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

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Trade theories covering Preferential Trade Agreements (PTAs) are as diverse as the literature in search of their empirical support. 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. BMA minimizes the sum of Type I and Type II error, the mean squared error, and generates predictive distributions with optimal predictive performance. Once model uncertainty is addressed as part of the empirical strategy, we report clear evidence of Trade Creation, Trade Diversion, and Open Bloc effects. After controlling for natural trading partner effects, Trade Creation is weaker – except for the EU. To calculate the actual effects of PTAs on trade flows we show that the analysis must be comprehensive: it must control for Trade Creation and Diversion as well as all possible PTAs. Several prominent control variables are also shown to be robustly related to Trade Creation; they relate to factor endowments and economic policy.

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1. Introduction

Bhagwati and Panagariya (1996) call Preferential Trading Arrangements (PTAs) "two faced." They introduce trade liberalization at the cost of discrimination in form of distorted trade preferences and market access. A controversy has raged since the 1950s regarding the benefits and costs of PTAs, due to possible Trade Creation among members and Trade Diversion among nonmembers (Viner, 1950). Time has not provided a consensus; to the contrary: as the proliferation of PTAs increased in the 1990s, so did the number of theories predicting either increasing or decreasing trade flows among (non)members. As the volume of competing theories has grown, the number of associated candidate regressors has also expanded to render comprehensive robustness analysis using traditional methods virtually impossible. Consequently, a large empirical literature emerged to estimate different subsets of PTA theories using gravity equations. It is therefore not surprising that coefficient estimates resulting from such regressions are well known to be highly dependent on the exact set of regressors selected in each study (see Baxter and Kouparitsas, 2006).

Ghosh and Yamarik (2004) provide the most extensive PTA robustness analysis to date. Not only do they include the largest possible number of PTAs, but they also use Extreme Bound Analysis (Leamer, 1983) to allow for the examination of a diverse set of PTA theories. They find *no* evidence of Trade Creation or Diversion for *any* PTAs and relaxed extreme bounds pick up only Trade Diverting PTAs. In this paper we introduce Bayesian Model Averaging (BMA) to the PTA literature, it is a statistical technique specifically designed to incorporate model uncertainty into the estimation process. It allows us to examine all possible models, to weigh each model according to quality, and to provide 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.[1]

Using this powerful technique, we take a fresh look at Trade Creation and Diversion for the 12 major PTAs examined by Ghosh and Yamarik (2004) in a dataset that covers 186 countries and five year intervals from 1970-95. Through country-pair fixed effects we also address "natural trading partner" effect that have not been fully accounted for by the common gravity controls. Hummels and Levinsohn (1995) first introduced such fixed effects to better

[1] Alternative applications of BMA to international economics are Wright (2003) and Chen and Rogoff (2006).

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 multilateral resistance (Anderson and van Wincoop, 2003). A growing literature on PTAs examines also the endogeneity of PTAs (see Magee, 2003; and Baier and Bergstrand 2002, 2004, 2007). All approaches to endogeneity generally use instruments that are also controlled for by our country-pair fixed effects. Country-pair fixed effects have been introduced into the analysis of PTAs by Cheng and Wall (2005), who examine Trade Creation for a subset of 5 RTAs in 29 countries over 3 years. Below we examine Trade Creation and Diversion for 186 countries, 12 PTAs over 25 years while simultaneously accounting for model uncertainty.

Our main finding is threefold. First, in our benchmark specification (which does not correct for country-pair fixed effects to replicate Ghosh and Yamarik, 2004) PTAs are shown to exhibit strong Trade Creation and Diversion. Second, after controlling for additional omitted variable bias with country-pair fixed effects, we find that most of the previously large PTA effects were due to natural trading partnerships. Trade Creation is muted, and all but one Trade Diversion effects disappear. Controlling fully for natural trading partner effects also highlights strong Open Bloc Trade Creation for a number of major PTAs. We can only speculate that these PTAs may have been created exactly because of such unobservables, but we cannot attribute the change in trade flows to the formation of PTAs (as pooled OLS regressions would). Finally, Our results emphasize that the appropriate empirical strategy to isolate effects of PTAs must involve as many PTAs as possible. The exact Open Bloc Trade Creation effect for a given PTA can only be determined after examining the exact interaction between PTAs. The actual impact of a PTA on bilateral trade is shown to depend not only on its own Trade Creation and Diversion but also on its trading partner's PTA effects.

These results are at odds with Ghosh and Yamarik (2004) and the differences arise for three reasons. First, BMA inference is based on an unrestricted search of the model space spanned by all candidate regressors. Secondly, BMA theory requires that each model is weighed according to its quality, while Extreme Bound Analysis weighs models equally and thus attributes equal power of inference to exceptionally weak or strong models. What is important, however, is not whether a method is too stringent to deliver results, but whether the methodology is theory-based and efficient.[2] Finally, our second set of results regarding the impact of natural trading partners differ from Ghosh and Yamarik's (2004) because we expand their dataset to allow for 3,420 additional fixed effects in the second part of our analysis.

