)	The absolute log difference of real GDP per capita	Penn World Tables
abs(*DENS_DIFF)*	The absolute log difference in population density	CIA World Fact Book
abs(*SCHOOL_DIFF*)	The absolute log difference in the average years of secondary schooling in the 25+ population	Barro and Lee (2001)
$BORDER_{ij}$	Dummy (1 if the two share a common land border and 0 otherwise)	Subramanian and Wei (2007)
$REMOTE_{ijt}$	The natural log of the product of the average distance (weighted by relative GDP) of each country from all trading partners*	CIA World Fact Book and Penn World Tables
$LANDLOCK_{ij}$	Number of landlocked countries (0,1,2)	Subramanian and Wei (2007)
log(*$AREA_i$ $AREA_j$*)	Natural log of the product of the surface area of the two countries	CIA World Fact Book
$ISLAND_{ij}$	Number of island countries (0,1,2)	Subramanian and Wei (2007)
$COMLANG_{ij}$	Dummy (1 if the two share a common language and 0 otherwise)	Subramanian and Wei (2007)
$COMCOL_{ij}$	Dummy (1 if the two share a common colonizer and 0 otherwise)	Subramanian and Wei (2007)
$COLONY_{ij}$	Dummy (1 if one was a former colony of the other and 0 otherwise)	Subramanian and Wei (2007)

* The construction of the remoteness variable in the Ghosh and Yamarik (2004) dataset varies slightly from ours, but does not alter the qualitative results.

Table 3: PTA Trade Creation and Trade Diversion

		Specification 1			Specification 2		
		Time Fixed Effects Original Ghosh & Yamarik (2004) Specification & Data			Time Fixed Effects Ghosh & Yamarik (2004) Specification, Updated Subramanian/Wei Data		
		p≠0	μ	σ	p≠0	μ	σ
Trade Creation	$AFTA_{ijt}$	0	-0.22	0.54	1	0.36	0.35
	$ANZCERTA_{ijt}$	1	0.89	0.96	1	0.88	0.62
	$APEC_{ijt}$	100	1.48***	0.15	100	1.71***	0.09
	AP_{ijt}	1	-0.05	0.27	99	0.67***	0.15
	$CACM_{ijt}$	100	2.25***	0.23	100	2.30***	0.15
	$CARICOM_{ijt}$	100	2.08***	0.41	100	2.83***	0.30