BMA's improved model selection approach and accounting for model uncertainty leads to the resolution of a number of empirical puzzles in the PTA literature. The implausibly large APEC coefficient that is commonly observed in the literature is only initially confirmed by BMA; after controlling for country-pair specific fixed effects, however, the purely consultative APEC no longer exhibits strong effects on trade flows. The European PTAs, on the other hand, reveal their strong impact only after we control for country-pair fixed effects, which establishes that EU countries naturally under-trade relative to the prediction of the standard gravity model.[3] NAFTA is shown to be the only Trade Diverting PTA and this only in trade with a select subset of countries. Due to the strong Open Bloc effects among Asian and European countries, their trade with NAFTA actually increased over the period of our sample.

The remainder of the paper is organized as follows. Section 2 discusses the BMA methodology used in our estimation to resolve model uncertainty present in the theoretical PTA literature. Since BMA is relatively new to international economics, we discuss briefly its basic framework. In Section 3 we take a look at the data and in Section 4 we report and discuss our results. Section 5 concludes.

2.1 The Empirical Framework

Econometric studies that seek to identify the impact of PTAs on trade flows are generally based on the gravity model.[4] 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. The basic gravity framework is given by

$$\log T_{ijt} = \alpha_t + \beta_1 \log Y_{it} Y_{jt} + \beta_2 \log D_{ij} + \beta_3 X_{ijt} + \varepsilon_{ijt}\,, \qquad (1)$$

[2] 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).
[3] Predominantly negative residuals for European country pairs tend to be a feature of the standard gravity model, an observation that has been made repeatedly in the literature, see e.g. Pollak (1996) or Rose (2004).
[4] The theoretical foundations of the gravity model are presented in Frankel (1997) and Deardorff (1998).

where bilateral trade, T_{ijt}, between country pairs 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, X_{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. Time fixed effects also mitigate any spurious correlation introduced, for example, by the use of a U.S. price index to deflate trade flows.

We follow Ghosh and Yamarik (2004) and include dummies that capture PTA effects on bilateral trade. The matrix X_{ijt} is then split into PTA related dummies and other covariates, Z_{ijt}, which we discuss in section 2.2. We then obtain

$$\log T_{ijt} = \alpha_t + \beta_1 \log Y_{it} Y_{jt} + \beta_2 \log D_{ij} + \beta_3 Z_{ijt} + \beta_4 PTA_{ijt} + \beta_5 PTA_{it} + \varepsilon_{ijt} \,. \quad (2)$$

Two sets of zero-one dummy variables are included to indicate whether two trading partners are members of the same PTA in year t, PTA_{ijt}, or whether only one trading partner has joined, PTA_{it}. These dummies enable us to isolate the three distinct effects that PTAs may exert on trade flows. A positive coefficient on PTA_{ijt} 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 positive PTA_{it} coefficients.

In equation (3) we extend the Ghosh and Yamarik (2004) framework to include country-pair fixed effects in order to account for the possibility of "natural trading partners." The term natural trading partner thus goes beyond pure distance or trade costs arguments. It captures any and all similarities among trading partners that are constant over time. The country-pair fixed effects model is the most general formulation of the gravity equation (Cheng and Wall, 2005) and a substantial literature insists that formulations without controls for unobserved heterogeneity are misspecified and biased (e.g., Egger, 2000; Baldwin, 2005). If country-pair fixed effects are omitted, the PTA coefficients are biased upward, if they pick up Trade Creation that is simply due to deep seated unobservables.

$$\log T_{ijt} = \alpha_t + \alpha_{ij} + \beta_1 \log Y_{it} Y_{jt} + \beta_3 \tilde{Z}_{ijt} + \beta_4 PTA_{ijt} + \beta_5 PTA_{it} + \varepsilon_{ijt} \quad (3)$$

Notice that by controlling for country-pair fixed effects, we lose our ability to estimate the direct effect of time-invariant variables, such as distance, D_{ij}. The matrix of controls is reduced to $\tilde{Z}_{ijt}$, since the explanatory power of time-invariant regressors is absorbed by the country-pair fixed effects.[5] In Table 3 we report results of regressions with and without country-pair fixed effects to allow for direct comparisons with the Ghosh and Yamarik (2004) benchmark.

2.2 Theory and Model Uncertainty in the PTA Literature

There exists a voluminous literature that discusses the appropriate controls to be included in Z_{ij}. They include covariates that reference Geography, Historical, Economic Policy, and Development/Factor Endowments. Each control is motivated by a particular theory, and at times the same control is claimed for different theories (with opposite sign), which reflects the inherent model uncertainty. Below we provide a brief description of the motivations and theories associated with the various controls suggested by the previous literature to highlight the diversity of the approaches. It is crucial for us to outline this diversity of approaches to justify the use of the model averaging methodology. Table 2 summarizes the degree of model uncertainty by tabulating the relationships of our covariates with bilateral trade as estimated by earlier studies. The table highlights the many attempts to identify determinants of trade flows, and the plethora of differing and/or opposite results. It provides a visual motivation for addressing model uncertainty inherent in gravity/PTA regressions directly as part of the estimation technique.

It is important to the BMA methodology to outline the theoretical backbone of each regressor included in the analysis. Without theoretical support the results are difficult to interpret. Feenstra, Markusen and Rose (2001) argue that empirical gravity models can be used to discriminate between alternative trade theories and Leamer (1978) first emphasized that any uncertainty regarding the validity of a theory must be accounted for in the empirical strategy. If 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.