	EEA_{ijt}	1	0.26	0.19	2	0.22	0.15
	$EFTA_{ijt}$	0	0.02	0.26	100	0.67***	0.13
	EU_{ijt}	0	0.03	0.14	100	0.51***	0.09
	$LAIA_{ijt}$	91	0.46***	0.13	1	-0.05	0.08
	$MERCOSUR_{ijt}$	12	1.66	0.7	14	0.96	0.36
	$NAFTA_{ijt}$	1	-0.89	0.84	0	0.20	0.47
	$BILATERAL_{ijt}$	na	na	na	1	0.13	0.13
Trade Diversion, Open Bloc	$AFTA_{it}$	3	0.17	0.11	100	0.41***	0.06
	$ANZCERTA_{it}$	100	-0.47***	0.1	100	-0.81***	0.06
	$APEC_{it}$	100	0.55***	0.06	100	0.48***	0.04
	AP_{it}	52	-0.19*	0.06	2	0.07	0.04
	$CACM_{it}$	85	-0.18**	0.05	100	-0.17***	0.03
	$CARICOM_{it}$	100	-0.74***	0.07	100	-0.58***	0.05
	EEA_{it}	0	0.01	0.08	92	-0.17**	0.04
	$EFTA_{it}$	100	0.35***	0.05	100	0.37***	0.03
	EU_{it}	100	0.56***	0.04	100	0.65***	0.03
	$LAIA_{it}$	100	-0.40***	0.07	100	-0.52***	0.03
	$MERCOSUR_{it}$	79	0.42**	0.12	0	-0.04	0.06
	$NAFTA_{it}$	100	-0.63***	0.1	4	0.13	0.06
	$BILATERAL_{it}$	na	na	na	100	-0.27***	0.04
Core Gravity	$\log(GDP_{it}\ GDP_{jt})$	100	0.88***	0.01	100	0.94***	0.01
	$\log(DISTANCE_{ij})$	100	-1.19***	0.02	100	-1.08***	0.02
	$\log(gdp_{it}\ gdp_{jt})$	100	0.55***	0.02	100	0.28***	0.01
Economic Policy	$SACHS_{it}+SACHS_{jt}$	100	0.35***	0.03	100	0.22***	0.02
	$VOLATILITY_{ijt}$	25	0.006	0.002	0	-0.0003	0.00
	$FLOAT_{ijt}$	0	-0.01	0.02	100	0.09***	0.02
	CU_{ijt}	100	1.40***	0.29	100	1.22***	0.10
Development, Factor Endowments	abs(*SCHOOL_DIFF*)	1	0.02	0.02	14	0.04	0.02
	abs(*DENS_DIFF*)	100	0.23***	0.01	100	0.13***	0.01
	abs(*gdp_DIFF*)	100	0.18***	0.02	100	0.08***	0.01
Geography	$BORDER_{ij}$	100	0.53***	0.1	100	0.40***	0.06
	$ISLAND_{ij}$	2	-0.05	0.03	100	-0.22***	0.03
	$LANDLOCK_{ij}$	100	-0.42***	0.04	100	-0.26***	0.02
	$\log(AREA_i\ AREA_j)$	92	-0.03**	0.01	100	-0.08***	0.01
	$REMOTE_{ijt}$	100	342***	39.79	100	1.31***	0.04
History	$COLONY_{ij}$	100	1.44***	0.12	100	1.12***	0.06
	$COMCOL_{ij}$	100	0.77***	0.07	100	0.55***	0.04
	$COMLANG_{ij}$	100	0.47***	0.05	100	0.28***	0.02