We therefore commence with a brief sketch of the alternative theories that have been proposed to identify the effect of preferential trade agreements on trade flows. We start with important control variables that capture Historical Ties, such as *Common Language, Common Colonizer,* or *Colony.* These covariates are commonly added in attempts to capture transaction

[5] We sacrifice insights regarding the time-invariant, country-pair regressors in hopes of attaining less contaminated PTA coefficients. The effects of such regressors could be recaptured in a two-stage procedure where the first stage is given by (3) and the regression in the second stage uses the estimated fixed effects as a dependent variable and time-invariant regressors are explanatory variables.

costs caused by the inability to communicate and/or overcome cultural differences.[6] 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 further 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.[7] It has also been motivated as a proxy for "multilateral resistance", or the average trade costs facing a country (Brun et al., 2005; Carrere, 2006). *Area* is supposed 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.[8] 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 proxies for proximity ought to be included and which covariates are relevant to explaining how PTAs influenced trade patterns.

Development/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 Splimbergo and Stein (1996) examine the issue empirically. Common proxies

[6] See Wei (1996), Frankel (1997), Frankel and Rose (2002), Rose (2000), Soloaga and Winters (2001), and Rose and van Wincoop (2001).
[7] See, for example, Wei (1996), Rose (2000), Soloaga and Winters (2001),and Baier and Bergstrand (2007).
[8] See Frankel and Romer (1999), Feenstra, Markusen and Rose (2001), Frankel and Rose (2002), Rose (2000), Rose and van Wincoop (2001), and Soloaga and Winters (2001).

for factor endowments differences are based on *Per Capita GDP, Schooling,* and *Population Density.*[9] 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 with 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 in the matrix Z_{ijt} include measures related to trade/financial openness and exchange rate management. These are important controls to account for trade restrictions that may explain trade patterns' deviations from those 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 which coefficient estimates are to be expected is riddled with uncertainty. 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.[10]

Finally we address model uncertainty in the PTA theory itself.[11] Not only do we have opposing implications suggested by different theories, at times opposing theories have been suggested by the same author (e.g., Krugman, 1991a,b). The theory of PTAs is based on Viner's (1950) theory of Trade Creation and Diversion. By the 1990s, however, 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 PTAs increase trade flows and subsequently welfare in the presence of prohibitive transport costs. Krugman's theories led Frankel (1997), Frankel, Stein, and Wei (1995), and Wei and Frankel (1998) to develop theories based on a continuum of transport costs. Their work

[9] They have been introduced by Frankel, Stein and Wei (1995), Frankel (1992), Frankel (1997), Frankel and Wei (1993), Frankel and Rose (2002), Rose and van Wincoop (2001), and Freund (2000).
[10] 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 (2002).
[11] For a more detailed literature review, the reader is directed to any of a number of surveys of various approaches to the study of PTAs, including Panagariya (1999, 2000).

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 are “locked” into PTAs. 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. Freund (2000) instead 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 the PTA, relative to the market power of each member taken individually, may lead to higher external tariffs.

2.3 Accounting for Model Uncertainty: Empirical Methodology

Next we briefly comment on the BMA methodology used in our estimation. We will limit ourselves to discussing the properties relevant to our application. The interested reader is referred to the comprehensive tutorial by Raftery et al. (1997) for further discussion. The Bayesian framework is a natural candidate to address model uncertainty surrounding the correct controls in (2) and (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 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 base inference on 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. Given the data, *d,* BMA first estimates a posterior distribution $P(\beta_r \mid d, M_k)$ 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, $P(\beta_r \mid d)$, using each model's posterior probability, $P(M_k \mid d)$, as model weight

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

The posterior model probability of M_k is simply the ratio of M_k's marginal likelihood to the sum of the marginal likelihoods over all other models[12]

$$P(M_k \mid d) = \frac{l(d \mid M_k)}{\sum_{h=1}^{2^k} l(d \mid M_h)} . \tag{6}$$

Intuitively, this implies that a model's weight is proportional to its relative efficiency in describing the data. Posterior model probabilities are also the weights used to establish the posterior means and variances

$$E[\beta_k \mid d] = \sum_{k \in M}^{K} \hat{\beta}_k \, pr(M_k \mid d), \tag{7}$$

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

Providing economically meaningful coefficient estimates requires conditioning them on whether a regressor is included in the model (otherwise the distribution would contain a spike a zero, representing models that do not include the regressor). By summing the posterior model probabilities over all models that include a candidate regressor, we obtain the posterior inclusion probability

[12] Equation (6) assumes a uniform prior over the model space, which is the standard in the literature; see Raftery et al. (1997) and Fernandez, Ley and Steel (2001a,b). The marginal likelihood includes parameter priors, and their choice can be contentious, see Eicher, Papageorgiou and Raftery (2007). Given the large dataset, our results are insensitive to the choice of parameter priors.

$$P(\beta_k \neq 0 \mid d) = \sum_{r \in M} P(M_k \mid d). \quad (9)$$

The posterior inclusion probability of a regressor is the probability that a variable is included in the true model describing bilateral trade. It also provides a probability statement regarding the importance of a regressor that directly addresses the researchers' prime concern: what is the probability that the coefficient has a non-zero effect on the dependent variable. The posterior inclusion probability thus also carries an important interpretation that goes beyond the is information contained in standard P-values.

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. Hjort and Claeskens (2003) point out that for good reasons BMA "dominates the literature on accounting for model uncertainty in statistical inference." Raftery and Zheng (2003) summarize the main theoretical results proving 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. BMA applications in economics include Fernandez, Ley and Steel (2001a), Eicher, Papageorgiou and Roehn (2007) and Hansen (2007).

As compared to Extreme Bound Analysis, BMA actually examines the entire model space and forces no restrictions on the size of the model that can be considered. For example, 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. This limits the search for the exact model to an exceedingly small part of the model space. The absence of information regarding the quality of models in Extreme Bound Analysis renders the approach excessively stringent (see Sala-i-Martin, 1997 and Sala-i-Martin, Doppelhofer and Miller, 2004).

3. Data

Our baseline dataset is identical to Ghosh and Yamarik (2004) to allow for a clean reexamination of the evidence with our alternative statistical method. Their dataset, in turn, is based on Frankel and Rose (2002); it covers 186 countries in 3,420 bilateral trade pairs at five year intervals from 1970 to 1995 and has 14,522 observations.[13] We analyze 12 major PTAs (summarized in Table 1), which results in 12 PTA_{ijt} and 12 PTA_{it} dummies. PTA_{ijt} takes the value of 1, when both trading partners i and j are members of the same PTA; and PTA_{it} takes the value of 1 when only one country is a member of the PTA.[14] The dependent variable is average bilateral trade recorded in U.S. dollars and deflated by the American GDP chain price index. Bilateral trade agreements are also prevalent, but their inclusion is unlikely to change our results since most datasets contain only a few bilateral agreements prior to 1995. In addition to the basic gravity and trade agreement variables, 16 controls variables have been suggested by various gravity approaches, which we discussed in Section 2.2. Table 2 lists and describes all variables.

4. Results

4.1 PTA Trade Creation / Diversion: 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 go far beyond what any ordinary robustness exercise can hope to represent. Our first objective is to contrast our BMA results with Ghosh and Yamarik's (2004) finding that there are no robust effects associated with any PTA.

BMA results are provided in Table, where the three columns 3-5 present posterior inclusion probabilities, means, and standard deviations for our baseline Specification 1. While the actual regressions are in logs, we also report in column 6 the implied percentage changes in

[13] See Ghosh and Yamarik (2004, Appendix C) for further details. To deal with the large number of fixed effects in BMA, we use a partitioned regression technique equivalent to Andrews et al.'s (2006) "FEiLSDVj" method.

[14] 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).

trade flows to clarify the exposition.[15] Coefficients on PTA_{ijt} variables can then be interpreted as the percentage changes in trade volume between two PTA members relative to the trade volumes the countries would have experienced if they had been non-members. A positive coefficient represents Trade Creation. Coefficients on PTA_{it} reflect percentage changes in bilateral trade when only one of the two trading partners belongs to a PTA. Positive coefficients are evidence for Open Bloc Trade Creation, while a negative coefficients suggest Trade Diversion.

The first important result is that the BMA methodology provides clear evidence that PTAs generate not only Trade Creation, but also Open Bloc Trade Creation, and Trade Diversion. While Specification 1 is identical in structure/data to Ghosh and Yamarik (2004) and differs only in terms of its methodology, the results disagree sharply with their implication that PTAs have no effect on trade flows. We obtain effective coefficients (indicated with asterisks) whose signs and magnitudes are similar to those commonly reported in the previous literature. BMA thus provides strong evidence that the expansion of the search space from Extreme Bound Analysis's particular subset of "free and doubtful variables" to the entire model space, along with theory-based model averaging to address model uncertainty, yields fundamentally different results.

Four trade agreements are shown to possess large Trade Creation effects (CACM, CARICOM, APEC, LAIA). In addition there is ample evidence for Open Bloc Trade Creation (EU, APEC, EFTA, MERCOSUR), but also widespread support for Trade Diverting effects of PTAs (LAIA, ANZCERTA, NAFTA, CARICOM, CACM, and AP). The theory-based BMA approach which accounts for model uncertainty thus provides solid support for all types of PTA effects predicted by trade theory. With the exception of Exchange Rate Regimes and Volatility, Schooling Differences, and the Island Dummy, all theory-based controls are also highly significant and enter with signs and magnitudes familiar from earlier studies.

The implication is then that the models discovered by Extreme Bound Analysis may not have contained those with high posterior probabilities, and that inappropriate weighting of the various models led to excessively conservative Extreme Bound Analysis implications. As mentioned in Section 2.3 above, it follows from the non-negativity of the Kullback-Leibler information divergence criterion that averaging over all the models in BMA fashion provides the best predictive performance, compared to predictions based on any subset of models. Therefore

[15] The transformation from logs to percentage changes follows Rose (2000). Details are provided in Table 4a.

we can securely rely on the BMA results to state that PTAs do generate Trade Creation, Diversion and Open Bloc effects.