Notes: Fixed effect coefficients are omitted. *, **, *** represent *weak*, *positive,* and *decisive* evidence for an effect of the regressor, corresponding to posterior inclusion probabilities of 50-75%, 75-99, and > 99%, respectively (see Jefferies, 1961 and Kass and Raftery, 1995). p≠0 is the inclusion probability, μ is the posterior mean, and σ is the posterior standard deviation.

Table 4: PTA Net Trade Creation
Controlling for Multilateral Resistance and Bilateral Heterogeneity

	Specification 3			Specification 4			Specification 5		
Updated Subramanian / Wei Data		**yes**			**Yes**			**yes**	
Time Fixed Effects		**yes**			**yes**			**yes**	
Importer Exporter Fixed Effects		**no**			**Yes**			**no**	
Country Pair Fixed Effects		**no**			**No**			**yes**	
Accession Dynamics?		**no**			**No**			**no**	
	p≠0	**μ**	**σ**	**p≠0**	**μ**	**σ**	**p≠0**	**μ**	**σ**
$AFTA_{ijt}$	1	0.46	0.35	1	-0.44	0.33	1	0.27	0.24
$ANZCERTA_{ijt}$	19	1.73	0.63	89	2.19**	0.58	0	-0.02	0.51
$APEC_{ijt}$	100	1.39***	0.08	100	0.64***	0.09	100	0.52***	0.06
AP_{ijt}	88	0.63**	0.16	93	0.62**	0.16	6	0.44	0.19
$CACM_{ijt}$	100	2.45***	0.15	100	2.45***	0.15	100	2.19***	0.26
$CARICOM_{ijt}$	100	2.89***	0.31	100	4.06***	0.29	63	1.45*	0.43
EEA_{ijt}	10	0.35	0.13	98	0.51**	0.12	25	-0.24	0.08
$EFTA_{ijt}$	1	0.15	0.12	1	-0.14	0.12	5	0.26	0.12
EU_{ijt}	19	-0.29	0.13	100	-1.15***	0.10	100	0.41***	0.10
$LAIA_{ijt}$	100	0.40***	0.09	100	0.89***	0.09	100	1.68***	0.19
$MERCOSUR_{ijt}$	6	0.79	0.37	57	1.16*	0.35	1	0.38	0.26
$NAFTA_{ijt}$	1	-0.25	0.48	0	0.08	0.45	1	0.48	0.34
$BILATERAL_{ijt}$	12	0.34	0.13	47	0.43	0.14	14	0.24	0.09
$\log(GDP_{it}\ GDP_{jt})$	100	1.02***	0.01				15	0.01	0.00
$\log(DISTANCE_{ij})$	100	-1.09***	0.02	100	-1.17***	0.02			
$\log(gdp_{it}\ gdp_{jt})$	100	0.18***	0.01				100	1.06***	0.02
$SACHS_{ijt}$	100	0.34***	0.02				100	0.20***	0.02
$VOLATILITY_{ijt}$	1	0.00	0.00	1	0.01	0.01	100	-0.01***	0.00
$FLOAT_{ijt}$	3	0.03	0.02				100	-0.06***	0.01
CU_{ijt}	100	1.26***	0.10	100	1.17***	0.10	100	0.66***	0.13
$\lvert SCHOOL\_DIFF \rvert$	100	0.08***	0.01	77	0.05**	0.02	100	0.23***	0.02
$\lvert DENS\_DIFF \rvert$	100	0.12***	0.01	100	0.12***	0.01	28	0.11	0.04
$\lvert gdp\_DIFF \rvert$	100	0.09***	0.01	6	-0.04	0.02	100	-0.19***	0.03
$BORDER_{ij}$	100	0.42***	0.06	98	0.24**	0.06			
$ISLAND_{ij}$	100	-0.26***	0.02						
$LANDLOCK_{ij}$	100	-0.20***	0.02						
$\log(AREA_i\ AREA_j)$	100	-0.13***	0.00						
$REMOTE_{ijt}$	100	0.81***	0.04				0	-0.01	0.02
$COLONY_{ij}$	100	1.19***	0.06	100	1.13***	0.06			
$COMCOL_{ij}$	100	0.27***	0.02	100	0.34***	0.05			
$COMLANG_{ij}$	100	0.59***	0.04	100	0.30***	0.03			

Notes: Fixed effect coefficients are omitted. *, **, *** represent *weak*, *positive,* and *decisive* evidence for an effect of the regressor, corresponding to posterior inclusion probabilities of 50-75%, 75-99, and > 99%, respectively (see Jefferies, 1961 and Kass and Raftery, 1995). p≠0 is the inclusion probability, μ is the posterior mean, and σ is the posterior standard deviation.

Table 5: PTA Accession Dynamics

		Specification 4a			Specification 5a		
Updated Subramanian / Wei Data			**Yes**			**yes**	
Time Fixed Effects			**Yes**			**yes**	
Importer Exporter Fixed Effects			**Yes**			**no**	
Country Pair Fixed Effects			**No**			**yes**	
Accession Dynamics?			**Yes**			**yes**	
		p≠0	**μ**	**σ**	**p≠0**	**μ**	**σ**
$AFTA_{ijt}$	***average (t, n)***	**1**	**-0.44**	**0.33**	**1**	**0.27**	**0.24**
	Pre-accession (t-1)	0	-0.16	0.36	1	0.00	0.07
	Accession (t)	1	-0.57	0.44	0	0.00	0.02
	Post accession (t+1, n)	0	-0.18	0.48	1	0.01	0.07
$ANZCERTA_{ijt}$	***average (t, n)***	**89**	**2.19****	**0.58**	**0**	**-0.02**	**0.51**
	Pre-accession (t-1)	3	2.24	1.14	1	0.00	0.03
	Accession (t)	1	1.76	1.14	0	0.00	0.05
	Post accession (t+1, n)	53	2.16*	0.66	0	0.00	0.04
$APEC_{ijt}$	***average (t, n)***	**100**	**0.64*****	**0.09**	**100**	**0.52*****	**0.06**
	Pre-accession (t-1)	100	0.73***	0.12	100	0.54***	0.08
	Accession (t)	100	0.77***	0.12	100	0.64***	0.08
	Post accession (t+1, n)	100	0.60***	0.12	100	0.66***	0.08
AP_{ijt}	***average (t, n)***	**93**	**0.62****	**0.16**	**6**	**0.44**	**0.19**
	Pre-accession (t-1)	3	-0.64	0.34	0	0.00	0.02
	Accession (t)	0	-0.02	0.34	2	-0.01	0.07
	Post accession (t+1, n)	96	0.70**	0.17	4	0.01	0.08
$CACM_{ijt}$	***average (t, n)***	**100**	**2.45*****	**0.15**	**100**	**2.19*****	**0.26**
	Pre-accession (t-1)	3	0.79	0.42	2	-0.02	0.21
	Accession (t)	2	-0.78	0.44	100	1.85***	0.35
	Post accession (t+1, n)	100	2.64***	0.16	100	2.24***	0.27
$CARICOM_{ijt}$	***average (t, n)***	**100**	**4.06*****	**0.29**	**63**	**1.45***	**0.43**
	Pre-accession (t-1)	0	-0.08	1.16	2	-0.02	0.21
	Accession (t)	100	3.93***	0.44	2	0.02	0.17
	Post accession (t+1, n)	100	4.14***	0.37	2	0.02	0.14
EEA_{ijt}	***average (t, n)***	**98**	**0.51****	**0.12**	**25**	**-0.24**	**0.08**
	Pre-accession (t-1)	2	0.24	0.15	92	0.34**	0.13
	Accession (t)	3	0.29	0.15	11	0.03	0.08
	Post accession (t+1, n)	100	0.76***	0.15	30	-0.10	0.16
$EFTA_{ijt}$	***average (t, n)***	**1**	**-0.14**	**0.12**	**5**	**0.26**	**0.12**
	Pre-accession (t-1)	3	-0.62	0.32	1	0.00	0.03
	Accession (t)	0	-0.11	0.25	1	0.00	0.01
	Post accession (t+1, n)	1	-0.16	0.13	30	-0.10	0.16
EU_{ijt}	***average (t, n)***	**100**	**-1.15*****	**0.10**	**100**	**0.41*****	**0.10**
	Pre-accession (t-1)	100	-0.95***	0.15	3	0.01	0.05
	Accession (t)	100	-0.78***	0.14	38	0.12	0.17
	Post accession (t+1, n)	100	-1.30***	0.10	95	0.37**	0.15
$LAIA_{ijt}$	***average (t, n)***	**100**	**0.89*****	**0.09**	**100**	**1.68*****	**0.19**
	Pre-accession (t-1)	42	-1.01	0.32	2	0.00	0.09
	Accession (t)	1	-0.15	0.26	42	0.31	0.40
	Post accession (t+1, n)	100	0.98***	0.08	100	1.62***	0.28
$MERCOSUR_{ijt}$	***average (t, n)***	**57**	**1.16***	**0.35**	**1**	**0.38**	**0.26**
	Pre-accession (t-1)	1	0.73	0.48	0	0.00	0.02
	Accession (t)	2	0.88	0.49	1	0.00	0.03
	Post accession (t+1, n)	13	1.26	0.48	1	0.00	0.06
$NAFTA_{ijt}$	***average (t, n)***	**0**	**0.08**	**0.45**	**1**	**0.48**	**0.34**
	Pre-accession (t-1)	0	-0.15	0.67	0	0.00	0.03
	Accession (t)	0	-0.14	0.67	1	0.00	0.04
	Post accession (t+1, n)	0	0.21	0.58	1	0.00	0.05
$BILATERAL_{ijt}$	***average (t, n)***	**47**	**0.43**	**0.14**	**14**	**0.24**	**0.09**
	Pre-accession (t-1)	1	-0.10	0.15	3	0.01	0.04
	Accession (t)	5	0.30	0.14	8	0.02	0.07
	Post accession (t+1, n)	98	1.96**	0.47	0	0.00	0.03

Notes: Fixed effect coefficients and additional controls omitted. *, **, *** represent *weak*, *positive,* and *decisive* evidence for an effect of the regressor, corresponding to posterior inclusion probabilities of 50-75%, 75-99, and > 99%, respectively (see Jefferies, 1961 and Kass and Raftery, 1995). p≠0 is the inclusion probability, μ is the posterior mean, and σ is the posterior standard deviation.