The scale of some of the Trade Creation effects is surprising, if not implausible, implying at times four to eight fold increases in trade. Coefficients of such aberrant magnitudes have been noted and questioned in the previous PTA literature (e.g., Frankel, 1992; Frankel and Wei, 1993; Frankel, Stein and Wei, 1995; Frankel, 1997). Our contention is that the coefficients in Specification 1 are contaminated by omitted variable bias. If the control variables in Z_{ijt} do not account fully for natural trading partner effects, the PTA_{ijt} coefficients are likely biased upward, since they may well pick up Trade Creation that is actually due to the natural similarities between trading partners. We investigate this bias further in the next section.

4.2 PTA Trade Creation / Diversion: Accounting for Natural Trading Partners

In order to capture any and all unobserved time-invariant heterogeneity among trade partners we reestimate Specification 1, accounting for country-pair fixed effects in Specification 2 (Table 3 columns 7-10).[16] A comparison of the two specifications in Table 3 highlights that the estimated effects of PTAs on trade flows depend crucially on how researchers control for country similarities. The differences between the specifications imply that substantial coefficient bias contaminates PTA estimates in Specification 1 when "natural trading partner effects" are not fully addressed by the control variables. In other words, the 16 geography, history, and culture regressors that have been introduced by previous studies to capture similarities across countries do not fully account for the apparently considerable systematic bilateral heterogeneity.

Specification 2 in Table 3 maintains that PTAs have important effects on Trade Creation, Diversion and Open Blocs; however, the effects are reduced and mainly limited to Trade Diversion/Open Bloc effects. Massive Trade Creation by CARICOM and APEC in Specification 1 is entirely negated by the country-pair fixed effects.[17] On the other hand, the EU exhibits strong Trade Creation in Specification 2, although Specification 1 provided no such evidence. Of the 9 Trade Diversion / Open Bloc effects in Specification 1, only three remain significant in

[16] These country-pair effects could, for example, speak to similarities in economic and social institutions, such as corruption or rule of law, or simple economic infrastructure such as telecommunications. A concrete example would be France-Germany, with excellent transport links (unobserved) and a PTA (observed), vs. Afghanistan-Kazakhstan, with bad transport links (unobserved) and no PTA (observed).

[17] In the presence of country-pair fixed effects, the estimates in Specification 2 are based on countries joining and leaving PTAs, which represents the true marginal effect of an PTA. CACM and LAIA then drop out due to a lack of variation in membership (countries exiting or joining) over the sample period.

Specification 2. It is comforting to note that all but one Trade Diversion coefficients lose significance once we account for country-pair fixed effects. Specification 1 clearly shows Trade Creation among PTA members, and while Specification 2 does not rule out that PTAs were formed *because* of country-pair similarities, it highlights that we cannot attribute all Trade Creation to PTAs. Rather, PTA members exhibit other non-PTA related unobserved similarities, which enhance bilateral trade.[18] Systematic country-pair unobservables that previously contaminated the PTA coefficients are now absorbed into the country-pair fixed effects along with time-invariant geographic and historic variables, thereby allowing a clean examination of the effects of PTA *accession*.

The EU is one PTA that is found to be clearly Trade Creating and not Trade Diverting. The EU Trade Creation effect materializes only, however, after we fully account for similarities among countries. One would expectto find robust Trade Creation among EU members, since it is by far the most integrated PTA in terms of trade barrier reductions and policy harmonization. Such deep integration also constitutes an argument in favor of Open Bloc effects based on fixed trade costs (see Freund, 2000). Pollak (1996) points out that it has been well known since the original Linnemann (1966) gravity specification that the approach systematically over-predicts trade among geographically proximate countries and under-predicts trade between distant country pairs. Gravity model refinements have attempted to capture some of this effect by adding the *Remoteness* variable. The comparison between our specification 1 and 2 shows, however, that this does not purge the entire systematic error.

In the presence of systematic under-trading compared to the gravity equation's predicted trade flows, and in the absence of country-pair fixed effects, the PTA dummy for EU membership in specification 1 is insignificant because it picks up two opposing effects: (1) systematic under-trading of European countries relative to the gravity equations prediction even after *Remoteness* has been taken into account, and (2) the effect of EU accession. Since specification 2 controls for country pair fixed effects, the *systematic* under-trading is purged from the estimate and only the true effect of EU *accession* on bilateral trade remains. Note that we can observe the exact opposite effect in the case of APEC countries (as predicted by Linnemann, 1966). As APEC countries are unusually distant geographically, they overtrade relative to the gravity predictions even after the *Remoteness* variable has been added. This effect

[18] The findings are also in line with those of Hummels and Levinsohn (1995).

turns out to be the exclusive driver behind its positive coefficient in Specification 1. Specification 2 illustrates that there exist no considerable APEC accession effect once we account for Linnemann's (1966) finding that the gravity specification systematically under-predicts trade between geographically distant country pairs. This is comforting, since APEC never instituted either tariff reductions or trade arrangements among its members.

4.3 Quantifying PTAs' Open Bloc and Trade Creation Effects

The detailed evaluation of the economic impact of PTAs on trade flows requires careful examination of each individual PTA coefficient. The results cannot be interpreted simply by reading off posterior means because membership in PTAs is overlapping and several countries may enter and exit PTAs, or belong to different PTAs during the sample period. Table 4 summarizes the net effects of each PTA on bilateral trade flows.

Table 4 has three important implications. First, on the diagonal, we recognize the object of our discussion in Section 4.2, namely that evidence for Trade Creation *within* PTAs is weak once we have accounted for country-pair fixed effects. The only exception is the EU, which presented a 93% increase in bilateral trade among member countries. Second, we observe Trade Diversion / Open Bloc Trade Creation *among* PTAs on the off-diagonals. These cells contain perhaps the most important implication of our PTA analysis: a complete assessment of PTA effects requires a comprehensive evaluation of all PTAs together. For example, Column 1 highlights that the NAFTA Trade Diversion is significantly muted and at times overturned when NAFTA countries trade with other PTAs – due to the other PTAs' strong Open Bloc effects. In the remaining columns, cross-PTA trade is always Open Bloc Trade Creating and often amplified by the interaction between two PTAs' Open Bloc effects. This provides ample evidence that the analysis of preferential trade agreements must include dummies that pick up both, Trade Creation and Trade Diversion to gauge the exact effects across PTAs.

In the same vein, it is interesting to note that, while no Open Bloc effects emanate from the EU in trade with non-member countries, trade with just about every other PTA is shown to have increased due to strong Open Bloc effects of other PTAs. The result is especially important because the EU features a customs union and one may have expected its large monopoly power to lead to incentives to reduce trade with non-members. Finally, Table 4 indicates strong trade gains for Pacific Rim and Asian countries' membership in AFTA, APEC and ANZCERTA.

These are generated without the inflated Trade Creation coefficients that are usually observed in the literature.

4.4 Beyond PTAs: Trade Creation/Diversion and Economic Policy/Factor Endowments

So far we have solely considered the impact of PTAs on trade flows. While the Geography and History controls are highly significant in Specification 1 (in agreement with the previous literature), their effects are absorbed into the country-pair fixed effects in Specification 2. Nevertheless a number of important non-PTA related controls need to be examined regarding their effect on trade. Trade Openness is a key variable in both 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 in either specification.

The Currency Union variable is significant only in Specification 1, indicating an extraordinarily large, 307% increase in trade, which is in line with Rose's (2000) estimate. This result evaporates entirely, however, once we consider country-pair fixed effects. Glick and Rose (2002) also find a sharp reduction in the effects of currency unions on trade flows after accounting for country-pair fixed effects, but with our introduction of the PTA variables the currency union effect vanishes entirely. This reversal of the currency union result might be caused by the fact that natural trade partners have synchronized business cycles and therefore greater incentives to join a currency union (see Frankel and Rose, 1998), which cannot be controlled for in Specification 1.

The expanded gravity equation has also been subjected to an extensive robustness check with regards to the development or factor endowment determinants of trade flows. The competing hypotheses being that trade flows are either driven by differences in endowments (Heckscher-Ohlin) or by similarities (Lindner). In Specification 1, 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 magnitudes of both coefficients are just about identical, implying that bilateral trade increases by roughly 20% when one of the trading partners is twice as dense or wealthy as the other. After considering country-pair fixed effects, the density differences still impact trade flows positively. However, per capita GDP differences changes sign providing support for the Linder hypothesis. This change is likely caused by the country pair fixed effects picking up slow-moving factor endowment differences as pointed out by Hummels and Levinsohn (1995). It thus seems like the data supports both Heckscher-Ohlin's and Linder's hypotheses simultaneously.

Taken together, these results reveal two positive implications for North-South trade: First, Specification 1 shows that North-South differences do drive trade flows (likely due to Heckscher-Ohlin-type factor endowment differences, which are later absorbed by the pair fixed effects). Second, Specification 2 indicates that North-South trade will increase strongly as developing countries catch up to their industrialized counterparts and develop more similar tastes, thereby increasing Linder-type trade. Finally, differences in education attainment are not robustly related to trade in either specification, similar to the results found in Frankel, Stein and Wei (1995).

5. Conclusion

The literature on preferential trade agreements (PTAs) features an unusual diversity of theoretical and empirical approaches. In this paper we incorporate the uncertainty about the true theory 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. In contrast, BMA indicates that PTA-internal Trade Creation is significantly positive and it produces coefficient estimates that resolve a number of empirical puzzles. We show that large Trade Creation is often an artifact of natural trading partners that formed PTAs. Once we also control for country-pair specific heterogeneity, we several strong Open Block effects but only one Trade Creating effect within a PTA (for the EU). This is quite intuitive, given that the EU also institutes the most profound market access for member countries. Trade diversion is only observed in one PTA (NAFTA) and there is strong evidence for significant Open Bloc Trade Creation among PTAs in Europe and Asia.

Another implication of our empirical investigation is that PTA analyses must be comprehensive. We show that studies must separate out Trade Creation and Trade Diversion to highlight the specific trade effects of PTAs. In addition, empirical studies must consider an exhaustive set of PTAs, since any individual's PTA's trade influence is not only a function of its own direct effect, but also a function of its interaction with other PTAs' Open Bloc effects. These effects can be significant. For example NAFTA's Trade Diversion is actually turned into Trade Creation when we consider the specific bilateral trade flows with AFTA and EFTA.

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Table 1
Preferential Trading Arrangements

Abbreviation	Name of PTA	Start	Member countries (year joined)
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 (1973), 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).

Table 1 is based on Ghosh and Yamarik (2004), it includes corrections to some of the original PTA coding: ASEAN, which is no free trade area was changed to AFTA with AFTA membership starting in 1995 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 2: Common Gravity Model Controls, Their Estimated Relationship with Bilateral Trade In Past Studies and Variable Description

		Est. relationship, past studies			Variable Description
		Positive	*None*	*Negative*	
Trade Creation	$AFTA_{ij}$	3	2		0-1 Dummies (1 if the two countries are contemporaneous member in the respective PTA; 0 otherwise).
	$ANZCERTA_{ij}$	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	$AFTA_i$	2	1	1	0-1 Dummies (1 if one and only one of the countries is a contemporaneous member in the respective PTA; 0 otherwise).
	$ANZCERTA_i$				
	$APEC_j$				
	AP_j		1	2	
	$CACM_j$		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	Nat. log of the bilateral distance b/w two capital cities
	$\log(GDP_i\ GDP_j)$	23	2	1	Nat. log of the product of real GDP
	$\log(gdp_i\ gdp_j)$	9	1	2	Nat. log of the product of real GDP per capita
Economic Policy Variables	$SACHS_i+SACHS_j$	1			Sum of Sachs-Warner index of open trade policy (0,1,2)
	CU_{ij}	3	1		0-1 Dummy (1 if the two share a common currency)
	$FLOAT_{ij}$	1		1	Number of countries with a floating exchange rate (0,1,2)
	$VOLATILITY_{ij}$	1	1	4	The standard deviation of the 1st difference in the bilateral real exchange rate during the previous 5 years
Dev't Factor Endowment	$abs(gdp\_DIFF)$	3	1	1	The absolute log difference of real GDP per capita
	$abs(DENS\_DIFF)$	1	1		The absolute log difference in population density
	$abs(SCHOOL\_DIFF)$		1		The absolute log difference in average years of secondary schooling in the 25+ population
Geography	$BORDER_{ij}$	19	5		0-1 Dummy (1 if the two share a common land border)
	$REMOTE_{ij}$	4	3		Product of average distance of each country from all trading partners other than the other country
	$LANDLOCK_{ij}$	3	2	2	Number of landlocked countries (0,1,2)
	$\log(AREA_i\ AREA_j)$	4			Number of island countries (0,1,2)
	$ISLAND_{ij}$	3	1	1	Nat. log of the product of the two countries' surface areas
Historical Ties	$COMLANG_{ij}$	12	1	1	0-1 Dummy (1 if the two share a common language)
	$COMCOL_{ij}$	3			0-1 Dummy (1 if the two share a common colonizer)
	$COLONY_{ij}$	5		2	0-1 Dummy (1 if one was a former colony of the other)

Notes: Studies that have been used in the construction of this table are highlighted by a star in our list of references. 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. Please refer to the Appendix of Ghosh and Yamarik (2004) for more detailed variable descriptions and a list of the countries in our sample.

Table 3: PTA Trade Creation and Trade Diversion

		Specification 1				Specification 2			
		Time Fixed Effects				Time & Country-Pair Fixed Effects			
		Post. Incl. Prob.	Post. Mean	Post. Std. Dev.	Post Mean in %	Post. Incl. Prob.	Post. Mean	Post. Std. Dev.	Post Mean in %
Trade Creation	$AFTA_{ijt}$	0.00	-0.22	0.54	-20%	0.00	-0.22	0.39	-19%
	$ANZCERTA_{ijt}$	0.01	0.89	0.96	144%	0.00	0.30	0.92	35%
	$APEC_{ijt}$	1.00	1.48***	0.15	338%	0.01	0.14	0.12	16%
	AP_{ijt}	0.01	-0.05	0.27	-5%	0.02	0.56	0.37	74%
	$CACM_{ijt}$	1.00	2.25***	0.23	848%				0%
	$CARICOM_{ijt}$	1.00	2.08***	0.41	702%	0.00	0.12	0.71	13%
	EEA_{ijt}	0.01	0.26	0.19	29%	0.00	0.06	0.17	6%
	$EFTA_{ijt}$	0.00	0.02	0.26	2%	0.03	0.52	0.32	69%
	EU_{ijt}	0.00	0.03	0.14	3%	1.00	0.66***	0.17	93%
	$LAIA_{ijt}$	0.91	0.46***	0.13	58%				0%
	$MERCOSUR_{ijt}$	0.12	1.66	0.70	424%	0.00	0.37	0.51	45%
	$NAFTA_{ijt}$	0.01	-0.89	0.84	-59%	0.00	0.60	0.65	81%
Trade Diversion, Open Bloc	$AFTA_{it}$	0.03	0.17	0.11	19%	1.00	0.40***	0.08	49%
	$ANZCERTA_{it}$	1.00	-0.47***	0.10	-37%	0.10	-0.18	0.09	-17%
	$APEC_{it}$	1.00	0.55***	0.06	73%	1.00	0.23***	0.05	26%
	AP_{it}	0.52	-0.19*	0.06	-17%	0.03	-0.17	0.10	-15%
	$CACM_{it}$	0.85	-0.18**	0.05	-17%				0%
	$CARICOM_{it}$	1.00	-0.74***	0.07	-52%	0.39	-0.29	0.11	-25%
	EEA_{it}	0.00	0.01	0.08	1%	0.20	-0.14	0.06	-13%
	$EFTA_{it}$	1.00	0.35***	0.05	43%	0.98	0.26**	0.08	29%
	EU_{it}	1.00	0.56***	0.04	75%	0.21	0.16	0.07	17%
	$LAIA_{it}$	1.00	-0.40***	0.07	-33%				0%
	$MERCOSUR_{it}$	0.79	0.42**	0.12	52%	0.01	0.11	0.09	11%
	$NAFTA_{it}$	1.00	-0.63***	0.10	-47%	0.99	-0.31***	0.08	-26%
Core Gravity	$\log(DISTANCE_{ij})$	1.00	-1.19***	0.02	-1%				0%
	$\log(GDP_{it}\ GDP_{jt})$	1.00	0.88***	0.01	1%	1.00	1.13***	0.05	1%
	$\log(gdp_{it}\ gdp_{jt})$	1.00	0.55***	0.02	1%	0.02	0.16	0.10	0%
Economic Policy	$SACHS_{it}+SACHS_{jt}$	1.00	0.35***	0.03	42%	1.00	0.13***	0.03	14%
	CU_{ijt}	1.00	1.40***	0.29	307%	0.01	-0.64	0.67	-47%
	$FLOAT_{ijt}$	0.00	-0.01	0.02	-1%	0.20	-0.05	0.02	-5%
	$VOLATILITY_{ijt}$	0.25	0.006	0.002	0%	0.01	-0.002	0.002	0%
Development, Factor Endowment	$abs(gdp\_DIFF)$	1.00	0.18***	0.02	0%	1.00	-0.31***	0.05	0%
	$abs(DENS\_DIFF)$	1.00	0.23***	0.01	0%	0.75	0.25**	0.09	0%
	$abs(SCHOOL\_DIFF)$	0.01	0.02	0.02	0%	0.03	-0.06	0.04	0%
Geography	$BORDER_{ij}$	1.00	0.53***	0.10	69%				
	$REMOTE_{ij}$	1.00	342***	39.79	342%				
	$LANDLOCK_{ij}$	1.00	-0.42***	0.04	-34%				
	$\log(AREA_i\ AREA_j)$	0.92	-0.03**	0.01	0%				
	$ISLAND_{ij}$	0.02	-0.05	0.03	-5%				
History	$COMLANG_{ij}$	1.00	0.47***	0.05	60%				
	$COMCOL_{ij}$	1.00	0.77***	0.07	116%				
	$COLONY_{ij}$	1.00	1.44***	0.12	320%				

Notes: Fixed Effect coefficients are omitted. *, **, *** indicate 50, 75, 99 percent inclusion probabilities roughly akin to ratios of the posterior mean to standard deviation of 1, 1.9, 2.3. For calculations of implied percentage changes see Table 4a

Table 4:
Trade Creation and Diversion among Trading Partners
(After Controlling for Natural Trading Partners / Country-Pair Fixed Effects)

	NAFTA	ANZCERTA	AFTA	APEC*	EU	EFTA
NAFTA	0%					
ANZCERTA	-26%	0%				
AFTA	**10%**	**49%**	0%			
APEC*	-26%	0%	**49%**	0%		
EU	-7%	0%	**87%**	**26%**	**93%**	
EFTA	**20%**	**63%**	**142%**	**63%**	**29%**	0%
Rest of the World	-7%	**26%**	**87%**	**26%**	0%	**29%**

Source: Table 3. *APEC refers only to APEC members that are not in NAFTA, ANZCERTA, or AFTA (Brunei, Japan, South Korea, China, Chile, Taiwan, Hong Kong, Papua New Guinea, for relevant years). For all other APEC countries, the $AFTA_{ijt}$ coefficient applies. For regressors with $P(\beta_k \neq 0 | d) \leq 50$, we assume $\beta_k = 0$. Equations for calculations are shown in Table 4a.

Table 4a:
Calculation of Trade Flows Among and Within PTAs

Trading Partner 1	Trading Partner 2	Net Trade Effect
PTA 1		$(1+\beta_{RTAi})-1$
PTA 1	PTA 1	$(1+\beta_{RTAij})-1$
PTA 1	PTA 2	$(1+\beta_{RTAi^1})*(1+\beta_{RTAi^2})-1$
PTA 1, PTA 2		$(1+\beta_{RTAi^1})*(1+\beta_{RTAi^2})-1$
PTA 1, PTA 2	PTA 1	$(1+\beta_{RTAij^1})*(1+\beta_{RTAi^2})-1$
PTA 1, PTA 2	PTA 3	$(1+\beta_{RTAi^1})*(1+\beta_{RTAi^2})*(1+\beta_{RTAi^3})-1$